Chapter 13
English Sounds in Context:
The Pronunciation of Phonemes and Morphemes

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ABSTRACT

The chapter takes the reader from the concrete phonetic descriptions of sounds, found in Chapters 11 and 12, to the use of these sounds in English. As in every language, sounds are influenced by their context. A large part of phonological description of a language is an effort to describe how the "same" sound is pronounced differently in different contexts, both phonetic and morphological. The chapter provides the phonemes of English, which are the distinctive units of sound, and examples of how they vary in context. It also illustrates the variation of English morphemes in context, by providing examples of allomorphy. Some implications of variation in context for teaching English are discussed.

WHAT IS PHONOLOGY?

Phonology is the branch of theoretical linguistics which focusses on the sounds of spoken languages, both in specific languages and cross-linguistically. Within a specific language, we seek to explain the system that speakers use to produce and interpret the sounds of that language, while cross-linguistically, we look for patterns that are systematic and shared. These patterns can involve not only individual consonants and vowels, but also larger units, such as syllables, which group both consonants and vowels together, or stress, which affects entire syllables, and smaller characteristics, such as voicing or rounding, which are just one component of the production of an individual consonant or vowel. While phonetics investigates the physical properties of sounds (production, acoustics, perception), phonology considers the use of sounds to encode meaning in a linguistic system. For example, phonology finds that each language organizes a wide variety of phonetic sounds into a smaller system of **phonemes**, the units which are able to make a contrast in meaning in a language; each phoneme may have a range of pronunciations in different phonetic contexts. These phonemes are combined to spell out the **morphemes,** or meaningful

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units of a language (see Chapters 2 and 3), but phonemes can systematically change when morphemes are added together to build words. Thus, both phonemes and morphemes can be pronounced with a variety of phonetic realizations, depending on context. Phonology seeks to discover the patterns governing these changes.

CONTRAST IN ENGLISH SOUNDS

Increased phonetic sophistication has allowed us to distinguish a vast variety of phonetic sounds used in English. However, not all of these phonetic sounds and distinctions do equal work in English, or in any language. Phonology begins with the study of which sounds are capable of making a meaningful difference between words, and organizing these sounds into distinct **phonemes**. The idea goes back to Saussure (1916/1959), who argued that the role of sounds in language is to make contrasts among words: "Phonemes are characterized…simply by the fact that they are distinct" (p. 119). Changing one phoneme changes the meaning of a word; for example, the words *pat* and *bat* are identical except for the initial sounds, which are therefore responsible for indicating the difference in meaning between the two words. Such pairs of words are called "**minimal pairs**": words that differ in only a single sound but differ in meaning. Thus the definition of the phoneme, as in Swadesh (1934, p. 117) is based on its ability to distinguish meaning in minimal pairs: "the phoneme is the smallest potential unit of difference between similar words recognizable as different to the native [speaker]". Some examples are provided in (1), following the convention that phonemes are provided inside slanted brackets / /, while the phonetics are provided in square brackets [ ]. The appearance of special phonetic diacritics, such as [ʰ˘˜] will be explained shortly; none of them is responsible for a contrast in English.

(1) Some minimal pairs and phonemes of English

	Spelling		Phonetics	Phonemes
Word-initial contrast	*pat*	vs. *bat*	[pʰǣt] vs. [bǣt]	/p/ vs. /b/
	could	vs. *good*	[kʰʊd] vs. [gʊd]	/k/ vs. /g/
Word-final contrast	*sun*	vs. *sum*	[sʌ̃n] vs. [sʌ̃m]	/n/ vs. /m/
	hiss	vs. *his*	[hɪ̆s] vs. [hɪz]	/s/ vs. /z/
Word-internal contrast	*pit*	vs. *put*	[pʰɪ̆t] vs. [pʰʊ̆t]	/ɪ/ vs. /ʊ/
	pat	vs. *pet*	[pʰæ̆t] vs. [pʰɛ̆t]	/æ/ vs. /ɛ/

Note that both vowels, such as /ɪ, ʊ, æ, ɛ/, and consonants, such as /p, b, m, n/, are phonemes, and furthermore, that a contrast between two words in a minimal pair can be made by the sounds at the beginning (*could* vs. *good*), end (*sun* vs. *sum*) or middle of a word (*pit* vs. *put*); all are equally valid as proof of the phoneme's ability to make a difference between words. Finally, note too that spelling, particularly English spelling, does not always correctly reflect the contrast in sound (as in *hiss* vs. *his*), so minimal pairs are based upon the phonetic transcription rather than the spelling.

THE PHONEME INVENTORY OF ENGLISH

Every language has an inventory of sounds that can make a contrast in meaning (that is, the phonemes), and the Tables 1 and 2 present minimal pairs to show the sounds that make a contrast in English. The sets of phonemes are usually different for different languages, and may even be slightly different in different dialects of the same language. A crucial part of learning a new language is learning which sounds are capable of making differences in meaning.

To show the inventory of consonant phonemes in American English, Table 1 below is organized by the phonetic characteristics of the sounds (this chart follows Hayes 2009). Along with each phoneme is provided a sample word in which that phoneme appears, with the letters used for the phoneme in question underlined.

In most cases, the words form a minimal pair/triplet/etc. with other similar sounds on the chart. There are a few exceptions, however, where a non-identical word is used because a word changed in only the relevant sound does not happen to exist in English; the methods for proving that phonemes are distinct in such cases, using similar words, are discussed in a later section (Methods).

The vowel system of American English can be plotted similarly, as in Table 2 (again based on Hayes 2009). The system includes vowels with a single quality (monophthongs) and vowels that are followed by a high offglide, approximately either [ɪ] or [ʊ] in quality (diphthongs). The diphthongs that begin with an upper mid /e/ or /o/ are included in the table, while the diphthongs that begin with a lower vowel are listed below it, as the two parts of these latter diphthongs differ in both height and front/back.

These tables present a fairly common set of consonant and vowel contrasts used in many varieties of English, although even within American English there are some dialectal differences. For example, the vowel in *bought* is given above as /ɔ/, but for many Americans there is no contrast between this vowel and that of *hot* (Labov, Ash, and Boberg, 2008). In fact, a pair of words that is a minimal pair in some

Table 1. The consonant phoneme contrasts in English

	Bilabial	**Labio Dental**	**Dental**	**Alveolar**	**Post-Alveolar**	**Palatal**	**Velar**	**Labio-Velar**	**Glottal**
stop (-voice)	/p/ *pill*			/t/ *till*			/k/ *kill*		
stop (+voice)	/b/ *bill*			/d/ *dill*			/g/ *gill*		
affricate (-voice)					/ʧ/ *chill*				
affricate (+voice)					/ʤ/ *Jill*				
nasal	/m/ *mill* *sum*			/n/ *nil* *sun*			/ŋ/ *sung*		
fricative (-voice)		/f/ *fill*	/θ/ *thin*[1]	/s/ *sill*	/ʃ/ *shill*				/h/ *hill*
fricative (+voice)		/v/ *villa*	/ð/ *this*	/z/ *Zillow*	/ʒ/ *vision*				
lateral approx..				/l/ *Lynn*					
approx..				/ɹ/ *rill*		/j/ *yell*		/w/ *will*	

Table 2. The vowel phoneme contrasts in English

	Front Unrounded	Central Unrounded	Back Unrounded	Back Rounded
upper high **lower high**	/i/ *beat* /ɪ/ *bit*			/u/ *boot* /ʊ/ *foot*
upper mid **lower mid**	/eɪ/ *bait* /ɛ/ *bet*	/ɚ/ *Bert* /ə/ *abbot*	/ʌ/ *but*	/oʊ/ *boat* /ɔ/ *bought*
low	/æ/ *bat*	/a/ *hot*, *father*[2]		
diphthongs:	/aɪ/ bite, /aʊ/ bout, /ɔɪ/ Coit			

dialects, *cot* vs. *caught,* may have identical pronunciations in others, with both *cot/caught* pronounced as [kʰăt]). For the consonants, some dialects have a distinction (not included above) between the voiced labio-velar approximant /w/ as in *will* or *witch* and a voiceless labio-velar fricative /ʍ/ as in *which* (Hayes, 2009). That is, even within a system like American English, there may be variations; if we look further afield, to British, Irish, Australian, and other varieties of English, we will find other minor points of difference in the inventory of contrasts. However, overall, the system of phonemes for most varieties of English includes about 40 contrasts: 23-24 consonants and 16-17 vowels.

