Phonetic and Grammatical Explanations for an Epenthesis and a Non-Epenthesis in English [1]

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At the last BLS, I criticized Wang (1968), Greenberg (1970), and Ladefoged (1971) for failing to notice Boyle (1662). In this paper, I would like to show how Javkin and Ohala (1973) erred in ignoring Javkin (1977), Drachman (1977), and Javkin (1978) which is the paper I am about to read.

In Javkin and Ohala (1973) we discussed an ongoing sound change in English. A number of words with /l/ + /s/ sequences are developing epenthetic /t/, so that a word such as 'false' /fɔls/ is becoming /fɔlts/ in the production of a number of speakers of American English. Some of the words in which this is happening are given in 1.

1.

else	ls	lts
pulse	pʌls	pʌlts
false	fɔls	fɔlts
calcify	kaelsIfaj	kaeltsIfaj

The epenthetic /t/ occurs rather consistently for certain speakers. These speakers do not appear to form a coherent dialect. Other speakers have this form some of the time. This insertion of a /t/ is very similar to an epenthesis reported by Phelps (1937). Phelps claimed that a number of Indo-European languages including Latin, Greek, Breton and Czech, have developed <u>stl</u> from <u>sl</u>. This would be the same process we found, but with the sounds occurring in the reverse order. However, as Gary Holland and Carol Justus have pointed out to me, none of the words on which Phelps bases his claim can be traced back to Indo-European. Nevertheless, the explanation given by Phelps applies (in reverse order) to the on-going change in English. The process can be seen in Fig. 1, which represents the output of a dynamic palatograph. The system is described in somewhat more detail in Javkin (1977). The areas of contact between the tongue and palate for /s/ and /l/ are complementary in that the gesture for /s/ closes off all but a small area at the front of the alveolar ridge, while /l/ closes off a small area only at the front, leaving an opening at the sides. If the /l/ contact is not released before the /s/ contact occurs, the result will be closure all around the alveolar ridge. Such contact constitutes a

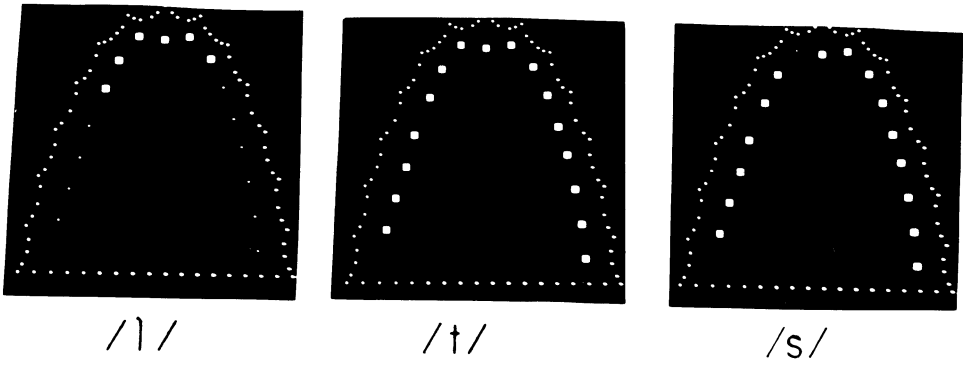/ l /   / t /   / s /

Figure 1

/t/ or /d/, depending on whether voicing is present.

The sound change in English seems somewhat curious given the fact that a similar change has not occurred with /lz/ sequences, that words such as 'falls' /fɔlz/ have not developed into /fɔldz/ even in those speakers who regularly use the /fɔlts/ form for 'false'. In Javkin and Ohala (1973) and in Javkin (1977), we showed that both <u>lts</u> and <u>ldz</u> occurred as articularoty "accidents" as can be seen in Figs. 2 and 3.

The palatographic patterns of contact did not reveal any reason why epenthetic stops should develop in the case of /l/ followed by a voiceless sibilant but not in the case of /l/ followed by a voiced sibilant. The voiced and voiceless sibilants had the same contact patterns. The articulations of both would lead to complete closure if the /l/ contact were not released in time. The articulatory pattern for /lz/ thus cannot explain the lack of epenthesis.

<u>Is</u> /ldz/ <u>difficult</u> <u>to</u> <u>perceive</u>?

