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WHAT IS PHONOLOGY?

1.1 Introduction

This book deals with *phonology*, the study of the sound systems of language. In the following chapters, a close look will be taken at the ways in which various languages organize or structure different sounds. Since speech sounds are used to convey meaning, sound systems cannot be fully understood unless they are studied in a wider linguistic context. A language learner, for instance, must master the production and perception of the sounds of a given language. He must also, however, learn *when* to use these sounds. Thus, speakers of English must learn not only the sounds [k] and [s], which are transcribed between phonetic brackets (see below), but also that the [k] of *opaque* changes to [s] when the suffix *-ity* is added to form the word *opacity*. This change of [k] to [s] is as much a part of the sound system of English as is the fact that English contains the sounds [k], [g], [s], and [z].

The goal of phonology is, then, to study the properties of the sound systems which speakers must learn or internalize in order to use their language for the purpose of communication. Thus, when approaching the sound system of a language, it is necessary to study not only the *physical* properties of the attested sounds (that is, how they are made and what their acoustic correlates are), but also the *grammatical* properties of these sounds.

1.2 Phonetics and Phonology

Since speech sounds are the product of human anatomy and physiology, it is not suprising to find similarities across languages. In some cases phonologists are tempted to claim certain *universals* (or at least certain *tendencies*) in the sound systems of the world. Thus, all languages appear to have the vowel [a] in their inventory of sounds. Other vowel sounds, such as [i] and [u], are extremely common in languages, but are not universal, while still other vowel sounds, such as [ü], as in French *rue* [rü] 'street,' are much more restricted in their distribution in the world's languages. In order to explain why certain sounds occur more frequently than others, one turns to the field of *phonetics*, the study of speech sounds. Within this field one might first look to *articulatory phonetics*, the study of how speech sounds are articulated or produced. It may be that certain sounds require less muscular effort in their production than other sounds, and since the latter sounds require greater effort, they are not as frequently found in languages. Nor, as we shall see (**1.5.2**), are they learned as early in language acquisition as are sounds requiring less effort. On the other hand, one might look to *acoustic phonetics*, the study of the physical properties of the sounds that are produced. In this case, it may be that a certain sound is not as frequently found as another because it is less acoustically *distinct* from other sounds.

Phonology has been defined as the study of sound systems, that is, the study of how speech sounds *structure* and *function* in languages. As we shall see, some speech sounds can be used in a language to distinguish words of different meanings, whereas other sounds cannot. Thus, Trubetzkoy, one of the founders of the Prague School of Linguistics, wrote (1939:10): "It is the task of phonology to study which differences in sound are related to differences in meaning in a given language, in which way the discriminative elements . . . are related to each other, and the rules according to which they may be combined into words and sentences." A phonetic study tells how the sounds of a language are made and what their acoustic properties are. A phonological study tells how these sounds are used to convey meaning.

While it may be the case that phonetic explanations readily account for the relative frequency of sounds, there are many issues in the study of speech sounds which cannot be resolved by reference to phonetics alone. Because speech sounds function to convey meaning, speakers sometimes have internal or mental representations of sounds which are not identical with their physical properties. That is, there is a *psychological* as well as a physical (phonetic) side to speech sounds.

In a *phonetic* study of a language, an inventory of sounds is provided. Part of a phonetic study of English will include a statement that the sound [θ] occurs but that the sound [x] does not occur. Part of a phonetic study of German, on the other hand, will include a statement that the sound [x] occurs but that the sound [θ] does not occur. Phoneticians point out that although speech is characterized by a (semi)continuous flow of sounds, speakers segment this continuous speech signal into discrete units. If one were to look at an acoustic record of the pronunciation of the English word *ran* (such as on a spectrogram), one would not observe a pause between the [r] and the [æ], or between the [æ] and the [n]. Nor would one find an abrupt change in the acoustic properties from one sound to the other. Instead, sounds blend into one another, creating transitions from one sound to another. In the above example, the lowering of the velum, which is necessary for the pronunciation of the nasal consonant [n], begins *before* the tip of the tongue reaches the alveolar position required for the articulation of this consonant. As a result, some of the acoustic properties of nasalization which belong to [n] will be realized on the preceding vowel. Because of such resulting transitions, it is impossible to delimit in all cases exactly where one sound begins and another ends. And yet, all speakers of English would agree that the word *ran* consists of three *discrete* sounds.

Since it is not always possible to ascribe a physical reality to the discrete sound units which are transcribed between phonetic brackets, such transcriptions as [ræn], where partial nasalization is not indicated on the vowel, necessarily represent an abstraction from the actual physical record. We shall refer to these discrete units as phonetic *segments* or *phones*. A phonetic study of a language, then, provides an inventory and description of the occurring phonetic segments. However, since speech signals are semicontinuous in nature, and since no two utterances are ever exactly the same, it should be clear that not all of the physical properties of a given form or utterance will ever be included in a phonetic transcription.

A phonological study also refers to the inventory of segments in a language. But stating which phonetic segments occur in a language and which do not is only a superficial part of phonology. As pointed out by Sapir (1925:16–18), two languages can have the same inventory of phonetic segments but have very different phonologies.

As an illustration of this point, consider the status of *ts* in English and German. Compare the German word *Salz* [zalt^s] 'salt' with the English plural form *salts* [sɔlts]. Although one might argue that these two words end with equivalent sound sequences, a closer examination of the two languages reveals that these sequences are analyzed quite differently by speakers of the two languages. The final *ts* of *salts* is considered to be *two* consonants by speakers of English, for two reasons. First, they know that the singular form is *salt* and that the plural form is obtained by adding the additional segment *s*. Second, *ts* is not found at the beginning of English words, unlike the single affricate segment *č* as in *chalk*, which phoneticians break up into a [t] closure and a [š] release. If *ts* were one consonant, it would be expected to occur in all of the general positions where single consonants are found in English. On the other hand, analyzing *ts* as two consonants allows the possibility of identifying *ts* with other consonant sequences such as *ps* and *ks*, which also are not found at the beginning of English words (see Sapir, 1925:20). In other words, there is a *structural* principle in English ruling out sequences of certain consonants followed by [s] in word-initial position. The analysis of *ts* as *t* + *s* therefore fits the pattern or structure of the language.

In German, on the other hand, *ts* (which is frequently written *z* in the orthography) is found in initial position as well as in final position, for example, *Zahl* [t^sa:l] 'number.' Because of its relatively free distribution, speakers of German analyze the [t] closure followed by an [s] release as the one segment t^s. While *ps* and *ks* are not found at the beginning of German words, t^s is found in this position. This difference in the structuring of *ps* and *ks*, on the one hand, and t^s on the other, makes German t^s different from English *ts*. Since the two are identical phonetically, a purely phonetic study would miss this distinction. It is in a *phonological* study that the difference between *ts* and t^s is captured. Thus, it is claimed that English has two *phonological* segments /t/ and /s/ in sequence, while German has, in addition to /t/ and /s/, a phonological segment /t^s/. Such phonological segments or *phonemes* are written between phonemic slashes.