As discussed in the next section, each phoneme is produced in a variety of ways, depending on its phonetic context, so that the number of sounds used in English is much larger. The phonemic system organizes all these sounds into those that are meaningfully distinct vs. those that are merely contextual variants. When transcribing English, the level of detail depends on the purpose. For native speakers of English, a phonemic transcription is enough, as speakers know how to pronounce each phoneme in context. For non-native speakers, or when comparing different varieties of English, more phonetic detail is required to show the specifics of pronunciation for those lacking the phonemic rules or for those with different rules.

NON-CONTRASTIVE SOUNDS IN ENGLISH

How each phoneme is pronounced phonetically often varies depending on the phonetic context in which it is pronounced. Therefore, what we consider to be the same phoneme in a language can be a whole set of phonetically different sounds, in different phonetic contexts. These different pronunciations of the same phoneme are called its "**allophones**", the variant pronunciations of a phoneme in context. Because they are different pronunciations of the same phoneme, they do not make a contrast even though they are phonetically distinct; these phonetic variants cannot be used to make a contrast in a minimal pair.

Generally, each allophone of a phoneme occurs in a different context. This is described as a "**complementary distribution"** because the distribution of the allophones complements each other. For example, the phoneme /t/ in English is pronounced one way word-initially, with a different sound between vowels, and with a third sound word-finally. Each of these pronunciations of /t/ is one of its allophones, and the three allophones are complementary as they each occur in a distinct context (a sound cannot be both word-initial and word-final, for example). Because the sounds are in complementary distribution, they cannot make a contrast in a minimal pair because they cannot appear in the same position in a word. Allophones of the same phoneme are representatives of that same phoneme, and native speakers of a language tend to hear them as the phoneme, rather than hearing the phonetic differences among allophones.

In addition to having its own inventory of phonemes, each language has its own system for pronouncing the allophone in different contexts. These rules are automatic for native speakers of a language, so much so that when learning a new language, speakers tend to follow the allophonic rules of their first language, even though that may not be appropriate in the new language. While replacing one phoneme with a different phoneme results in a different word (or no word at all), using the wrong allophone for the context is more likely to result in a non-native accent. Learners need to be aware of both these possible errors, if they want to avoid them.

EXAMPLES OF ALLOPHONES IN ENGLISH

Allophonic variation is found in both consonants and vowels, and can be caused by the immediate phonetic context (the surrounding consonants or vowels), by a sound's position in the word or syllable, or by whether it is in a stressed or unstressed syllable. This section will provide several examples of allophonic variation that are common in most varieties of English, including the aspiration of voiceless stops (/p t k/), the velarization of /l/ syllable-finally, and shortening and nasalization of vowels.

First, the phonemes /p,t,k/ each have at least two allophones, based on their position in a syllable at the beginning of a word. In absolute word-initial position of a one-syllable word, a /p t k/ phoneme is pronounced with a following puff of air, called aspiration, as [p^{h} t^{h} k^{h}], but after an /s/, these phonemes are pronounced with an unaspirated allophone, as [p t k], as shown in the words in (2).

(2) Two allophones each for /p, t, k/:

Phoneme	Spelling	Sound	Spelling	Sound	Allophones
/p/	*pat*	[p^{h}æ̆t]	*spat*	[spæ̆t]	[p^{h}, p]
	pit	[p^{h}ĭt]	*spit*	[spĭt]	
	pike	[p^{h}ăɪk]	*spike*	[spăɪk]	
	pool	[p^{h}uɫ]	*spool*	[spuɫ]	
/t/	*tote*	[t^{h}ŏʊt]	*stoat*	[stŏʊt]	[t^{h}, t]
	top	[t^{h}ăp]	*stop*	[stăp]	
	take	[t^{h}ĕɪk]	*steak*	[stĕɪk]	
	tone	[t^{h}õʊ̃n]	*stone*	[stõʊ̃n]	
/k/	*kale*	[k^{h}eɪɫ]	*scale*	[skeɪɫ]	[k^{h}, k]
	cope	[k^{h}ŏʊp]	*scope*	[skŏʊp]	
	key	[k^{h}i]	*ski*	[ski]	
	coop	[k^{h}ŭp]	*scoop*	[skŭp]	

In each word pair across a row, the only difference between the word is whether it begins with a /p t k/ or with an /sp st sk/. The two allophones of each voiceless stop are in complementary distribution in these examples. For example, in word-initial position where the aspirated [p^{h}] is used), the unaspirated [p] would not be used (*[pæt]),[3] and likewise after /s/, where [p] is appropriate, the [p^{h}] allophone would sound wrong to native speakers (*[sp^{h}æt]). These allophones cannot be used to make a contrast or change in meaning, because they both are allophones of the same phoneme /p/. A lack of knowledge of the rules of allophonics leads to speakers mispronouncing words in ways that at best sound like a foreign accent (e.g., [sp^{h}æt]), and at worst can lead to misunderstandings. For example, [pæt] with an unaspirated voiceless [p] sounds more similar to the English word *bat* than to *pat*, since phonetically the [p] sound is closer to the expected allophone of /b/ than of /p/ in word-initial position; in American English, the voiced stop /b/ is unaspirated and weakly voiced in word-initial position in *bat*, while the voiceless stop /p/ is strongly aspirated word-initially in *pat*.

A second example of a phoneme and its allophones is the lateral phoneme /l/, which has different allophones at the beginning and end of syllables. In syllable-initial and word-initial position, the /l/ is pronounced as the alveolar lateral approximant [l], as in the examples on the left below. In syllable and word final position, however, it is pronounced with a secondary velarization, meaning that the back of the tongue is raised towards the velum at the same time as the tongue tip touches the alveolar ridge. This results in the sound transcribed phonetically as [ɫ], as in the examples on the right. Two syllable words appear in the data below with the IPA symbol [ˈ] appearing before the syllable which has main stress.

(3) Two allophones of the phoneme /l/ = [l, ɫ]:

Syllable-initial /l/ = [l]		**Syllable-final /l/ = [ɫ]**			
laugh	[lǣf]	*fall*	[faɫ]	*bale*	[beɪɫ]
loop	[lŭp]	*pool*	[pʰuɫ]	*bell*	[bɛɫ]
listen	[ˈlɪsɛ̃n]	*file*	[faɪɫ]	*feel*	[fiɫ]
lie	[laɪ]	*toll*	[tʰoʊɫ]	*pull*	[pʰʊɫ]
allow	[əˈlaʊ]	*ill*	[ɪɫ]	*foul*	[faʊɫ]
blend	[blɛ̃nd]	*wealth*	[wɛɫ̪θ]	*filthy*	[ˈfɪɫ̪θi]

The two environments are complementary, as the /l/ is either syllable-initial or syllable- final, so the two allophones [l] and [ɫ] cannot appear in the same context nor be used to distinguish word meanings. That is, we cannot make a minimal pair contrasting the two sounds in word-initial position, because we find only [l] there; likely we cannot make a minimal pair contrasting the two in word-final position, because there we find only [ɫ]. Complementary distribution of two sounds guarantees that we cannot make the sounds contrast with each other in a minimal pair.

Likewise, consonants may have multiple allophones. In the examples for /l/ above, a closer inspection reveals that the /l/ has a dental place of articulation in *wealth* [wɛɫ̪θ] and *filthy* [ˈfɪɫ̪θi], where /l/ appears before an interdental fricative /θ/; [ɫ̪] is another allophone of /l/ in a very specific context. The phoneme /l/ has yet another allophone, which occurs when /l/ is pronounced after a voiceless stop in word-initial position. This is the position in which the voiceless stop is usually aspirated. In this case, the aspiration of the initial stop carries over onto the /l/, making it into a voiceless [l̥]; a circle below a normally voiced symbol indicates that it is voiceless. This pattern affects not only the lateral approximant, but the other approximants /w j ɹ/ as well, as shown below. The symbol for the voiceless palatal approximant is [j̊] here, as a circle below the segment would be hard to see.

