Glide and Glottal Stop Insertion in Slavic Languages: A DOT Analysis

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This article investigates glide and glottal stop insertion in Bulgarian, Slovak (two dialects), Polish (two dialects), and Czech. It is argued that Optimality Theory should be modified by introducing derivational levels and that OT auxiliary theories, in particular, output-output theory, MAX(Feature) theory, and sympathy theory, should be rejected.

Keywords: Optimality Theory, derivationalism, glide, glottal stop, sympathy theory, analogy

As is well known, introduction of a new theoretical paradigm often leads to a renewed interest in the data because new questions are asked. Optimality Theory (OT) is a recent example of this situation (Prince and Smolensky 1993, McCarthy and Prince 1993, 1994, 1995). With the introduction of the prominent constraint ONSET (''Syllables must have onsets'') in OT, we may ask what languages do in order to maximally comply with this constraint in instances in which the onset is not naturally provided by a CV string in the underlying representation. One typical strategy is to insert a segment and thus fill what would have been an empty onset position. The prime candidates for insertion are glides and glottal stops, a widely known fact that has been discussed in the recent OT literature, particularly by Rosenthall (1994) and Keer (1995, 1996).

In this article I investigate glide and glottal stop insertion in Slavic languages. I consider four languages, two of which show dialectal variation, which brings the number of phonological systems under investigation to six. These six systems exhibit typologically different cases, a fact that is interesting in its own right. The primary source of data for this article is extensive fieldwork that I have carried out with native speakers. This was necessary since, with the exception of Czech and, to some extent, Slovak, the relevant facts are not reported in adequate detail in descriptive grammars. Unsurprisingly, then, Slavic glide and glottal stop insertion has not been discussed in the generative literature to date.

On the theoretical side, this study focuses on the need for recognizing derivational levels within the OT paradigm. The modified paradigm, which I call *Derivational Optimality Theory*

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(DOT), stems from the philosophy that the number of constraints should be minimized because only then can constraints and their interactions be insightful. This goal can only be achieved at a price, however: we must permit a vestige of derivationalism. Although I am far from advocating that the proliferation of constraints be replaced by the proliferation of derivational levels, the price associated with the proposed analysis (two or three levels) is not difficult to pay. The reason is simple. The theories that proliferate constraints in order to avoid a derivational step, in particular, output-output theory, MAX(Feature) theory, and sympathy theory, cannot deal with glottal stop and glide insertion in any event. If this is correct, and I will argue that it is, then two or three derivational levels should be permitted and output-output theory, MAX(Feature) theory, and sympathy theory should be rejected. The upshot is that the number of constraints is reduced dramatically, a welcome result.

1 Preliminaries

Before I present the data and their analysis, I should clarify two points. First, I need to comment on the type of data I use, and, second, I need to make explicit the type of representations I assume.

Many of the data are drawn from what a historical linguist would identify as etymologically non-Slavic vocabulary. For example, clusters of vowels show that a word must have originated from a foreign source because Slavic had a process that simplified such clusters historically (Jakobson 1948).

Although an etymological perspective plays a role in a diachronic study, it is not relevant for our purposes. First, etymologically foreign vocabulary has been well integrated into the system of modern Slavic languages.[1] Second, the generalizations that I discuss extend to foreign acronyms, nonce words, and errors made by Slavic speakers in acquiring foreign languages. These generalizations are therefore exceptionlessly productive and pay no attention to the etymological status of words. Third, the generalizations conflict internally within the class of etymologically nonnative words, acronyms, nonce forms, and foreign accent data. This is illustrated by an example from Polish, which, next to Russian, is the best-investigated Slavic language.

The word *Papuas* 'Papuan', an etymological borrowing, shows the same behavior as native words, such as *trzos* 'purse', in the sense that it takes a full array of inflectional and derivational suffixes and is not an exception to any phonological rules of Polish. For example, it undergoes palatalization (underlying //s// changes into the prepalatal fricative [ɕ] before front vowels).[2]

(1) a. Papuas [s] (nom.sg.): Papuas + ie [ɕ + e] (loc.sg.), Papuas + ik [ɕ + ik] (diminutive (dimin.)), Papuas + isk + o [ɕ + isk + o] (augmentative)
b. trzos [s] (nom.sg.): trzos + ie [ɕ + e] (loc.sg.), trzos + ik [ɕ + ik] (dimin.), trzos + isk + o [ɕ + isk + o] (augmentative)

[1] See, for example, Rubach 1984 for Polish, Kenstowicz and Rubach 1987 and Rubach 1993a for Slovak, and Plapp 1996 for Russian.