In Javkin and Ohala, we suggested that /d/ would be less perceptible than /t/ between /l/ and a following sibilant. The cues for the presence of an alveolar stop in an environment between two alveolar consonants are relatively scarce. The formant transitions which would occur if the stop were surrounded by vowels do not provide a cue for the presence of a stop. The stops are of relatively short duration. One cue for the presence of a stop, of course, would be the presence of a period of silence between the /l/ and the following sibilant. However, the silence characteristic of a stop also occurs at the beginning of a sibilant when a stop is not present. The silence in these cases is probably due to the fact that it takes a certain time for sufficient pressure to build up in the oral cavity to provide fricative noise. A listener, therefore, hears almost exactly the same thing regardless of the presence or absence of a stop in this environment, with one exception. That exception is the burst characteristic of the release of the stop into the sibilant. If a stop is present, there will be a momentarily high fricative noise level, which will decay rapidly. This burst is smaller in the case of a voiced consonant, because the pressure build-up is smaller. The difference can be seen in the overall amplitude of the stop bursts measured for example by Halle, Hughes and Radley (1957). The result is that the one cue available to the listener that a stop has occurred is weaker for a voiced than for a voiceless epenthetic stop. Therefore, although both types of stops probably occur with similar frequencies accidentally, only the voiceless is likely to be noticed
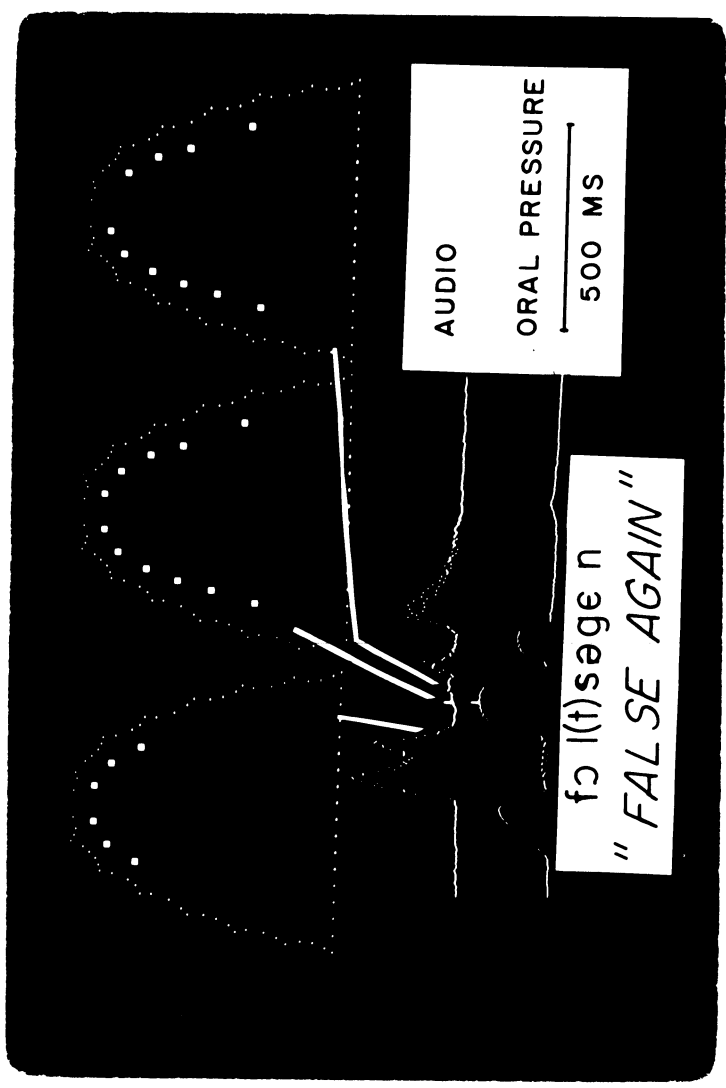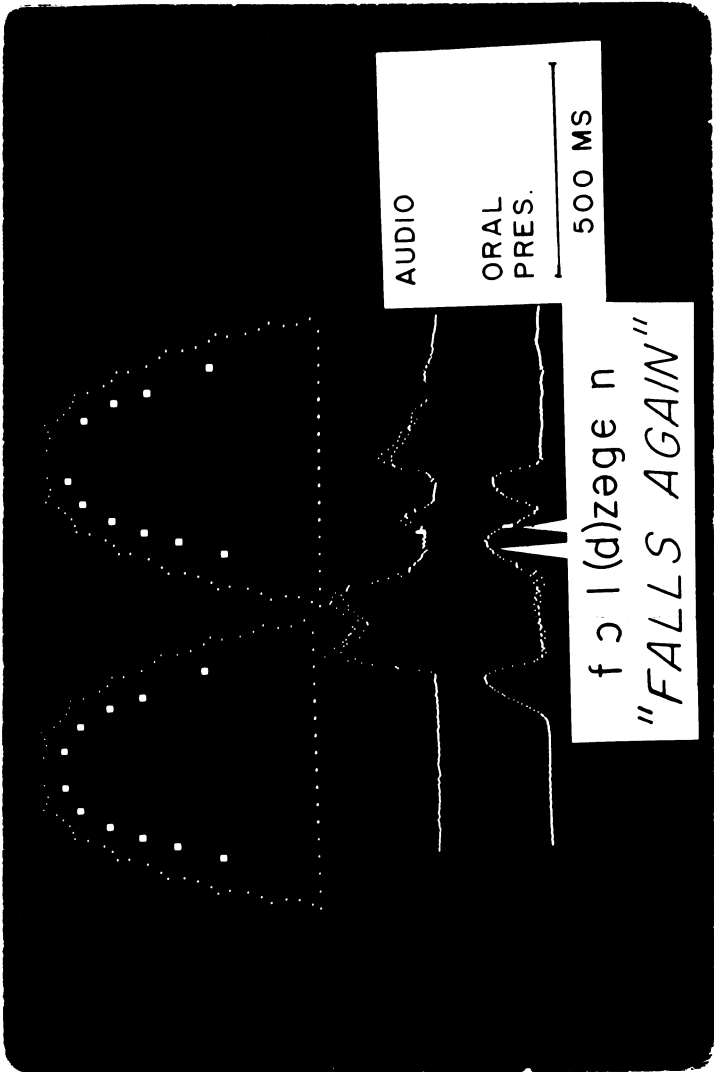
Figure 2