A phonological study thus deals with the *structure* of the phonetic segments in a language. It also deals with the *function* of these segments. In one sense this means determining whether a given sound is used in words of everyday speech or only in a particular style of speech (poetic, archaic, etc.). For example, languages often use exceptional sounds or sound sequences in *ideophones*, a class of forms which express noises, feelings, intensity, etc. The bilabial trill represented orthographically as *brrr* in English and used to convey the idea of one's being cold falls outside the sound system of English. Unlike the sound *b* or the sound *r*, which are phonetic and phonological segments of English, *brrr* does not combine with other sounds to build words. While there is a word *bat* and a word *rat*, there is no English word [ḅæt], where [ḅ] represents this bilabial trill. A bilabial trill does occur in some languages, for example, in the Babanki word [ḅì] 'dog,' though it is relatively rare. A second sound occurring only in a single English ideophone is the coarticulated labiovelar stop [k͡p] as found in [k͡pək͡pək͡pə] (the ideophone used to call chickens). The status of [k͡p] in English is quite different from that of the [k͡p] which frequently occurs in West African languages, for example, Igbo [àk͡pà] 'bag.' A purely phonetic study of English *describes* this sound and notes its infrequency in the language. A phonological study points out the limited *function* of [k͡p] in English, that is, the fact that it is permissible only in one ideophone. It therefore differs from [p] and [k] not only quantitatively (that is, in frequency), but also qualitatively. While

English speakers have no difficulty pronouncing the consonants in Igbo [òpì] 'horn' and [áká] 'hand,' they experience great difficulty in reproducing the [k͡p] of [àk͡pà] 'bag.' This is true even for speakers who use the sound to call chickens. This reveals the different *psychological* status of [k͡p] as opposed to [p] and [k]. Like the *brrr* sound, [k͡p] is not part of the sound structure of English. It cannot be used to build words.

1.3 Redundancy and Distinctiveness

The preceding section establishes that there is a difference between phonetics and phonology. While the former is concerned with the physical properties of speech sounds, the latter is concerned with the structure and function of these sounds in conveying meaning. It was said that two languages can have the same phonetic segments, and yet these segments may have different phonological properties in the two languages.

This statement can be better understood by comparing a fragment of the phonologies of English and Thai. English has two kinds of voiceless stops phonetically: aspirated [p^h, t^h, k^h] and unaspirated [p, t, k]. Aspirated stops are found at the beginnings of words. As a result, the word which is written *pin* is pronounced [p^hɪn]. On the other hand, unaspirated stops are found after word-initial *s*. Thus, the word *spin* is pronounced [spɪn], not *[sp^hɪn]. That the stop consonant in *spin* is phonetically different from the stop consonant in *pin* can be demonstrated by holding a lit match in front of the mouth: pronouncing the word *spin* makes the flame flutter less than pronouncing the word *pin*.

There are also two series of voiceless stops in Thai: an aspirated series and an unaspirated series. The Thai words [p^hàa] 'to split' and [pàa] 'forest' (Ladefoged, 1971:12) illustrate the same difference between [p^h] and [p] as in the English words *pin* and *spin*. However, if the comparison were to stop at the observation that English and Thai share a common inventory of aspirated and unaspirated stops, an important phonological distinction would be missed.

In English, the two different *ps* are found in different environments. The fact that one *p* is aspirated and the other is not is predictable from the place it falls within the word. Thus, given the environments,

___ ɪn   ## s ___ ɪn

where ## marks the beginning of a word, it would sound un-English to put [p] instead of [p^h] in the first blank and [p^h] instead of [p] in the second blank. The same distribution is observed in the words *tick* and *stick*, pronounced with [t^h] and [t], and the words *kin* and *skin*, pronounced with [k^h] and [k]. Since the presence or absence of aspiration can be predicted from the environment of the voiceless stop in a word, aspiration is said to be *redundant* in English.

The difference between English and Thai is that aspiration is not redundant in Thai. Since [pʰ] and [p] both occur in exactly the same environment in 'to split' and 'forest' (namely, at the beginning of a word and before [àa]), it is not possible to predict whether a given *p* will be aspirated or unaspirated in this language. When two words such as [pʰàa] and [pàa] differ only by one sound, they are said to constitute a *minimal pair*. The difference between the two sounds is sufficient to signal a difference in meaning. Examples of minimal pairs in English are *pin* and *bin*, *cat* and *cad*. In Thai, if we pronounce [pʰ] instead of [p] we risk pronouncing a word of a different meaning (for example, 'to split' instead of 'forest'). In English, on the other hand, if we pronounce [pʰ] instead of [p], as in the non-native sounding [spʰɪn], we probably will not be misunderstood, since aspiration is a redundant property predictable from the presence or absence of a preceding [s]. If we pronounce [b] instead of [pʰ], however, a word of a different meaning will result (for example, *bin* instead of *pin*). This means that the difference between [b] and [pʰ] is not redundant in English.

We now begin to appreciate Trubetzkoy's definition of phonology (**1.2**). Since both *p's* are capable of occurring in the same place in a word in Thai, and since the substitution of one for the other results in a word of a different meaning, aspiration is said to be *distinctive* in Thai. Similarly, the difference between [b] and [pʰ] is distinctive in English, though the difference between [p] and [pʰ] is redundant. Trubetzkoy rightly pointed out that the concerns of phonology go beyond those of phonetics. In phonology we are concerned with the distinctive vs. redundant function of speech sounds (or, more correctly, features, as we shall see below). If the goal of phonetics is to understand the physical properties of speech sounds, then the goal of phonology is to understand the ways these sounds function in language.

Phoneticians have long talked about sounds grouping into intersecting classes. Some classes are more general or inclusive (for example, the class of voiced sounds), while some classes are more specific or exclusive (for example, the class of voiceless aspirated stops). While these classes are assumed to be universally available to all languages, they are used differently by different languages (compare the use of aspiration in English and Thai). However, phonologists argue that there are only a certain number of "natural" ways a language can deal with these classes. It should be clear that one way languages differ is in their general inventory of sounds. A language can lack a sound (for example, French does not have [h]) or even a whole series (class) of sounds (for example, English does not have breathy voiced consonants). However a difference in inventory between two languages has not only *phonetic* consequences, but also *phonological* consequences.