[2] I use double slashes for underlying representations, single slashes for intermediate derivational stages, and square brackets for phonetic representations.

It should be emphasized that Slavic languages differ from languages such as English and Japanese because they do not warrant stratification into distinct lexical levels based, at least historically, on the different origins of words (e.g., Germanic vs. Latinate lexical levels in English). On the contrary, the strategy is to immediately assimilate loanwords to the native pattern.[3]

Foreign acronyms, nonce words, and the facts of Polish interference in the acquisition of foreign languages all testify to *w*-insertion and show that [u] does not glide to [w] before a vowel.[4]

(2) a. *Acronyms and nonce words*
UEFA [uwefa] (soccer association), suam [suwam] (nonce word)
b. *Foreign accents*
English *cruel* is mispronounced as [kruwel], French *tuer* as [tjuwe].

These data show that *w*-insertion and the absence of $u \rightarrow w$ gliding are entirely exceptionless generalizations. The pronunciation of the words in (2) cannot be a matter of listing since the number of inputs is infinite (nonce words, foreign accents). No phonological theory can ignore these facts and disclaim responsibility for the productive patterns in (2).

Finally, an attempt to discard the data by assuming that they belong to some special class of etymological borrowings would not only require arbitrary diacritics but also, interestingly, serve no purpose. Questions such as why the [u] in *Papuas* does not glide to [w] and why a glide is inserted instead (hence [papuwas]) are internal to this word. Both require an answer and both concern the same word. Similarly, *idiot* [ʔidijot] 'idiot' in Czech, an etymological borrowing, poses the questions of why glottal insertion occurs word-initially and why glide insertion occurs word-medially, rather than the reverse (*[jidiʔot]). These questions pertain to the same word; that is, it is not the case that glottal insertion operates in one class of words and glide insertion in another class of words. I conclude that the distinction between etymologically foreign and etymologically native words is not useful for the data analyzed here; consequently, I will ignore it.

In sum, the data analyzed here reveal fully productive, entirely exceptionless, and clearly phonologically conditioned patterns. Therefore, they constitute an excellent testing ground for evaluating various phonological theories.

With regard to representations, I depart from the standard OT treatment of the skeleton and assume X-slots rather than moras. This assumption is well documented in the literature and has never been challenged by a reanalysis in terms of the moraic skeleton (see, e.g., Harris 1985, Tranel 1991, Rubach 1993b, 1998). As pointed out to me by a reviewer, an additional argument for the X-skeleton can in fact be found in the ensuing analysis of glide insertion (see section 4).

The assumption of X-slots rather than moras does not change the nature of the constraints. It is purely technical and affects one constraint. Instead of Rosenthall's (1994) VOWEL-MORA (''For every vocalic Root node Rt_i, there is a mora μ_i''), we have VOWEL-NUCLEUS, which

[3] This strategy is documented in detail in Rubach 1984 for Polish and Rubach 1993a for Slovak.
[4] Needless to say, the same is true of etymological loanwords. Thus, *Papuas* is pronounced [papuwas].

penalizes glides in the onset or in the coda since they are [− cons] segments and do not constitute a syllable nucleus.

(3) *Vowel-Nucleus* (V-Nuc)
Every [− cons] segment must be linked to N.

Although I will assume the X-skeleton throughout this study, for compactness I will leave out the X-slots and use ordinary transcription whenever reference to the skeletal tier is not crucial.

The remainder of the article is structured as follows. To minimize confusion about what are objectively confusing data, the presentation is organized around particular languages. Slovak, discussed in sections 2, 3, and 4, provides an opportunity to introduce the constraints and the assumptions that turn out to be central to the subsequent discussion of other languages. The need for derivational stages first appears in section 3. It also comes to light in the analysis of Bulgarian in section 5. This need is strengthened further by the analysis of Polish in sections 6 and 7, and it finds its most forceful expression in the analysis of Czech in section 8. Section 9 considers nonderivational alternatives, in particular, output-output theory, Max(Feature) theory, and sympathy theory. The most important conclusions are summarized in section 10.