(4)

After voiceless stops		**After voiced stops**		**Phoneme & Allophones**
played	[pl̥eɪd]	*blade*	[bleɪd]	/l/ = [l̥ l]
clay	[kl̥eɪ]	*glade*	[gleɪd]	
pray	[pɹ̥eɪ]	*brain*	[bɹẽĩn]	/ɹ/ = [ɹ̥ ɹ]
train	[tɹ̥ẽĩn]	*drain*	[dɹẽĩn]	
crane	[kɹ̥ẽĩn]	*grain*	[gɹẽĩn]	
tweed	[tw̥id]	*dweeb*	[dwib]	/w/ = [w̥ w]
queen	[kw̥ĩn]	*guacamole*	[gwakəˈmoʊli]	
pew	[pj̊u]	*beautiful*	[ˈbjutɪfʊɫ]	/j/ = [j̊ j]
cute	[kj̊ut]	*argue*	[ˈaɹgju]	

As seen in these examples, entire groups of phonemes often have allophones following the same pattern. For example, all the approximants (/l, ɹ, j, w/) have voiceless allophones after voiceless stops (/p, t, k/) at the beginnings of syllables, and all the voiceless stops (/p, t, k/) have aspirated allophones initially and unaspirated allophones after /s/. Groups of sounds that share phonetic properties pattern together in having the same kinds of allophones in the same positions. The descriptions of the positions that provide the context for the allophones, such as being before or after voiceless stops, also often refer to groups of sounds that share phonetic properties. These groups provide the basis for writing phonological rules (see Chapter 14).

As mentioned above, not only consonants but also vowels have allophones. In English, vowels are longer before voiced consonants in the same syllable and shorter before voiceless consonants in the same syllable. In the data below, the short version of the vowels is marked with a diacritic mark over the vowel, as in [ĕ] (some of the data is from Hayes, 2009, p. 22).

(5) Two allophones for each vowel before voiced and voiceless consonants:

Before voiceless		**Before voiced**		**Phoneme & allophones**		
wick	[wɪ̆k]	*wig*	[wɪg]	/ɪ/	=	[ɪ̆, ɪ]
hiss	[hɪ̆s]	*his*	[hɪz]			
hack	[hæ̆k]	*hag*	[hæg]	/æ/	=	[æ̆, æ]
pat	[pʰæ̆t]	*pad*	[pʰæd]			
safe	[sĕɪf]	*save*	[seɪv]	/eɪ/	=	[ĕɪ, eɪ]
fate	[fĕɪt]	*fade*	[feɪd]			
bet	[bɛ̆t]	*bed*	[bɛd]	/ɛ/	=	[ɛ̆, ɛ]
peck	[pʰɛ̆k]	*peg*	[pʰɛg]			
boat	[bŏʊt]	*bode*	[boʊd]	/oʊ/	=	[ŏʊ, oʊ]
lope	[lŏʊp]	*lobe*	[loʊb]			
bite	[băɪt]	*bide*	[baɪd]	/aɪ/	=	[ăɪ, aɪ]
white	[wăɪt]	*wide*	[waɪd]			

Across each row, the word-final consonants in each pair above differ only in voicing, as in the [f] vs. [v] of *safe* vs. *save*, and that difference between consonants results in a predictable difference in the length of the vowels. While examples are provided for only six vowels here, every vowel in English follows this pattern of having two allophones (so far), a shorter and a longer version.

In American English, vowels also show allophonic variation based on whether the following consonant is oral or nasal. Vowels are pronounced with a nasalized allophone when they appear before the nasal consonants [n, m, ŋ] in the same syllable. Thus, for a vowel such as [i], we have three allophones: short [ĭ] before voiceless consonants, [i] before voiced oral consonants, and nasalized [ĩ] before voiced nasal consonants. The data below shows that the same pattern holds for other vowels in English.

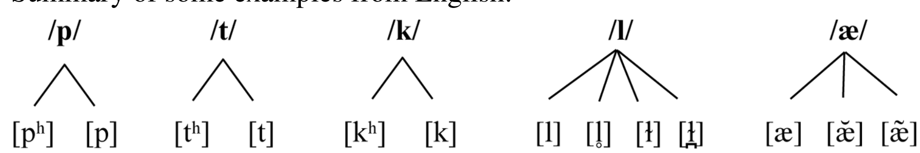
(6) Three allophones of each vowel before voiceless, voiced and nasal consonants:

Before voiceless		**Before voiced**		**Before Nasal**		**Phoneme & Allophones**
seat	[sĭt]	*seed*	[sid]	*seen*	[sĩn]	/i/ = [ĭ i ĩ]
bit	[bɪ̆t]	*bid*	[bɪd]	*bin*	[bɪ̃n]	/ɪ/ = [ɪ̆ ɪ ɪ̃]
safe	[sĕɪf]	*save*	[seɪv]	*sane*	[sẽɪ̃n]	/eɪ/ = [ĕɪ eɪ ẽɪ̃]
bet	[bɛ̆t]	*bed*	[bɛd]	*Ben*	[bɛ̃n]	/ɛ/ = [ɛ̆ ɛ ɛ̃]
cat	[k^{h}æ̆t]	*cad*	[k^{h}æd]	*can*	[k^{h}æ̃n]	/æ/ = [æ̆ æ æ̃]
lock	[lăk]	*log*	[lag]	*long*	[lãŋ]	/a/ = [ă a ã]
suit	[sŭt]	*sued*	[sud]	*soon*	[sũn]	/u/ = [ŭ u ũ]
cup	[k^{h}ʌ̆p]	*cub*	[k^{h}ʌb]	*come*	[k^{h}ʌ̃m]	/ʌ/ = [ʌ̆ ʌ ʌ̃]
boat	[bŏʊt]	*bode*	[boʊd]	*bone*	[bõʊ̃n]	/oʊ/ = [ŏʊ oʊ õʊ̃]
Bert	[bɚ̆t]	*bird*	[bɚd]	*burn*	[bɚ̃n]	/ɚ/ = [ɚ̆ ɚ ɚ̃]

In each row, the final consonant differs only in whether it is voiceless, voiced, or a nasal consonant, while each vowel differs in being shortened in the first column, and nasal in the final column. Thus every vowel in English has at least three allophones, shortened, nasalized, and plain, depending on the consonant that follows it syllable-finally.

The realization of a phoneme as a particular allophone depends on phonetic context alone. As we have seen, this context can be the immediate neighboring sound, the consonants or vowels nearby, or the position in the syllable or word. In (7) are provided a summary, with /æ/ standing for any vowel.

(7) Summary of some examples from English:



With each phoneme having several allophones, it is clear that a detailed phonetic transcription will include hundreds of sounds. While some differences between sounds are capable of making a contrast between words ([p^h] vs. [b]), others are predictable variations of the same phoneme in context ([p^h] vs. [p]).

METHODS FOR FINDING PHONEMES/ALLOPHONES

This section will explain the methods of determining phonemes and allophones from speech data. The examples above have illustrated the primary method for demonstrating that two sounds represent distinct phonemes: the existence of minimal pairs. Such pairs provide immediate confirmation that two sounds are capable of making a difference in meaning, and hence make a contrast between words, which means they must be allophones of distinct phonemes.