Figure 3

by listeners, so that such stops are less likely to become part of the listener's code.

The occurrence of /dz/ in other languages

Tests to determine the relative perceptibility of /lts/ clusters versus /ldz/ clusters have not been performed at this time. However, there is a way of assessing the relative perceptibility of the two sequences. Since a preceeding /l/ will have a similar perceptual effect on /t/ and /d/, a comparison of the phones /ts/ and /dz/ in the world's languages will show whether /d/ is relatively imperceptible. If the smaller amplitude burst of /d/ causes it to be relatively less perceptible when followed by a sibilant, one would expect /dz/ sequences to occur with less relative frequency than /ts/ sequences in the world's languages. Furthermore, if /d/ were relatively imperceptible in this environment, one would expect that phones consisting of [dz] sequences would tend to alternate with [z] phones and be members of the same phoneme more frequently than would be the case with the phones [ts] and [s].

There is a problem with this comparison in that voiced obstruents occur less frequently than voiceless obstruents. This can be taken into account by comparing the number of times /ts/ and /dz/ occur with the number of times that /s/ and /z/, and /t/ and /d/, occur.

The 221 languages whose phonologies are in the Stanford Phonology Archive were examined. [2] The results are given in 2.

2.   The occurrence of dental/alveolar stops, affricates and fricatives

	t or d	ts or dz	s or z
Voiceless	198	84	198
Voiced	169	42	89

It can be seen that /dz/ occurs in half as many languages as /ts/. This is slightly fewer than one would expect from looking at the frequency of /t/ and /d/, but slightly greater than we would expect looking at /s/ and /z/.

What we really want to answer is how distinct /dz/ and /z/ are, in order to see how perceptible /d/ is. Contrast between them suggests distinctiveness, alternation suggests perceptual similarity. There were

23 languages in which /dz/ and/z/ contrast, while only four have an alternation. The table in 3 allows a comparison with /ts/ and /s/.

3.   Contrasts between affricates and fricatives

	Voiceless	Voiced
Languages with [ts] or [dz]	84	42
Languages with [s] or [z]	198	89
Languages contrasting [ts] and [s] or [dz] and [z]	80	23
Languages with alternations [ts] ~ [s] or [dz] ~ [z]	3	4

We can compare the number of languages which contrast the pairs /ts/ and /s/, and the pair /dz/ and /z/, to the probability of co-occurrence of each of the pairs. I have calculated the probabilities, which are given in 4, according to the method in Ohala and Lorentz 1977. (p) = probability of.