As an illustration, consider the case of English and Berber. In the labial

series, English has four oral consonants, while Berber, like many languages in North Africa and the Middle East, has only two:

	ENGLISH	BERBER
voiceless stop	p	
voiced stop	b	b
voiceless fricative	f	f
voiced fricative	v	

Berber does not have a [p] or a [v], whereas English does. In English, in order to distinguish [f] from all other consonants, it is necessary to say that it is (1) voiceless, (2) labial, and (3) a fricative. We must specify it as voiceless, because there is a [v] in English which differs from [f] only in that it is voiced. We must specify it as labial, because there is an [s] in English which differs from [f] primarily in that it is alveolar. Finally, we must specify it as a fricative, because there is a [p] in English which differs from [f] primarily in that it is a stop. Thus, three features are required to distinguish [f] from other sounds in English.

In Berber, on the other hand, only two features are needed. In order to specify [f] in Berber, we can say either that it is (1) voiceless and (2) labial or that it is (1) a fricative and (2) labial. In the first case we need not add that it is a fricative, because we know that if a Berber consonant is voiceless and labial, it can only be [f]. It cannot be [p], since this sound does not exist in the language. Similarly, in the second case we need not add that it is voiceless, because we know that if a Berber consonant is a fricative and labial, it can only be [f]. It cannot be [v], since this sound does not exist in the language.

Thus, in English each of these phonetic features is *distinctive* for all these sounds, whereas in Berber there is some *redundancy*. In labial consonants in Berber, voiceless + fricative go together: one can be predicted from the other. In English, each phonetic property has distinctive value. Thus, if one feature is changed, say, voiceless to voiced, a distinctive sound of the language is obtained (for example, [v]). Notice also in Berber that while voiceless + fricative go together in the labial series, voiced + stop also go together. Thus, we find only [b] and not [p]. In summary, the two Berber labials [f] and [b] differ from each other in *two* features, whereas in English, [p] and [b], [p] and [f], [f] and [v], and [b] and [v] each differ from each other in only *one* feature. As a result, there is less redundant information in English than in Berber, for the labial series of sounds.

A child in acquiring his language must learn to recognize which sounds of his language are distinctive and which sounds are redundant. Distinctive sound units, that is, those which are capable of distinguishing words of different meanings, are termed *phonemes*, whereas redundant sounds, that is, those which are predictable from a given environment, are termed *contextual* *variants* or *allophones* (see **3.1**). As the child learns the phonemes and contextual variants of his language, he establishes that certain phonetic features are distinctive, whereas others are redundant. Some of these redundancies are language-specific, such as the Berber case just examined. Other redundancies are *universal* (for example, no language has a sound which is both an affricate and nasal). In addition, there are some redundancies which are not universal but which are frequently attested in languages. Thus, most languages only have *voiced* sonorants (that is, nasals, liquids, glides, and vowels) and no *voiceless* ones. Burmese, however, has a complete contrast between voiced and voiceless nasal consonants, as seen in the following examples (Ladefoged, 1971:11):

[mà]	'healthy'	[nà]	'pain'	[ŋâ]	'fish'
[m̥à]	'order'	[n̥à]	'nostril'	[ŋ̊â]	'rent'

From these words it can be seen that voicing is *distinctive* in nasal consonants in Burmese. Such a situation is relatively rare, and voiceless nasal consonants are among those sounds which are viewed as complex by phonologists. Finally, there are many sounds which are frequently missing from the phonetic inventories of languages, for example, the interdental fricatives [θ] and [ð], the front rounded vowels [ü, ø, œ], the labiovelar stops [k͡p, g͡b, ŋ͡m], and the South African click sounds. As was seen in Berber, gaps in the phonetic inventory of a language partly determine which features are used distinctively and which features are used redundantly.

1.4 Levels of Sound Representation

The preceding sections have illustrated that there are two separate (though interdependent) fields, phonetics and phonology, and that for any given language it is possible to provide either a phonetic description or a phonological description. The units of phonetic description are sound segments (or *phones*), while the units of phonological description are *phonemes*. In order to characterize the relationship between the phonemes of a language and its inventory of phonetic segments, two levels of sound representation are distinguished, a *phonological level* and a *phonetic level*. Phonological representations consist of sequences of phonemes, transcribed between slashes (/.../)[1]; phonetic representations consist of sequences of phones, transcribed between square brackets ([...]). Thus the phonological

[1] As we shall see in **3.3.2**, grammatical information such as the presence of morphological boundaries plays an important role in phonology and must therefore often be included in phonological representations.

representation of the English word *pin* will be /pɪn/, while its phonetic representation will be [pʰɪn].

Since the phonological level represents the distinctive sound units of a language and not redundant phonetic information (such as the aspiration of the initial [pʰ] of English /pɪn/), it is appropriate to think of it as approximating the *mental* representations speakers have of the sounds of words in their language. As an example, consider the *ch* sounds in German. As seen from the words *lachen* [laxən] 'to laugh' and *riechen* [ri:çən] 'to smell,' orthographic *ch* is pronounced both as a velar fricative [x] and as a palatal fricative [ç]. Whether *ch* will be pronounced [x] or [ç] can, however, be predicted from what precedes it: *ch* will be pronounced [x] if it is preceded by a back vowel; it will be pronounced [ç] if it is preceded by a front vowel, a consonant, or zero:

[x]		[ç]	
Buch	'book'	*mich*	'me'
hoch	'high'	*Pech*	'pitch'
noch	'still'	*horch*	'hark!'
Bach	'stream'	*China*	'China'

Because the phonetic difference between [x] and [ç] can be predicted by context, the two sounds are derived from the same unit on the phonological level, that is, from the same phoneme. The phonological identity of the two phonetic realizations [x] and [ç] is of course reflected in German orthography. More important, however, is the claim inherent in deriving these two sounds from the same phoneme; namely, it is claimed that speakers of German mentally "store" [x] and [ç] as one unit in their brain. Since there can never be a contrast between two such sounds found in mutually exclusive environments, the difference between [x] and [ç] can never serve to make a meaning difference between two words. In this sense [x] and [ç] are comparable to the earlier example of [p] and [pʰ] in English. Thus both *lachen* and *riechen* will be represented phonologically with the phoneme /x/, although the /x/ of *riechen* is pronounced [ç].[2]

1.4.1 Phonological and Phonetic Constraints

From the preceding example it should be clear that the phonetic and phonological levels sometimes differ in their inventories. Thus, both [x] and [ç] are part of the phonetic inventory of German, though only /x/ is posited in the phonological inventory. As demonstrated in **1.4**, the exact inventory partly establishes the redundancies in the use of phonetic features in a

[2] The choice of representing this single phoneme as /x/ rather than as /ç/ may seem arbitrary at this point, as may some of the solutions which will be discussed below. See Chapter 3 for a survey of the general considerations involved in establishing phonological representations.

language. In the German case, since /ç/ is not an independent phoneme, it is possible to formulate the following redundancy on the *phonological* level: *if a fricative is articulated further back than the alveopalatal region* (that is, where [š] is produced), *then it will be velar*. That is, there is no phonological unit which combines the features fricative and palatal, or fricative and uvular, as would be the case if either /ç/ or /X/ were among the list of German phonemes. Such a restriction on the feature composition of a unit is termed a *segmental constraint*. Since the constraint under discussion here characterizes the phonological level, we can refer to it as a *phonological* segmental constraint.