Sometimes languages do not provide exact minimal pairs for a contrast. In Table 1, there are a few consonantal phonemes whose example words do not match the general pattern of "__ill" used for most to provide minimal pairs. In the case of the phoneme /ŋ/, the gap results from the systematic absence of this sound from word-initial position in English (and many languages), which means that English speakers would reject a word like *[ŋɪɫ]. To contrast this sound with the other nasal consonants in English, a minimal pair using the word-final position (*sum/sun/sung*) was provided in Table 1 instead. For other sounds, as in the case of the phoneme /j/, the lack of a word "yill" in English is merely an accidental gap, one which might be filled in later if such a word were invented or borrowed. Whether the gap is accidental or motivated by the system, we can instead use a "near-minimal pair" or "analogous pair" as a proof of two sounds being distinct, i.e., allophones of different phonemes. Analogous pairs are two words that contain the suspiciously similar sounds in locally similar contexts, although the entire word may not be otherwise identical. For example, the two sounds [ʒ] and [ʤ] are very similar phonetically, differing only in manner of articulation (fricative vs. affricate), but otherwise both voiced post-alveolars. It is difficult to find a minimal pair in English for the two sounds, partly because the sound [ʒ] is relatively rare, but we can find a near-minimal pair in *pleasure* [ˈpl̥ɛʒɚ] and *ledger* [ˈlɛʤɚ]. The sounds of interest appear in very similar environments, between the same vowels [ɛ__ɚ], and preceded by a lateral, with the only difference being the initial [p]. We can also note that the words sound wrong if we replace one phone with the other: *[pl̥ɛʤɚ] and *[lɛʒɚ] are not possible pronunciations of *pleasure* and *ledger*, supporting the argument that the two sounds belong to distinct phonemes /ʒ/ and /ʤ/, rather than the two sounds being mere allophonic variants of the same phoneme. When there are no minimal pairs, near-minimal pairs can provide evidence of phonemic status.

It is important to be careful that the context is truly analogous, however. While a phonetic transcription of American English reveals that there are different vowels in *cub* [kʰʌb] vs. *come* [kʰʌ̃m], this pair of words cannot be used to argue that there is a phonemic difference between the vowels /ʌ/ and /ʌ̃/, because the words do not provide an analogous context. The difference between the two vowels is that one is oral and one is nasal, and the difference between the two words is also that one ends in an oral consonant /b/, while the other ends in a nasal consonant /m/. The difference in the vowel sounds (oral vs. nasal) might be directly related to the difference in context (oral vs. nasal). A phonemicist should conclude then, that the pair of words is not analogous and the pair of sounds bears further investigation. Only when the context for the sounds is similar, as in *pleasure* and *ledger*, do we feel confident in concluding that the two sounds under examination belong to distinct phonemes, even though the language does not provide minimal pairs.

When we lack both minimal pairs and near-minimal pairs, however, we then investigate whether sounds are allophones of the same phoneme. As in the examples above, cross-linguistic analysis has generally found that allophones of the same phoneme are phonetically similar to each other. For example, the allophones discussed thus far differ in aspiration, nasality, velarization, length, and voicing. Pairs of sounds that are similar to each other and might be allophones of the same phoneme are called "suspicious pairs" (Pike, 1947, p. 75); in the absence of a minimal pair or analogous pairs proving two similar sounds to be distinct, we are suspicious that they may be allophones of the same phoneme. One way to support the conclusion that sounds belong to the same phoneme is by examining the phonetic contexts in which each sound occurs. For example, the [l] occurs at the beginning of syllables and words, while the velarized [ɫ] occurs at the ends of syllables and words. Conversely, the velarized [ɫ] never occurs at the beginning and the plain [l] never at the end. These statements describe a "complementary distribution": where one sound is found, the other is not. When two phonetically similar sounds are in complementary distribution, they are likely allophones of the same phoneme. They cannot be used to make a minimal pair, because the sounds cannot be pronounced in the same context to make a contrast. For example, English cannot make two contrasting words such as [lup] versus [ɫup] meaning something different, because English speakers do not pronounce [ɫ] word-initially and would not allow *[ɫup] at all.

Although the phoneme itself is something more abstract than any of its allophones, which are actual phonetic sounds, we usually name the phoneme with the symbol of its most common allophone, especially if that allophone seems to be the one least affected by its phonetic environment. For example, we consider the vowel phonemes of English to be oral rather than nasal, because the nasalized vowels occur only before nasal consonants in the same syllables, while the oral ones occur when various other sounds, or nothing at all, follows. The context is often responsible in straightforward ways for the allophonic variation, as when vowels are pronounced with nasalization before a nasal consonant; the vowel anticipates the production of the nasal, which involves lowering the velum to allow air out the nose. While the contexts for the nasalized vowel allophone can be simply described, the contexts for the oral allophone cannot; it is often called the "elsewhere" allophone, meaning it occurs wherever the other allophones do not. The name of the phoneme can also be chosen because it is the simpler allophone, either phonetically (plain [l] is a less complex articulation than velarized [ɫ]) or even typographically (/p/ is often used without any examination of whether the [p] allophone is more common or less affected than [p^{h}]).

There is one type of allophonic distribution not yet discussed which does not involve complementary distribution, called free variation. The term is used when a phoneme can be pronounced more than one way in the same context, without affecting the meaning. An example would be the pronunciation of word-final voiceless stops in English, illustrated below for the phoneme /p/. The phonetic symbols [p˺] and [p˚] indicate an unreleased and released consonant, respectively, and either can be used word-finally for the /p/:

(8) Word-final /p/

step	[stɛ̆p˺] or [stɛ̆p˚]	*loop*	[lŭp˺] or [lŭp˚]
keep	[k^{h}ĭp˺] or [k^{h}ĭp˚]	*sheep*	[ʃĭp˺] or [ʃĭp˚]
tap	[t^{h}æ̆p˺] or [t^{h}æ̆p˚]	*help*	[hɛɫp˺] or [hɛɫp˚]

Note that this is a pattern for any instance of the phoneme /p/, which can always be pronounced as either [p˺] or [p˚] word-finally, without changing the meaning. Truly free variation is rare; often the choice of allophone is conditioned by something non-phonological, like wanting to emphasize or disambiguate a word. Free variation is also distinct from the case of a single word having more than one pronunciation, like the word *either*, which may be pronounced as [iðɚ] or [aɪðɚ]. There are two differences that distinguish the two pronunciations of *either* from a case of free variation. The first is that these variant pronunciations are not part of a general pattern (or part of only a very small pattern, including *neither)*. The second is that the two vowel sounds that alternate, [i] and [aɪ], are known to occur in minimal pairs (e.g., *beat* vs. *bite*), so that these two vowels belong to two different phonemes and can make a contrast. Sounds in a true free variation, on the other hand, are allophonic and do not contrast. In a case of a word having more than one phonemic pronunciation, such as *either*, we generally consider these two pronunciations to be merely a fact that must be memorized about the individual word.

One final situation that arises in a phonemic analysis is the finding that sometimes two phonemes have the same allophone in a specific phonetic context, which means that in that particular context, there is no contrast between the two phonemes. A commonly cited example is from American English, where the /t/ and /d/ phonemes in intervocalic position are both pronounced in casual speech as the flap [ɾ], when the following syllable does not have stress.

(9) Flapping in American English

	/t/	**[t]**			**[ɾ]**
fat	/fæt/	[fæ̆t]	*fatter*	/ˈfætɚ/	[ˈfæɾɚ]
bet	/bɛt/	[bɛ̆t]	*betting*	/ˈbɛtɪŋ/	[ˈbɛɾɪ̃ŋ]
beat	/bit/	[bĭt]	*beating*/	ˈbitɪŋ/	[ˈbiɾɪ̃ŋ]
	/d/	**[d]**			**[ɾ]**
mad	/mæd/	[mæd]	*madder*	/ˈmædɚ/	[ˈmæɾɚ]
bed	/bɛd/	[bɛd]	*bedding*	/ˈbɛdɪŋ/	[ˈbɛɾɪ̃ŋ]
bead	/bid/	[bid]	*beating*	/ˈbidɪŋ/	[ˈbiɾɪ̃ŋ]

The loss of contrast between two phonemes in a specific environment is called neutralization. Because of this neutralization between /t/ and /d/, we can find that a single pronunciation like [bɛɾɪ̃ŋ] can be ambiguous between the words *betting* and *bedding*, which have different phonemic representations /bɛtɪŋ/ and /bɛdɪŋ/.