4.   Co-occurrence Probabilities

(p)ts = 84/221 = .38

(p)s = 198/221 = .90

(p)ts <u>and</u> s = (p)ts x (p)s = .34 = 75.1 languages

(p)dz = 42/221 = .19

(p)z = 89/221 = .40

(p)dz <u>and</u> z = (p)dz x (p)z = .076 = 16.8 languages

As shown in 4, 75.1 languages can be expected to have a co-occurrence of /ts/ and /s/; 80 languages actually have a contrast between these two sounds. 16.8 languages can be expected to have a co-occurrence of /dz/ and /z/; 23 languages have a contrast between them. The fact that the number of languages which have a contrast between /dz/ and /z/ exceeds the number of languages which would be expected to have a mere co-

occurrence shows that we cannot conclude that contrasts between /dz/ and /z/ are unlikely.

There is further evidence that it is not for perceptual resasons that the process of lz to ldz is disfavored. Drachman (1977) found some dialects of Greek in which exactly this process occurs. Although Drachman came to some fanciful conclusions on the basis of his evidence, that evidence, together with the evidence just given, argues against a perception disfavoring the epenthesis of d.

Finally, if more evidence is needed to show that Javkin and Ohala were wrong in 1973, it can be shown that dz is far more prevalent in the world's languages than other homorganic affricates. Looking at the velars in the Archive sample, there were only 6 languages with the kx affricate and only 2 languages with the gɣ affricate. Among the labials, there were only 3 languages with pɸ affricates, and only 1 with bβ .

The totals for labials and velars are given in 5 and 6.

5.   The occurrence of labial stops,
            affricates and fricatives

	p or b	ɸ or β	pɸ or bβ
voiceless	190	119	3
voiced	177	63	1

6.   The occurrence of velar stops,
            affricates and fricatives

	k or g	x or ɣ	kx or gɣ
voiceless	199	88	6
voiced	160	69	2

Thus, the presence of /d/ is perceptible in this environment before a sibilant, and the tentative conclusion that it is not must be abandoned. A different type of explanation is needed.

Morphological constraints of English for /ls/ and /lz/

In English, /lz/ and /ls/ occur under different grammatical conditions. Nearly all the words which

potentially could develop an epenthetic /d/ between an /l/ and a following /z/ contain a morpheme boundary between these two sounds. The sound /z/ follows /l/ only as the plural morpheme, as a possessive suffix, or as a third person singular marker. All the cases in which /s/ follows /l/ occur within a morpheme. This difference changes what is involved in the epenthesis of a stop in the two cases.

The fact that epenthesis does not occur when a word boundary separates /l/ and /s/ provides support for the hypothesis that the boundary between /l/ and /z/ also prevents epenthesis. Phrases such as "tall Sam", "tell Sandy", "yell softly" do not contain the epenthetic /t/, even for speakers who have the epenthetic /t/ within words. The non-occurrence of accidental epenthesis in "call Sue" in this experiment of Javkin and Ohala (1973) is suggestive. The organization of the motor movements by the speaker are apparently different in cases where a morpheme or word boundary intervenes. The result could be a delay in the tongue gesture for the sibilant until the /l/ contact is released.

Conclusion

In conclusion, the results suggest that the epenthesis of /t/ between /l/ and /s/ is due to the occasional occurrence of such stops as a result of the failure to release /l/ contact before /s/ contact begins. The failure of epenthetic stops to develop between /l/ and /z/ in English appears to be due to the fact that a morpheme boundary always occurs between these sounds in English.

Three related ideas are given additional support by this paper.

1) Both phonetic and grammatical facts are relevant to sound change.

2) Phonetic facts should be examined _first_ since they are inherently more easily tested.

3) Sometimes the phonetic facts can be determined by looking at the phonological facts.

FOOTNOTES

2. In preparing these other tabulations, I noticed that one language, Yurak, had the phone [dz], despite the fact that the computer printout did not list this language as having [dz]. This seems to have occurred because the records of the Archive for Yurak were not complete at the time that the printout was prepared. The phone [dz] thus occurs in 42 languages, although a reader obtaining the same printout from the Archive would only find 41.

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