There are also segmental constraints characterizing the phonetic level of representation. In this case we speak of *phonetic* segmental constraints. If the inventories of both the phonological and the phonetic levels are identical, then the same segmental constraints are said to characterize both levels. However, the two inventories typically differ, as in the German case. Since [ç] does exist on the phonetic level, we cannot state the same restriction as a phonetic segmental constraint. However, the voiced velar fricative [ɣ] is missing from both levels in Standard German. Thus the following segmental constraint characterizes both the phonological and the phonetic levels: *if a fricative is velar, it is voiceless*. This generalization does not, of course, apply to those dialects of German which do have [ɣ].[3]

In addition to segmental constraints, there are also *sequential constraints*, and these too can pertain to either the phonological level or the phonetic level, or both. We thus speak of *phonological* sequential constraints and *phonetic* sequential constraints. That is, on both levels there are restrictions on how segments can be combined sequentially. This may mean that words or syllables can begin with only certain segments or that certain segments cannot occur before or after other segments. Let us first cite a case from English, where the same sequential constraint is found phonologically and phonetically, schematized as follows:

$$\begin{array}{llccc} \text{If:} & \#\# & \text{C} & \text{C} & \text{C} \\ & & \Downarrow & \Downarrow & \Downarrow \\ \text{Then:} & & \text{s} & \begin{Bmatrix} \text{p} \\ \text{t} \\ \text{k} \end{Bmatrix} & \begin{Bmatrix} \text{l} \\ \text{r} \\ \text{y} \\ \text{w} \end{Bmatrix} \end{array}$$

If a word (##) begins with three consonants in English, then the first consonant must be *s*, the second consonant must be *p*, *t*, or *k*, and the third

[3] A situation whereby a language would have a phonetic/segmental constraint which is not also a phonological/segmental constraint would mean that a certain phoneme, say /p/, is never realized as [p] phonetically. This possibility relates to the question of abstractness in phonology, which is discussed in **3.3.5**.

consonant must be *l*, *r*, *y*, or *w*. Any other word-initial combination of three consonants is unacceptable (for example, *fpl*–, *sfl*–, *spv*–). Notice, however, that this sequential constraint, as written, is not entirely satisfactory. The if-then condition allows word-initial *spl*–, *spr*–, *stl*–, *str*–, *skl*–, and *skr*– clusters. Words such as *spleen*, *spring*, *stroke*, and *scream* show that initial *spl*–, *spr*–, *str*–, and *skr*– are well attested in English. On the other hand, words with initial *skl*–, such as *sclerosis*, are extremely rare and are limited to a handful of learned borrowings. Also, no word in English begins with *stl*–, since *l* cannot follow *t* or *d* (thus we have the words *play* and *clay*, with *pl*– and *kl*–, but no corresponding word **tlay*). Finally, there are severe restrictions on the occurrence of *CCy*– and *CCw*–. When *y* is the third of three word-initial consonants, the following vowel must be *u*, for example, *spew* [spyu], *skew* [skyu].[4] When *w* is the third consonant, the second consonant must be *k*, for example, *square* [skwer]. Thus the precise statement of a sequential constraint can often be quite complex in nature.

While this sequential constraint on word-initial three-consonant clusters pertains to both the phonological and the phonetic levels, the sequential constraints of the two levels sometimes differ in a language. This can mean either (1) that there is a sequential constraint which characterizes the phonological level but not the phonetic level; or (2) that there is a sequential constraint which characterizes the phonetic level but not the phonological level. As an example of the first situation, French disallows many consonant clusters on the phonological level which are nonetheless permitted on the phonetic level. For instance, phonologically there are no word-initial /fn/ or /št/ sequences in the language. However, phrases such as *la fenêtre* 'the window' and *le jeton* 'the token' are pronounced [la fnɛ:tr] and [lə štɔ̃], respectively. On the phonological level, on the other hand, these consonants do not occur in sequence, but rather are separated by a schwa, as seen in the pronunciation of such words in isolation, that is, [fənɛ:tr] and [žətɔ̃]. As will be discussed in **1.4.2**, this phonological /ə/ is sometimes deleted when the phonological representation is converted into the corresponding phonetic one.

As an example of the second situation (that is, where a phonological sequence is not permitted on the phonetic level), consider the case of word-initial *sC*– clusters in Spanish. Phonetically speaking, word-initial sequences

[4] There have been a number of proposals for the transcription of English vowels. In capturing the phonetic differences between [uw] as in *fool* and [ʊ] as in *full*, we note that (1) [uw] is longer than [ʊ]; (2) [uw] is dipthongized, while [ʊ] is not; and (3) [uw] is tense, while [ʊ] is lax. In the remainder of this study we shall transcribe this difference as one between tense and lax. That is, the so-called diphthongized vowels will be transcribed as [i, e, u, o] rather than as [iy, ey, uw, ow], while the corresponding nondiphthongized vowels will be transcribed as [ɪ, ɛ, ʊ, ɔ].

of [s] followed by another consonant must be preceded by [ɛ], for example, [ɛspaɲa] 'Spain,' [ɛstufo] 'stove,' [ɛskwela] 'school.' However, this [ɛ] is predictable from the fact that it is required any time a word would otherwise begin with an [sC] sequence. It therefore need not be represented in the phonological representations /spaɲa/, /stufo/, and /skwelo/ (just as aspiration and the difference between [x] and [ç] were not represented phonologically in English and German, respectively). Thus, the sequential constraint against word-initial *sC–* applies only to the phonetic level and not to the phonological level.