To summarize the procedures, the investigation of the phonemic system of a language involves first looking for minimal and analogous pairs of words. If such pairs of words can be found, they show that sounds are allophones of distinct phonemes. If such a pair of words cannot be found for a suspicious pair of sounds, then the pattern of distribution for each sound is examined, to determine whether two sounds can be described as being in a complementary distribution, characteristic of allophones of the same phoneme. The exercises will provide a set of data for practice of those methods.

MORPHEMES AND ALLOMORPHS

The second type of variation in context involves **morphemes** (the minimal meaningful unit of language, including roots, prefixes, and suffixes; see Chapters 2 and 3). The pronunciation of a morpheme can also change in the new contexts that result from combining morphemes to make words. Parallel to the term "allophone" for different pronunciations of the same phoneme, different pronunciations of the same morpheme are called its "**allomorphs**". For example, the regular plural suffix, spelled *–s/-es,* is pronounced differently depending on the final sound of the singular word it is added to; after voiceless stops it is [s], after voiceless fricatives it is [əz], and after other sounds, like nasals, voiced stops, or vowels, it is [z], as illustrated in (10).

(10) Allomorphs of plural morpheme

Spelling	Sound	Spelling	Sound	Allomoprh
tip	[tʰɪ̆p]	*tips*	[tʰɪ̆ps]	[-s]
cat	[kʰæ̆t]	*cats*	[kʰæ̆ts]	
pick	[pʰɪ̆k]	*picks*	[pʰɪ̆ks]	
bath	[bæ̆θ]	*baths*	[bæ̆θs]	
bus	[bʌ̆s]	*busses*	['bʌsəz]	[-əz]
bush	[bʊ̆ʃ]	*bushes*	['bʊʃəz]	
buzz	[bʌz]	*buzzes*	['bʌzəz]	
hatch	[hæ̆ʧ]	*hatches*	['hæʧəz]	
badge	[bæʤ]	*badges*	['bæʤəz]	
tab	[tʰæb]	*tabs*	[tʰæbz]	[-z]
bed	[bɛd]	*beds*	[bɛdz]	
dog	[dɔg]	*dogs*	[dɔgz]	
hive	[haɪv]	*hives*	[haɪvz]	
ball	[baɫ]	*balls*	[baɫz]	
pen	[pʰɛ̃n]	*pens*	[pʰɛ̃nz]	
ear	[iɹ]	*ears*	[iɹz]	
woe	[woʊ]	*woes*	[woʊz]	
fee	[fi]	*fees*	[fiz]	

This allomorphy is based on the phonetic context, as the suffix is pronounced differently after different sounds. As with phonemes and their allophones, we often consider the elsewhere allomorph to be the original form of the morpheme; in this case the plural morpheme would be /-z/, because the allomorph [-z] appears in more kinds of environments, while the other two allomorphs occur in narrowly defined environments.

The same allomorphy is found for other suffixes that are spelled *-s*, such as the third-person singular verb suffix, the possessive, and the contracted form of auxiliary verbs *is* and *has*.

(11) Identical allomorphy for other morphemes

	[s]		[z]		[əz]	
3rd person singular verbs	*pats*	[ts]	*wags*	[gz]	*teaches*	[ʧəz]
	tips	[ps]	*brings*	[ŋz]	*washes*	[ʃəz]
	laughs	[fs]	*sieves*	[vz]	*trudges*	[ʤəz]
possessive	*cat's*	[ts]	*dog's*	[gz]	*witch's*	[ʧəz]
	wife's	[fs]	*bear's*	[ɹz]	*the Bush's*	[ʃəz]
contracted 'is'	*the cat's gone*	[ts]	*the dog's playing*	[gz]	*my watch's slow*	[ʧəz]
	the tap's running	[ps]	*the tab's on me*	[bz]	*the bus's gone*	[səz]

Like the allophonic realizations of a phoneme, this is a regular pattern that is applied by native speakers without conscious awareness. Unlike the allophones, however, morphophonemic alternations typically replace one phoneme with another. That is, /s/ and /z/ are normally separate phonemes, and as we saw above, they can be used to distinguish words with different meanings (e.g., *sip* [sɪ̆p] vs. *zip* [zɪ̆p]). However, in the context of allomorphy, the two sounds are realizations of the same morpheme (the present tense, the possessive, etc.) and indicate the same meaning.

A morpheme may have distinct allomorphs because adding it to a base brings sounds in contact with each other so that they affect each other, as above, or because the resulting word has a new stress pattern, and stressed sounds are pronounced differently. This chapter will discuss several other examples of allomorphy in English, including the past tense suffix *-ed*, vowel laxing (*nation/national, sane/sanity*), and velar softening (*critic/criticize, legal/legislation*).

While there are some exceptions (irregular past tense forms), the usual (regular) past tense in English is formed by adding a suffix spelled *-ed* to a verb form. Although the spelling is consistent, the pronunciation is not. As shown in the data below, the regular past tense is pronounced in three distinct ways: as [t], [d], and as [əd]. Examine the data below to see the distribution of these three allomorphs.

(12) Past tense spelled *-ed*

Allomorph [t]					
beeped	[bĭpt]	*soaped*	[sŏʊpt]	*laughed*	[læ̆ft]
bussed	[bʌ̆st]	*washed*	[wɑ̆ʃt]	*biked*	[băɪkt]
faked	[fĕɪkt]				
Allomorph [d]					
ebbed	[ɛbd]	*probed*	[pɹ̥oʊbd]	*waved*	[weɪvd]
mouthed	[maʊðd]	*buzzed*	[bʌzd]	*bagged*[	[bægd]
banned	[bæ̃nd]	*dimmed*	[dĩmd]	*banged*	[bæ̃ŋd]
speared	[spiɹd]	*hoed*	[hoʊd]	*bowed*	[baʊd]
sued	[sud]	*chilled*	[ʧɪɫd]		
Allormorph [əd]		**in careful speech:**			
waited	[ˈweɪtəd]	*toted*	[ˈtʰoʊtəd]	*pitted*	[ˈpʰɪtəd]
boarded	[ˈboɹdəd]	*waded*	[ˈweɪdəd]	*loaded*	[ˈloʊdəd]
		in casual speech:			
waited	[ˈweɪɾəd]	*toted*	[ˈtʰoʊɾəd]	*pitted*	[ˈpʰɪɾəd]
boarded	[ˈboɹɾəd]	*waded*	[ˈweɪɾəd]	*loaded*	[ˈloʊɾəd]

The forms in casual speech show the results of the allophonic rule of flapping; the careful speech form is also provided to indicate the final phoneme of the verb in order to make the conditioning of the allomorphy clearer. The allomorph [t] appears after voiceless consonants (/p, k, f, θ, s, ʃ, ʧ/), while the allomorph [əd] appears after the alveolar stops (/t/d/) and the flap that is their allophone. The allomorph [d] appears in what we call the elsewhere case. That is, it appears in all other contexts, such as after all of the vowels and after voiced consonants (/b, ɡ, v, ð, z, ʒ, m, n, ŋ, ɹ, l/) except /d/. The allomorphy resembles that of the plural and other suffixes spelled *–s*, which also have three variants: a voiceless one [s] after voiceless consonants, one with a vowel after sibilants [əz], and a voiced one [z] elsewhere. However, in the case of the past tense, which is pronounced with an alveolar stop (t/d), the allomorph with a vowel occurs after verbs ending in an alveolar stop or flap; in the case of the plural suffix which consists of a sibilant (-s), the allomorph with a vowel occurs after forms ending in sibilants.

It is not just suffixes that have allomorphs: prefixes and roots can have them as well. There are many ways to create new words in English by adding various prefixes and suffixes. Some of the suffixes tend to cause a change in the vowel quality of the original word. Consider the data below, in which the addition of various suffixes causes the vowel in the base word to change in quality from [eɪ] to [æ]; the vowels which change are underlined in the spelling of the word. In English, the spelling of the vowels usually stays the same, despite the change in sound to a different phoneme. Note that the longer words are marked not only with [ˈ] before the syllable with primary stress, but also with [ˌ] before a syllable with secondary stress.