1.4.2 Phonological Rules

The reason that phonological constraints sometimes differ from phonetic constraints in a language is that there are *phonological rules* (P-rules) which convert phonological representations into phonetic ones. For example, /la fənɛ:tr/ 'the window' is converted to [la fnɛ:tr] in French by a phonological rule which can be schematized as follows[5]:

$$\text{ə} \rightarrow \emptyset \;/\; V\,C\,\_\_$$

This rule states that schwa may be deleted (that is, becomes zero or Ø) when the preceding consonant is in turn preceded by a vowel.[6] Thus there are phonological rules, such as this rule of schwa deletion, which relate the phonological and phonetic levels. These rules, which reveal linguistically significant generalizations in phonology, are either *optional* or *obligatory*. The above French rule is optional, since it is possible for the same speaker to pronounce either [la fnɛ:tr] (in fast or allegro speech) or [la fənɛ:tr] (in slow, articulated speech). The Spanish rule which inserts [ɛ] before word-initial /sC/ sequences, and which can be schematized as follows:

$$\emptyset \rightarrow \varepsilon \;/\; \#\#\,\_\_\,s\,C$$

is, however, obligatory, since [ɛspaɲa] 'Spain' cannot be pronounced *[spaɲa].

Phonological rules can also be divided into those which produce *alternations* and those which do not, a distinction which will be of significance in

[5] The segment to the left of the arrow is to be read as the input to be changed by the rule; the segment to the right of the arrow represents the change, while the information to the right of the "environment slash" / indicates the grammatical or phonetic context in which the rule takes place. Thus, in this French rule, /VCə/ is converted to [VC]. For a discussion of notational conventions and the role of formalisms in phonology, see **4.3.1**.

[6] This statement covers only the major cases of schwa deletion in French, a phenomenon which is particularly complex (see Dell, 1973:221–260). Thus, it does not cover examples such as *je t'aime* 'I love you,' which is pronounced [žə tɛ:m] in slow speech, but [štɛ:m] in rapid speech.

the discussion of abstractness in **3.3.5**. A particularly clear example of a rule which produces alternations is seen in the following forms:

we miss you	→	[wi mɪš(y)u]
we please you	→	[wi pliž(y)u]
we bet you	→	[wi bɛč(y)u]
we fed you	→	[wi fɛǰ(y)u]

The phonetic forms on the right represent possible pronunciations of these forms in American English. In careful speech, speakers may pronounce [wi mɪs yu], etc., but the more rapid the pace, the more likely that forms such as the above will be heard.[7] The following optional rule is therefore needed:

$$\begin{bmatrix} s \\ z \\ t \\ d \end{bmatrix} \rightarrow \begin{bmatrix} \check{s} \\ \check{z} \\ \check{c} \\ \check{j} \end{bmatrix} \;/\; \_\_\, y$$

This rule states that /s/ becomes [š], /z/ becomes [ž], /t/ becomes [č], and /d/ becomes [ǰ] before /y/ (which in turn may be deleted, as indicated by the parentheses in the phonetic transcriptions).

Because of this rule, a word such as *miss* will have two pronunciations. It will be pronounced [mɪs] in a context such as *we miss it* [wi mɪs ɪt], but [mɪš] in a context such as *we miss you*. These alternants of the same word or *morpheme*[8] 'miss' are termed *allomorphs*. Whenever such alternants are conditioned by a phonological rule, the phonetic shape of the allomorphs is *predictable*. Thus, American English speakers say [wi mɪš(y)u], but never *[wi mɪš ɪt]. While many allomorphs are predictable in this way, others are not. A morpheme may have different pronunciations not because of different phonological environments but because of different grammatical environments. Thus, the past tense of the verb *to go* is *went*, and the plural of the noun *mouse* is *mice*. In both of these cases it is not possible to derive one form from the other by means of a general phonological rule. Such cases of irregular allomorphs (known as *suppletion*) therefore differ in a crucial way from the more regular allomorphs derived by phonological rules. While [mɪš] can be derived from /mɪs/ by a general rule of English phonology, [wɛnt] cannot be derived from /go/.

[7] The change of /s/ to [š] is also affected by stress. Thus, the /s/ of the phrase *I miss yóghurt* and the word *mis-úse* does not become [š] as readily as in *I miss you*, since the syllable following /s/ is stressed in the first two instances.

[8] A morpheme can be defined for our purposes as a minimal unit of sound carrying meaning. It can consist of a single segment (e.g., the /z/ of *dogs* [dɔgz], which denotes plurality), or of several segments (e.g., /dɔg/).

Because native speakers hear and produce [s] and [š] in the same morpheme (depending on the phonological context), the English language is said to have an *alternation* between [s] and [š]. Whenever there is an alternation, the need for a phonological level distinct from a phonetic one is evident. In this case, speakers are aware of the underlying (phonological) /s/ and are capable of saying [wi mɪs yu] in slow or careful speech. Thus phonological /s/ is sometimes pronounced [s], sometimes [š].

However, there is not always an alternation for each phonological rule. Returning to the [p] vs. [pʰ] distinction discussed earlier, there must be a rule such as the following in English:

$$\begin{bmatrix} p \\ t \\ k \end{bmatrix} \rightarrow \begin{bmatrix} p^h \\ t^h \\ k^h \end{bmatrix} / \#\# \_\_$$

Phonological /p, t, k/ is converted by this rule to phonetic [pʰ, tʰ, kʰ] at the beginning of a word. There are, however, no resulting allomorphs and no alternations of the kind we have just seen. English does include a few remnants of alternations, such as in the words *take* [tʰek] and *mistake* [mɪstek] (where the latter form is derived historically from *mis* + *take*). In these forms it might be argued that there is an alternation between [tʰ] and [t]. However, in order to maintain this position, it is necessary to demonstrate that native speakers view *take* and the final part of *mistake* as the same morpheme.

In summary, some phonological rules are obligatory, while others are optional; and some phonological rules produce alternations, while others do not. While we shall look in depth at numerous phonological processes in languages in subsequent chapters, the different kinds of operations that phonological rules can perform are summarized below:

1. Phonological rules can change segments (or, as will be seen in Chapter 2, change the phonetic features of segments). In the American English example, /s, z, t, d/ are changed to [š, ž, č, ǰ] before /y/. In terms of phonetic features, alveolar consonants become alveopalatal before the palatal glide /y/.

2. Phonological rules can delete segments. The schwa of French /fənɛ:tr/ 'window' is deleted in the phrase [la fnɛ:tr] 'the window,' as illustrated earlier.

3. Phonological rules can insert segments. We have seen that Spanish inserts [ɛ] before word-initial /sC/ sequences, for example, /spaɲa/ 'Spain' is pronounced [ɛspaɲa].

4. Phonological rules can coalesce segments. In many languages /ai/ and /au/ are realized respectively as [e] (or [ɛ]) and [o] (or [ɔ]). In such cases the phonetic output is in a sense a "blend" of the two segments in the phonological input: the lowness of /a/ combined with the close tongue position of /i/ and /u/ results in the mid vowels [e] and [o].