(13) Vowel laxing in the base

[eɪ]		**[æ]**	
nation	[ˈneɪʃə̃n]	*national*	[ˈnæʃənəɫ]
sane	[sẽĩn]	*sanity*	[ˈsænɪɾi]
opaque	[oʊˈpʰĕɪk]	*opacity*	[ˌoʊˈpʰæsɪɾi]
volcano	[ˌvaɫˈkʰeɪnoʊ]	*volcanic*	[ˌvaɫˈkʰænĭk]
state	[stĕɪt]	*static*	[ˈstæɾĭk]
pale	[pʰeɪɫ]	*pallid*	[ˈpʰælɪd]
rabies	[ˈɹeɪbiz]	*rabid*	[ˈɹæbɪd]
Spain	[spẽĩn]	*Spanish*	[ˈspænĭʃ]
flame	[flẽĩm]	*flammable*	[ˈflæməbəɫ]
explain	[ĕkˈsplẽĩn]	*explanatory*	[ĕkˈsplænəˌtʰoɹi]

This is a case where it is not the suffix that shows allomorphy, but rather the root or base word, where one phoneme is replaced by another in the morpheme. We can prove that [eɪ] and [æ] can make a contrast in English by minimal pairs like *bait* [beɪt] vs. *bat* [bæt], so that they do belong to distinct phonemes, but we see that the vowel [eɪ] in the first column is replaced by the vowel [æ] in the second, where a suffix (*-al, ity, -ic,* etc.) has been added to the stem. Thus, the same morpheme, with the same meaning, has two allomorphs, or two pronunciations (*nation* has [neɪʃə̃n -] and [næʃən-]) depending on whether or not it bears a suffix.

There are a large number of suffixes that can cause allomorphy, although certainly not all do. Yip (1987) discusses cases in which suffixes that begin with *i-* or *a-* cause shortening: *-ic, id, ish, ity, ify, itude, icide, ison, itive, ifer, atory, ative, acy, able*. These suffixes change a variety of vowels in the base, and there are some regular patterns to the changes. As above, if the unsuffixed base word has the vowel [eɪ], the allomorph that appears with the suffix has [æ]. Other pairs include [aɪ]-[ɪ], [oʊ]-[a], [i] - [ɛ] as below (some examples from Yip, 1987, p. 465).

(14) Base allomorphy with suffixation for various vowels in stems

[aɪ]		**[ɪ]**	
mime	[mãĩm]	*mimic*	[ˈmɪmĭk]
final	[ˈfaɪnəɫ]	*finish*	[ˈfɪnĭʃ]
divine	[dɪˈvãĩn]	*divinity*	[dɪˈvɪnɪɾi]
vile	[vaɪɫ]	*vilify*	[ˈvɪlɪfaɪ]
divide	[dɪˈvaɪd]	*divisible*	[dɪˈvɪsɪbəɫ]
line	[lãĩn]	*linear*	[ˈlɪniəɹ]
[oʊ]		**[a]**	
cone	[kʰõʊ̃n]	*conic*	[ˈkʰanĭk]
code	[kʰoʊd]	*codify*	[ˈkʰarɪˌfaɪ]
sole	[soʊɫ]	*solitude*	[ˈsalɪˌtʰud]
provoke	[pɹ̥əˈvŏʊk]	*provocative*	[pɹ̥əˈvakəɾɪv]
omen	[ˈoʊmə̃n]	*ominous*	[ˈamənəs]
[i]		**[ɛ]**	
brief	[bɹĭf]	*brevity*	[ˈbɹɛvɪɾi]
supreme	[səˈpɹ̥ĩm]	*supremacy*	[səˈpɹ̥ɛməsi]
regal	[ˈɹigəɫ]	*regicide*	[ˈɹɛdʒɪˌsaɪd]
legal	[ˈligəɫ]	*legislation*	[ˌlɛdʒɪsˈleɪʃə̃n]
repeat	[ɹɪˈpʰĭt]	*repetitive*	[ɹəˈpʰɛɾɪˌtɪv]
compete	[kə̃mˈpʰĭt]	*competitive*	[kə̃mˈpʰɛɾɪˌtɪv]

Many phonologically triggered allomorphic variations are very **productive**; that is, if speakers add the morpheme to a new word, they follow the generalizations about which allomorph is appropriate. Linguists have tested this using "wug" tests (Berko, 1958), which present speakers with fictitious words (such as "wug") and ask them to make plurals or past tenses, etc. How speakers produce the new combinations of morphemes gives us evidence about how productive (or not) an allomorphic alternation is. Berko's (1958) research on English speaking children aged 4 to 7 showed they were still learning the plural allomorphy, as they could correctly use the [-s] and [-z] forms most of the time, but did not extend the [-əz] allomorph reliably to new cases like "gutch" or "niz". Adults, on the other hand, predictably and productively used all three allomorphs with the new forms provided.

Not all morphological alternations are equally productive. While the different allomorphs of the past tense and plural suffixes, for example, are extremely productive, the vowel allomorphy in (13) and (14) has some exceptions (e.g., *obesity* keeps the vowel of *obese*), and most speakers do not extend the allomorphy to new words. Another example of allomorphy with limited productivity is traditionally known as "velar softening" (Chomsky & Halle, 1968). In this allomorphy, the two velar stops in English, /k/ and /g/ can alternate due to suffixation; a stem-final /k/ alternates with /s/, while a stem-final /g/ alternates with /ʤ/ before certain suffixes.

(15) Velar softening in base

	[k]		**[s]**
critic	[ˈkɹ̥ɪɾɪ̆k]	*criticize*	[ˈkɹ̥ɪɾɪˌsaɪz]
electric	[əˈlɛktɹ̥ɪ̆k]	*electricity*	[əlɛ̆kˈtɹ̥ɪsɪɾi]
opaque	[ˌoʊˈpʰĕɪk]	*opacity*	[ˌoʊˈpʰæsɪɾi]
medical	[ˈmɛɾɪkəɫ]	*medicine*	[ˈmɛɾəsɪ̃n]
classic [	ˈkl̥æsɪ̆k]	*classicist*	[ˈkl̥æsɪsɪ̆st]
public	[ˈpʰʌblɪ̆k]	*publicity*	[pʰəˈblɪsɪɾi]
	[g]		**[ʤ]**
legal	[ˈligəɫ]	*legislation*	[ˌlɛʤɪsˈleɪʃə̃n]
regal	[ˈɹigəɫ]	*regicide*	[ˈɹɛʤɪˌsaɪd]
analog	[ˈænəˌlag]	*analogy*	[əˈnæləʤi]
pedagogue	[ˈpʰɛdəgag]	*pedagogic*	[ˌpʰɛdəˈgaʤɪ̆k]
prodigal	[ˈpɹ̥adɪgəɫ]	*prodigy*	[ˈpɹ̥adɪˌʤi]

The allomorphy of the plural and the past tense was very productive; native speakers of English would follow the generalizations above when making the plural or past of a new word (wugz, wugged). The velar softening allomorphy is partly productive, but only for Latinate words with the suffix *–ity*; Pierrehumbert (2006) found that educated speakers did tend to follow the *electric-electricity* pattern for invented words like *interponic-interponicity*. However, other instances of velar softening were only sporadically productive.

Some allomorphy examples are in between the two extremes, being moderately productive, and possibly applied to new words by native speakers. An example of this is the alternation in the words that end in /–f/ in the singular, changing to a final /–v/ in the plural (Hayes, 2009, p. 193); many very common words show this alternation, as below.