5. Finally, there are occasional cases where phonological rules can permute or interchange segments. This operation, known as *metathesis*, as when *ask* is pronounced [æks], converts phonological /AB/ to phonetic [BA].

1.5 Some Universals of Phonological Systems

Recent phonological studies have revealed a number of common properties shared by the sound systems of the world's languages. One of the major goals of phonologists is to discover *phonological universals*. One such universal, the presence of the vowel /a/ in all languages, has already been mentioned. Other universals (or, in some cases, "universal tendencies") have been hypothesized on the basis of cross-linguistic comparisons of phonological inventories, language acquisition, and language change.

1.5.1 Phonological Inventories

As stated above, certain sounds are found in more languages than others. Cross-linguistic comparisons have been made on the basis of both phonetic and phonological inventories, although we shall look only at the latter. Thus the phonological segment /s/, for instance, is more frequent in the world's languages than is /θ/. In addition, it has been observed that the presence of certain segments in a language often implies the presence of other segments. If a language has /θ/, it can be assumed that it also has /s/. The reverse is not true, since there are languages which have /s/ but do not have /θ/. Such *implicational universals* have been discussed by Jakobson (1941) and Greenberg (1966*a*). In an implicational universal, X implies Y but Y does not imply X. Thus, to take another example, the consonant /d/ implies the consonant /t/, but /t/ does not imply /d/. That is, it has been suggested that any language which has /d/ also has /t/. There are, however, many languages which have /t/ but do not have /d/ (for example, Finnish, Korean, Southern Paiute).

Ferguson (1966) and Greenberg (1966*a*) have devoted considerable attention to the status of nasalized vowels in languages. Some languages have a distinctive contrast between oral and nasalized vowels. Thus, the French words *sept* [sɛt] 'seven' and *sainte* [sɛ̃t] 'saint(f.)' differ primarily in that the latter has a nasalized vowel while the former has an oral vowel. Given that both oral and nasalized vowels are found in languages, it is logically possible to imagine four different vowel systems:[9]

(a) languages with V and Ṽ
(b) languages with V only
(c) languages with Ṽ only
(d) languages with neither

[9] The symbol V stands here for any oral vowel, and the symbol Ṽ for any nasalized vowel.

Of the four possible vowel systems, only the first two are in fact found. French is an example of (a), since it has both oral and nasalized vowels. Italian is an example of (b), since it has only oral phonological vowels.[10] No language has only nasalized vowels (c), and no language has no vowels at all (d). We can conclude that the presence of nasalized vowels *implies* the presence of oral vowels in a language, but not the reverse. Thus X implies Y but Y does not imply X.

Another instance of an implicational universal concerns voiceless and voiced stops. Again, there are four logically possible systems:

(a) languages with /p, t, k, b, d, g/
(b) languages with /p, t, k/
(c) languages with /b, d, g/
(d) languages with neither series

As in the previous example, only the first two possible stop systems are found. There are languages with voiceless and voiced stops (a), such as English and French; there are also languages with only voiceless stops (b), such as Southern Paiute (Sapir, 1933). No language has only voiced stops (c), and no language has no stops at all (d). Thus, the series /b, d, g/ implies the series /p, t, k/, but the series /p, t, k/ does not imply the series /b, d, g/.[11]

1.5.2 Language Acquisition

We also owe to Jakobson (1941) the observation that, in all languages, sound segments tend to be learned in a relatively fixed order by children. While more recent studies have not always confirmed the details of Jakobson's relative chronology of sound acquisition, certain general tendencies cannot be missed. It can be observed, for instance, that children learning English acquire [f] before they acquire [θ]. A child is quite likely to produce a word such as *thumb* with an initial [f]. As a result, the word *three* may become homophonous with the word *free*. Other general tendencies include the learning of voiceless stops before voiced stops, as well as the learning of front consonants such as [p] and [t] before back consonants such as [k].

[10] Since all languages show a tendency for a vowel to receive at least a slight degree of nasalization in the context of a nasal consonant, the minute nasalization of the two instances of [a] in the word *andante* cannot be said to be a *phonological* property of Italian (see 5.2.5).

[11] This implicational universal can be extended to include all *obstruents* (i.e., stops, affricates, and fricatives). Notice, however, that some languages may lack one particular member of a series. Thus, Arabic, Berber, Hausa, and several other languages lack /p/ and /v/, although they have /f/ and /b/. In these languages, /t, k, f, s . . . / are said to imply /b, d, g, z . . . /. It still remains true that no language will have a series of voiced obstruents unless it also has a series of voiceless obstruents.

This last tendency is revealed by the predominance of front consonants in the following common forms for 'mother' and 'father' in child language (Jakobson, 1960):

	LABIAL	DENTAL/ALVEOLAR	
nasal	mama	nana	'mother'
oral	papa/baba	tata/dada	'father'

The presence of labial or dental/alveolar consonants in the forms for 'mother' and 'father' is widely attested in the acquisition of unrelated languages. In addition, cross-linguistic investigations of child language indicate a nasal consonant in 'mother' but an oral consonant in 'father.' While the above forms are frequently heard, it is rarely the case that a child refers to his mother as [ŋaŋa] and to his father as [kaka]. The statistical bias in favor of front consonants in the terms 'mother' and 'father' is presumably due to the fact that labial and dental/alveolar consonants are learned before velar consonants. Thus, numerous studies in child language have reported children replacing velars by dental/alveolar consonants. Stampe (1969:446), for instance, reports a child saying [ta] instead of *car* [kar], and [tæt] instead of *cat* [kæt].

Jakobson further made the discovery that there is a correlation between the order in which sounds are acquired by children and the implicational universals noted on the basis of phonological inventories. While a language will not have /b, d, g/ unless it has /p, t, k/, a child will presumably not learn [b, d, g] until he has learned [p, t, k]. This correlation is not accidental, but rather results from the relative complexity of some sounds (for example, [b, d, g]) as compared to others (for example, [p, t, k]).

1.5.3 Language Change

The notion of relative complexity of certain speech sounds over others also plays a role in determining the direction of sound change. While it is a well-known fact that sounds change through time, some sound changes are more frequently attested than others, while still other potential sound changes are not attested at all. For example, the sound change turning [b, d, g] into [p, t, k] has been observed in several language families of the world (for example, in the history of Chinese). This change constitutes part of the consonant shift known as Grimm's Law, which separates the Germanic branch from the rest of the Indo-European languages. On the other hand, a sound change turning all instances of [p, t, k] into [b, d, g] has never been reported. If such a sound change were to take place, the resulting system would include a series of voiced stops but no series of voiceless stops. In other words, the Jakobsonian implicational universal whereby /b, d, g/ implies /p, t, k/ would be violated. As pointed out by Greenberg (1966a:510), any sound change which produces an impossible sound system (such as the one which would result from a change voicing all voiceless stops) is an impossible sound change.