(16) Stem allomorphy in plurals (Hayes, 2009, p. 193)

	[f]		**[v]**
wife	[wăɪf]	*wives*	[waɪvz]
half	[hæ̆f]	*halves*	[hævz]
knife	[năɪf]	*knives*	[naɪvz]
calf	[kʰæ̆f]	*calves*	[kʰævz]
life	[lăɪf]	*lives*	[laɪvz]
elf	[ɛlf]	*elves*	[ɛlvz]
leaf	[lĭf]	*leaves*	[livz]
shelf	[ʃɛlf]	*shelves*	[ʃɛlvz]
thief	[θĭf]	*thieves*	[θivz]
wolf	[wʊlf]	*wolves*	[wʊlvz]
loaf	[lŏʊf]	*loaves*	[loʊvz]
scarf	[skaɹf]	*scarves*	[skaɹvz]
hoof	[hŏf]	*hooves*	[hʊvz]

Note that again the allomorphy is in the base words, not the suffix. The usual result of attaching the plural suffix to a word ending in a voiceless sound like [f], as we saw earlier, would be to use the allomorph [s] for the plural. However, here we see that the base word in the plural has a [v] and attracts the [z] allomorph for the plural, the usual after a voiced consonant. The set of words with this allomorphy seems to be learned, since there are plenty of words ending in [f] which do not follow this pattern, but instead behave normally with no change to the base while taking the [s] plural allomorph.

(17) Plurals for final [f] without allomorphy (Hayes, 2009, p. 194)

trough	[tɹ̥ɔ̆f]	*troughs*	[tɹ̥ɔ̆fs]	*[tɹ̥ɔvz]
oaf	[ŏʊf]	*oafs*	[ŏʊfs]	*[oʊvz]
chief	[ʧĭf]	*chiefs*	[ʧĭfs]	*[ʧivz]
reef	[ɹĭf]	*reefs*	[ɹĭfs]	*[ɹivz]
gaffe	[gæ̆f]	*gaffes*	[gæ̆fs]	*[gævz]
motif	[moʊ′tĭf]	*motifs*	[moʊ′tĭfs]	*[moʊ′tivz]
spoof	[spŭf]	*spoofs*	[spŭfs]	*[spuvz]

Furthermore, the allomorphy in (16) applies when forming the plurals only, not before other suffixes, even if they sound identical to the plural *-s*. We saw, for example, that the possessive suffix *'s* follows the same pattern of allomorphy as the plural, but the possessive forms of words like *wife* takes the usual allomorph [-s] in the possessive (forming *wife's* [wăɪfs]); in fact, all forms ending in /f/ follow the usual allomorphy in the possessive, even though their plurals end in [vz]. Despite the limitations on the allomorphy of (16), it does still seem to be somewhat productive in the sense of being applied to new words. Berko (1958) found that the adults, tested on the novel form *heaf*, generated two plurals: 58% preferred *heafs*, while 42% said *heaves* (1958, p. 162), which suggests that a good number of speakers apply the allomorphy of *wife/wives* to new forms, while others follow the general pattern.

IMPLICATIONS FOR TEACHING ENGLISH LANGUAGE LEARNERS

Knowledge of the English phonemes and of common allophonic and allomorphic variations can be applied to teaching English learners. In order to teach English pronunciation, comprehension, reading and spelling, it may be helpful for teachers to understand some of the common allophonic and allomorphic variations in English; this section provides some of the applications of the information and concepts above.

For native speakers of English, the allophonic generalizations described in this chapter are below the level of consciousness. This is true of allophonics in general; native speakers have acquired the patterns of their first language through implicit learning, and automatically follow them without being aware of or able to articulate them. When learning a second language, speakers may transfer the patterns of their first language, causing difficulties in learning to perceive or produce the new language. Major (2008) notes that while transfer does not explain all the errors that L2 learners make, knowledge of the differences between the L1 and L2 systems can lead to valid predictions about which sounds and structures are likely to cause problems for learners. For example, it is common for speakers to substitute a sound from their L1 for a similar sound in their L2; Spanish speakers may produce their [r] for English [ɹ], and Hindi speakers tend to use their retroflex [ʈ ɖ] for English alveolar [t d]. The allophonic systems may also play a role; for example, French speakers would use an [l] at the end of words, where English speakers would expect [ɫ], while word-initially, French speakers would tend to use an unaspirated (and dental) [t̪] rather than the expected [tʰ] in English. Learners may also fail to differentiate two sounds that are phonemes in English because those sounds are only allophones in their L1s; for Korean speakers, the /s/ vs. /ʃ/ distinction of English may be difficult because Korean has only an /s/ phoneme with a palatalized allophone. Differences in phonemic systems can also affect comprehension, as they may interfere with accurate perception. Major (2008) points to how perception can interfere in L2 learning, especially for sounds that are similar to but not identical with L1 sounds; L2 sounds that are completely new are easier to learn than L2 sounds that are similar to, and may easily be mistaken for, L1 sounds.

When learning a second language, learners generally use both implicit and explicit learning. Research has shown that explicit teaching of pronunciation can be successful for second language learners (Levis & Wu, 2018). When pronunciation and perception issues result from transfer, a teacher can use an understanding of phonemics to help pinpoint issues causing learners to sound non-native, and to improve their accents. In order to improve intelligibility in English, teachers need to be aware of the phonemic differences, especially those which bear a heavier information load. Some contrasts are very important in making speech intelligible, while others do not bear much information load (Jenkins, 2002); for example, the difference between /p/ and /b/ is used to contrast hundreds of words, while the phonemes /θ/ and /ð/ make very few contrasts. Jenkins argues for perfecting the more important contrasts first, in order to improve intelligibility.

While not all learners of English can or want to acquire a native accent, improving pronunciation can also help learners to avoid judgements associated with non-native accents. Research has shown that speakers with non-native accents may face discrimination or negative judgements; Lev-Ari and Kaysar (2010), for example, found that accented speech was judged less credible than speech with a native accent. For those learners who do want to sound more native-like, control of the allophonic variation is important. Applying knowledge of English allophonics can improve pronunciation teaching, while applying the methods of phonemics to understand the learner's L1 system can help provide teachers with an understanding of the issues their language learners face or the prior knowledge they bring from their L1 phonemics.

Allophonic differences are rarely, if ever, represented in spelling cross-linguistically, so learners need teachers who are able to explain them. Allomorphic differences are represented in some languages, but English generally favors spelling a stem morpheme in the same way in all words despite its distinct pronunciations. For example, in *legal* vs. *legislation*; the *leg-* morpheme has the [l] pronounced the same in both words, but the ‘e’ and ‘g’ are pronounced differently in the two words ([lig] vs. [lɛʤ]), due to the vowel laxing and velar softening mentioned above. For prefixes and suffixes, some allormorphs are spelled differently, but not all. For example, the plural suffix is spelled *–s*, regardless of whether it’s pronounced [s] or [z], although the [əz] allomorph is generally represented as *–es*. The possessive morpheme, on the other hand, is always spelled *-’s* despite having the same allomorphy. Understanding how morphemes vary in context can help learners to recognize the same morpheme when it is used with different pronunciations, improving comprehension, and to pronounce a new combination of morphemes correctly when reading it for the first time, improving pronunciation.

DISCUSSION QUESTIONS

1. Which type of change in phonological context are L1 English speakers more likely to notice: allophonic or allomorphic? Why?
2. Is there a need to teach allomorphy that is not very productive? Are there any advantages or disadvantages to doing so?
3. Can a learner’s L1 phonemic system (phonemes and allophones) be helpful in learning the system of phonemes and allophones of English as a second language? How?
4. Can a learner’s L1 morphemic system be helpful in learning allomorphy in English as a second language? How?
5. What advantages and disadvantages does a teacher who speaks English as a second language have in teaching the allophones and allomorphs of English? How might these advantages or disadvantages affect students who are learning English pronunciation?