In the study of sound change it becomes apparent, then, that some changes are unidirectional. While X frequently becomes Y, Y rarely (if ever) becomes X. In addition, while a sound X may be frequently observed to change into another sound Y, it may not change into a third sound Z. For example, an aspirated stop easily becomes an affricate (compare English *to* [t^{h}u], German *zu* [t^{s}u]). It does not normally become a nasal consonant. Thus, we would not expect the English word *to* to change its pronunciation to [nu], although it could conceivably go the route of German affrication.

Each time a sound change is observed, the relationship between the original sound and the new sound can be examined. If all occurrences of X change to Y, we look for some articulatory or acoustic property shared by X and Y. If only some instances of X change to Y (for example, those which are followed by the sound Z), we again assume a phonetic property shared by X and Y, and then seek to understand the way that Z motivates the sound change in question. In general, sound changes of the first type, which are said to be *context-free*, tend to produce segments which are articulatorily or perceptually less complex, while sound changes of the second type, which are said to be *context-sensitive*, tend to produce more complex segments. Voiced stops can become voiceless in a context-free fashion (thereby producing less complex segments), but voiceless stops cannot become voiced as a context-free sound change. On the other hand, voiceless consonants can become voiced in restricted contexts (producing more complex segments). In particular, [p, t, k] may become [b, d, g] between vowels (for example, the consonant in English *auto* is frequently voiced) as well as after a nasal consonant (for example, Kpelle *m̀* 'my' + *pólù* 'back' is pronounced [m̀bólù] (Welmers, 1962:73)).

The study of sound change is thus intimately tied to the study of implicational universals and language acquisition. As a final example, the tendency of sounds to be dropped (lost) at the end of words more readily than at the beginning can be cited. The spelling of the French word *rat* 'rat' indicates that there once was a final [t]. The original pronunciation [rat] has become [ra], and not [at]. Similarly, the Proto-Bamileke form [kám] 'crab' has become [ká] in Dschang-Bamileke, and not [ám]. In both cases a final consonant has been lost historically, revealing that consonants are more stable in word-initial position than they are in word-final position. What this means is that a syllable consisting of three segments, consonant-vowel-consonant (CVC), is more likely to become CV than VC. This fact correlates with a universal established by Jakobson and others to the effect that all languages have CV syllables (see **6.1.1.1**). Not all languages have VC syllables. A historical change of all CVC syllables to VC would therefore create an

impossible phonological system. Finally, it has been noted in studies in language acquisition that CV is the earliest syllable structure to be acquired by children. All three of these observations (the favoring of CV syllables in phonological systems, in language acquisition, and in language change) are related and are receiving attention from linguists working in each of these areas.

1.6 The Psychological Reality of Phonological Descriptions

In **1.4** we distinguished a phonological level, a phonetic level, and phonological rules converting phonological representations into phonetic ones. The phonological level captures the distinctive sound contrasts of a language, while the phonological rules specify how the underlying phonological units (or *phonemes*) are to be pronounced in the various environments in which they are found. The resulting phonetic level provides a transcription of the sound segments used in actual utterances.

Learning a language, especially one's native language, requires that a person learn the distinctive contrasts on the phonological level, the phonological rules, and the resulting phonetic properties specified by these rules. It is therefore quite appropriate to ask for evidence that the phonological properties described by linguists are in fact learned by speakers—that is, that they are *psychologically real*. While many kinds of evidence have been seen in the literature, only four will be mentioned here.

1.6.1 Linguistic Intuitions

The first kind of evidence comes from the probing of linguistic intuitions. This has been done informally by asking a native speaker (perhaps the linguist himself) for his intuition on some aspect of the phonology of his language. It has also been done employing more sophisticated experimental techniques. As a case in point, let us return to the issue of sequential constraints in phonology. The question is, how do we know that native speakers "know" (in some tacit, not necessarily verbalizable form) the sequential constraints of their language?

According to Chomsky (1964:64) and Chomsky and Halle (1968:380ff), knowledge of these sequential constraints is responsible for the fact that speakers of a language have a sense of what "sounds" like a native word and what does not. Thus, the word *brick* is an English word familiar to all speakers of the language. The word *blick* is equally acceptable (we shall say "well-formed") in its phonological structure, but happens not to be a word of

English (that is, it is nonoccurring). On the other hand, *bnick* is not acceptable in its phonological structure (we shall say "ill-formed"), since /n/ cannot follow /b/ at the beginning of an English word.[12] As the second element in a word, /n/ can only be preceded by /s/ or a vowel.

The *brick:blick* opposition shows that two forms which both satisfy the sequential constraints of the language (are well-formed) can differ in that one word occurs in the dictionary or *lexicon* (*brick*), while the other does not (*blick*). Words which are well-formed but are not found in the lexicon are termed *accidental gaps*. On the other hand, the *blick:bnick* opposition shows that two words not occurring in the lexicon can differ in that one is well-formed (*blick*) and the other ill-formed (*bnick*). Words which are ill-formed and do not occur in the lexicon are termed *systematic gaps*.

As a final possibility, exceptional words such as *sclerosis* and *sphere* (*skl-* and *sf-* sequences are normally not found word-initially in English) are ill-formed but occur in the lexicon. We therefore have the following four possibilities:

	OCCURRING	NONOCCURRING
well-formed	*brick*	*blick*
ill-formed	*sphere*	*bnick*

It is just an accident that English does not have a word *blick*, but it is not an accident that English does not have a word *bnick*; there is a systematic reason, namely a sequential constraint forbidding *bn-* sequences at the beginning of a word (but see footnote 12). *Bnick* violates the system in a way that *blick* does not. Thus, it would not be surprising if a new product on the market were called *Blick Soap*. It would be quite surprising to find anyone inventing *Bnick Soap*.

While most work on phonological constraints is done on the basis of intuitive judgments about permissible sequences, there is also *experimental* evidence that speakers are aware of sequential constraints in their language. A particularly revealing experimental study is reported by Greenberg and Jenkins (1964). They demonstrate that speakers of English judge nonsense words such as *swit* [swɪt] and *gluck* [glək] to be much more English-like than the nonsense words [čwʊp] and [ðyəŋ], which violate the sequential constraints of the language. What is of interest is that they show that there is a continuum from completely well-formed nonsense words to nonsense words which are aberrant in that they violate not only the sequential constraints but also the segmental constraints, since they contain non-English sounds, for example, [zbüɣ].

[12] Actually, the sequence *bn-* cannot occur at the beginning of a *syllable* in English (see **6.1.2.1**).

1.6.2 Foreign Accents

It is well known that speakers substitute sounds of their own language for the sounds of foreign languages they attempt to speak. The result is that they typically have "foreign accents." Often these accents are directly attributable to the phonological properties of the native language. Thus, speakers of Spanish tend to insert [ɛ] before English words beginning with /s/ followed by another consonant (for example, *I espeak espanish*). This insertion is due to the (improper) operation in English of the spanish ɛ-insertion rule discussed and exemplified in **1.4.2**. Similarly, American English speakers have been known to pronounce the French word *monsieur* [məsyø] as [məšə] and the Spanish word *gracias* [grasyas] as [grašəs]. This substitution can be accounted for on the basis of the phonological rule in American English which derives [š] from /s/ followed by /y/ (see **1.4.2**). The foreign sound substitutions made by Spanish speakers when they speak English and by American English speakers when they speak French or Spanish reveal that the phonological rules in question have an objective reality. That is, phonological analysis, far from being a purely formal study of patterns, makes predictions about how speakers of one language will reproduce sounds of another language.

1.6.3 Speech Errors

While speech errors have long fascinated linguists and nonlinguists alike, it is only recently that attention has been focused on the possibility of using the data of speech errors as an indication of the psychological reality of phonological descriptions. A commonly studied type of speech error—a *spoonerism*—occurs when the initial consonants of two words are interchanged, as when someone says *tips of the slung* instead of *slips of the tongue*. The theoretical interest of such speech errors is discussed in the works of Fromkin (1971, 1973a, b). Spoonerisms can involve interchanging the place of initial consonants, as in the above example; in other examples, a consonant is interchanged with zero, that is, it is transposed, as when someone says *pick slimp* [pɪk slɪmp] instead of *pink slip* [pɪŋk slɪp]. The nasal consonant of the word *pink* has been transferred to the resulting nonsense word *slimp*. But notice that somehow in the transformation from the intended utterance to the speech error, [ŋ] has become [m]. If the velar nasal had been transferred as such, the resulting error would have been *[slɪŋp]. However, this sequence is ill-formed in English, since there is a sequential constraint stating that within a word a nasal consonant is made at the same place of articulation as a following consonant.[13] Thus we have the words *ramp*, *rant*, and *rank* with [mp, nt, ŋk], but not the words **ranp*, **rangt*, and **ramk*. The modification of [ŋ] to [m] which accompanies the speech error thus provides evidence for the reality of this sequential constraint. As pointed out by Fromkin, forms resulting from speech errors generally do not violate the phonological properties of the language.

Speech error phenomena motivate the necessity of a fundamental distinction in the study of language. Speakers of English "know" that the word *pink* should be pronounced [pɪŋk] rather than [pɪk]. The error involved in pronouncing [pɪk] is therefore one of *language use* rather than one in the *knowledge* that the speaker has of the way this word should be pronounced. In other words, the speaker who uttered *pick slimp* did not think that the correct pronunciation of *pink* was [pɪk]. Thus a distinction is necessary between *linguistic competence*, which represents the underlying "system" of a language and aims at revealing the speakers' implicit knowledge, and *linguistic performance*, which represents the way speakers *use* that system (competence) in producing and perceiving utterances. In our phonological descriptions we shall be concerned with competence, that is, the knowledge speakers have of the sound system of their language. On the other hand, the data of performance, such as in speech errors, may very well provide supporting evidence for the reality of phonological analyses.

1.6.4 Language Acquisition

The study of language acquisition is of importance to phonologists, since it is possible to observe the stages children go through as they attempt to discover the phonology of their language. In particular, the errors they make are sometimes quite revealing. For instance, children speaking English have frequently been observed to substitute the sound [w] for [r]. Thus they say *wabbit* instead of *rabbit* and *wight* instead of *right*. However, when adults repeat *wabbit* and *wight* back to the children who normally produce these forms, it is often discovered that the children, capable of *perceiving* the difference between [w] and [r], are annoyed at the adults' use of child language. This ability of the child to perceive a sound distinction which he does not produce is justification for distinguishing a phonological level as opposed to a phonetic level. The phonological level, representing the child's mental representation of words, has the forms *wabbit* and *wight* beginning with /r/.

[13] There are some important exceptions to this constraint, as when the negative marker *un-* is prefixed to a labial-initial stem, e.g., *un-predictable* (not **um-predictable*), or when the past tense marker *-ed* is suffixed after a labial nasal, e.g., *strummed* [strəmd], not *[strənd] or *[strəmb]. Note, however, that for those speakers who pronounce *pink* as [pĩk], i.e., with a nasalized vowel and no nasal consonant, the speech error change of *pink slip* [pĩk slɪp] to *pick slimp* [pɪk slĩp] may involve only a switch of nasality on the vowels of the two words.

The phonetic level has these forms beginning with [w]. Thus, at this stage in the child's linguistic development, there is a phonological rule merging /r/ with /w/. He keeps track of which words with [w] have a phonological /r/ and which have a phonological /w/, since he will later give up this temporary rule and put in phonetic [r] in the appropriate places.

This example shows that, in language acquisition at least, it is possible to have different phonological representations for the same sound. Thus [w] is sometimes represented as /r/ and sometimes as /w/. A similar example is found in the phonological system of a child isolated for twelve of her fourteen years (Curtiss et al., 1974). In the speech of "Genie," word-initial /sC/ sequences are pronounced either without the initial /s/ or with an inserted [ə] between the consonants, for example, *spoon* [pũn] or [səpũn]. In this case such words have been internalized (stored phonologically) with the underlying clusters, but the phonological system is characterized by a phonetic sequential constraint disallowing these clusters on the surface. At this stage in Genie's development, there are two conflicting phonological rules (one of *s*-deletion and one of ə-insertion) which guarantee that [sC] sequences will not appear at the beginning of a word.

1.7 Summary

In this chapter we have distinguished between phonetics and phonology and, in the description of sound systems, between a phonetic and a phonological level. In the following chapters a close look will be taken at these and other aspects of the study of phonology. In Chapter 2 we shall begin by focusing attention on the development of *distinctive feature theory*, which provides the framework most commonly used in the description of phonological and phonetic segments. In Chapter 3 different approaches to phonological analysis will be treated, with particular emphasis on the nature of underlying (phonological) representations. In Chapters 4 and 5 the notions of *simplicity* and *naturalness* will be discussed within the framework of *generative phonology*. Finally, in Chapter 6, stress, tone, and other *suprasegmental* properties of phonology will conclude our study.