EXERCISES

1. **/t/ in American English**

   The description of the three allophones of /t/ in American English in the chapter was not complete. In the data below, you will find three allophones of /t/: [tʰ], [t], and [ɾ]. Note that syllables that have stress are preceded by the symbol [ˈ]. Use the stress information to give a better description of where the [tʰ], [t], and [ɾ] allophones occur (the data is not organized for you).

top	/tap/	[ˈtʰăp]	*spat*	/spæt/	[ˈspæ̆t]
daughter	/datɚ/	[ˈdaɾɚ]	*state*	/steɪt/	[ˈstĕɪt]
city	/sɪti/	[ˈsɪɾi]	*autograph*	/atogɹæf/	[ˈaɾəgɹæ̆f]
edit	/ɛdɪt/	[ˈɛɾɪ̆t]	*later*	/leɪtɚ/	[ˈleɪɾɚ]
potato	/pəteɪtoʊ/	[pəˈtʰeɪɾoʊ]	*tomato*	/təmeɪtoʊ/	[təˈmeɪɾoʊ]
stick	/stɪk/	[ˈstɪ̆k]	*sensitive*	/sɛnsɪtɪv/	[ˈsɛ̃nsɪɾɪv]
editorial	/ɛdɪtoɹiəl/	[ɛɾɪˈtʰoɹiəɫ]	*tick*	/tɪk/	[ˈtʰɪ̆k]
sensitivity	/sɛnsɪtɪvɪti/	[ˌsɛ̃nsɪˈtʰɪvɪɾi]	*pot*	/pat/	[ˈpʰăt]
tutor	/tutɚ/	[ˈtʰuɾɚ]	*computer*	/kəmpjuɾɚ/	[kə̃mˈpjuɾɚ]

2. ***t* vs *th* in Indian English**

Some varieties of Indian English have the following pronunciations:

a.	*taught*	[ʈɔʈ]	*thought*	[t̪ʰɔʈ]
b.	*tin*	[ʈɪn]	*thin*	[t̪ʰɪn]
c.	*team*	[ʈim]	*theme*	[t̪ʰim]

What do these words prove about their system of phonemes and allophones for the sounds spelled *t* vs *th*? Is their pronunciation likely to cause any difficulties for speakers of American English?

3. [ð] **in Spanish vs. English**

English has the sound [ð] as a phoneme distinct from similar sounds [d] and [θ], as proven by minimal pairs such as *den* [dɛ̃n] vs. *then* [ðɛ̃n] or *ether* [iθɚ] vs. *either* [iðɚ]. Apply the phonemic methods to determine whether [ð] is an allophone of a distinct phoneme in Spanish, by looking for minimal pairs or complementary distribution with [d̪] in the data below (the ̪ indicates that the sound is dental rather than alveolar).

Spanish:	**Words with [d̪]**		**Words with [ð]**	
	where	[d̪ond̪e]	nothing	[naða]
	to have to	[d̪eβɛɾ]	spoken	[ablaðo]
	giving	[d̪and̪o]	bodega	[boðeɣa]
	days	[d̪ias]	you (polite)	[usteð]
	ribbon	[band̪a]	side	[laðo]
	finger	[d̪eðo]	finger	[d̪eðo]
	they give	[d̪an]	wall	[pareð]
	store	[tiend̪a]	help	[ajuða]

Given your findings, does the fact that English and Spanish have some of the same phonetic sounds help your Spanish speakers to learn English as a second language? Can you use your knowledge of the Spanish phonemic system to help?

4. Examine the data below verbs and nouns, and determine the patterns of sound and stress change for each pair.

$\text{content}_{\text{verb}}$	[kə̃nˈtʰɛ̃nt]	$\text{content}_{\text{noun}}$	[ˈkʰãntɛ̃nt]
$\text{refuse}_{\text{verb}}$	[ɹəˈfjuz]	$\text{refuse}_{\text{noun}}$	[ˈɹɛfjŭs]
$\text{project}_{\text{verb}}$	[pɹ̥əˈdʒɛ̆kt]	$\text{project}_{\text{noun}}$	[ˈpɹ̥ɔdʒɛ̆kt]
$\text{conduct}_{\text{verb}}$	[kə̃nˈdʌ̆kt]	$\text{conduct}_{\text{noun}}$	[ˈkʰãndʌ̆kt]
$\text{addict}_{\text{verb}}$	[əˈdɪ̆kt]	$\text{addict}_{\text{noun}}$	[ˈædɪ̆kt]
$\text{record}_{\text{verb}}$	[ɹəˈkʰoɹd]	$\text{record}_{\text{noun}}$	[ˈɹɛkɚd]
$\text{permit}_{\text{verb}}$	[pɚˈmɪ̆t]	$\text{permit}_{\text{noun}}$	[ˈpɚmɪ̆t]

5. **//in-//** English has a morpheme //ɪn-// meaning ‘not’, which can be found in adjective pairs as in the data below (based on the data in Peng, 2013, pp. 101-102).
   a. This morpheme has several allomorphs, and the data is organized based on which allomorph appears in the words. Determine the basis for the different allomorphs: in which context does each allomorph appear?
   b. The spelling of the prefix sometimes changes when added to different roots, making it harder for learners to recognize it as the same prefix or to apply it to new forms without understanding

how it changes in new contexts. When does the spelling accurately reflect the allomorphy? When does the spelling differ from the pronunciation?

c. Could an understanding of this allomorphy help you to explain the //in-// prefix to learners of English?

Allomorph /ɪn-/			
Adjective		**//in-// + Adjective**	
attentive	[ə′tʰɛ̃ntɪv]	inattentive	[ɪnə′tʰɛ̃ntɪv]
offensive	[ə′fɛ̃nsɪv]	inoffensive	[ɪnə′fɛ̃nsɪv]
explicable	[ɛ̆k′splɪkəbəɫ]	inexplicable	[ɪnɛ̆k′splɪkəbəɫ]
humane	[h̥ju′mẽĩn]	inhumane	[ĩnh̥ju′mẽĩn]
tolerable	['t̊ʰalɚɹəbəɫ]	intolerable	[ĩn′t̊ʰalɚɹəbəɫ]
defensible	[də′fɛ̃nsɪbəɫ]	indefensible	[ĩndə′fɛ̃nsɪbəɫ]
sensitive	[′sɛ̃nsɪɾɪv]	insensitive	[ĩn′sɛ̃nsɪɾɪv]
Allomorph /ɪm-/			
perfect	[′pʰɚfɛ̃kt]	imperfect	[ĩm′pʰɚfɛ̃kt]
pure	[p̥juɹ]	impure	[ĩm′p̥juɹ]
balanced	[′b̊ælə̃nst]	imbalanced	[ĩm′b̊ælə̃nst]
Allomorph /ɪŋ-/			
considerate	[kə̃n′sɪdɚɹə̆t]	inconsiderate	[ĩŋkə̃n′sɪdɚɹə̆t]
correct	[′kʰəɹɛ̆kt]	incorrect	[ĩŋ′kʰəɹɛ̆kt]
glorious	[′gloɹiə̆s]	inglorious	[ĩŋ′gloɹiə̆s]
Allomorph /ɪ-/			
legal	[′ligəɫ]	illegal	[ɪ′ligəɫ]
literate	[′lɪɾɚɹə̆t]	illiterate	[ɪ′lɪɾɚɹə̆t]
legible	[′lɛʤɪbəɫ]	illegible	[ɪ′lɛʤɪbəɫ]
relevant	[′ɹɛləvæ̃nt]	irrelevant	[ɪ′ɹɛləvæ̃nt]
responsible	[ɹə′spãnsɪbəɫ]	irresponsible	[ɪɹə′spãnsɪbəɫ]
rational	[′ɹæʃənəɫ]	irrational	[ɪ′ɹæʃənəɫ]
mature	[mə′ʧuɹ]	immature	[ɪməʧuɹ]
material	[mə′tʰiɹiəɫ]	immaterial	[ɪmə′tʰiɹiəɫ]
numerable	[′numɚɹəbəɫ]	innumerable	[ɪ′numɚɹəbəɫ]

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ENDNOTES

[1] The contrast could be illustrated using a word *thill* that fishermen might recognize, but as that is not in common use, the word *thin* appears in Table 1 instead to provide a context that is analogous (see section on Methods).

[2] The common symbol /a/ is used here for the low non-front unrounded vowel, which in most varieties of American English can vary phonetically from a central unrounded lower-mid vowel (IPA [ɐ]) to a back low vowel (IPA [ɑ]).

[3] The asterisk before the phonetic data is used to indicate that this form would be ungrammatical or inappropriate.