2 Standard Slovak

Standard Slovak is an extreme case of Onset violation in Slavic languages: it has no glide insertion and no glottal stop insertion at all (Zauner 1966, Král' 1988). In fact, any trace of a glottal stop anywhere in the phonological string is a sure giveaway of a Czech accent in Slovak (Martin Votruba, personal communication). The consequence is that there are many onsetless syllables, as shown in (4). Here and below I will distinguish six different contexts: *iV* (the vowel *i* followed by another vowel), *Vi* (reverse), *uV* (*u* followed by a vowel), *Vu* (reverse), *VV* (vowel hiatus where none of the vowels is high), and *#V* (word-initial vowel). These distinctions are important since they provide a dimension across which Slavic languages differ from each other, as will become evident later.

(4) a. *iV* patriot [i.o] 'patriot', diéta [i.e:][5] 'per diem'
b. *Vi* altruizmus [u.i] 'altruism', intuitívny [u.i] 'intuitive'
c. *uV* eventuálne [u.a:] 'perhaps', január [u.a:] 'January'
d. *Vu* múzeum [e.u] 'museum', vákuum [u.u] 'vacuum'
e. *VV* neandertálec [e.a] 'Neanderthal man', poeta [o.e] 'poet'
f. *#V* Irán [i] 'Iran', ucho [u] 'ear'

Since insertion is controlled in OT by Dep(Seg) (''Do not insert a segment''),[6] the optimal surface

[5] In Slovak and Czech, accents denote long vowels, but this is irrelevant since vowel length is not a factor in glide and glottal stop insertion.

[6] More exactly, it is Dep_{IO}(Seg), where *IO* refers to the correspondence relation between the input and the output and *Seg* means a segment. Since all the faithfulness constraints in this article are of the IO type, I will adopt the practice of leaving out *IO* in their names (except in section 9, where this distinction becomes essential). Thus, $\textit{Dep}_{\textit{IO}}\textit{(Seg)}$ is written as *Dep(Seg)* and $\textit{Max}_{\textit{IO}}\textit{(Seg)}$ as *Max(Seg)*.

candidate is selected by ranking DEP(Seg) above ONSET.[7] In (5) we consider *trio* 'trio'. As a matter of convenience, the winning candidate is always listed first and is indicated by a right-pointing hand. An exclamation sign marks a candidate that has been eliminated from further evaluation. Solid lines indicate ranking and dashed lines (as in (6)) show that the ranking is not essential.

(5) //trio//

	DEP(Seg)	ONSET
☞ a. tri.o		*
b. tri.jo	*!	
c. tri.ʔo	*!	

Insertion is not the only way to avoid onsetless syllables. Below I consider other options, none of which, however, is attested in Slavic languages.[8] This being the case, it seems appropriate to exclude them up front and thus clear the ground for subsequent discussion.

One way to solve the problem of an onsetless syllable is to delete a vowel. Thus, *trio* [tri.o] 'trio' could become [tri] or [tro]. Since this never happens in Slavic languages, I assume that MAX(Seg) (''Do not delete a segment'') dominates ONSET.[9]

Another strategy is to change a vowel into a glide. Then, the optimal output from *trio* would be [trjo]. Since, with the exception of Polish (see section 6), this strategy is never utilized with *CiV* strings, I conclude that *COMPLEX(Onset) (''Do not have complex onsets'') outranks ONSET.

(6) //trio//

	MAX(Seg)	*COMPLEX(Onset)	ONSET
☞ a. tri.o		*	*
b. trjo[10]		**!	
c. rjo	*	*!	
d. tjo	*	*!	
e. jo	**!		

[7] If not otherwise indicated, the constraints used in this article come from Prince and Smolensky 1993 and McCarthy and Prince 1994, 1995.

[8] One option I discuss below—the change of *i* into a glide in *CiV* strings—is actually used in Polish. I therefore discuss this option further in section 6.

[9] There are many languages that, unlike Slavic languages, use elision to resolve hiatus; see Casali 1996, 1997 for a detailed study of this problem.

[10] The fact that this candidate has a superheavy onset (three segments) and consequently violates *COMPLEX(Onset) twice rather than once is not relevant. If a choice exists, as it does in *CiV* strings, Slovak always prefers to avoid a complex onset and hence it does not glide the /i/. Therefore, not only *trio* 'trio' but also *Rio* (name) and *biológ* 'biologist' have [i] rather than [j]. As pointed out to me by a reviewer, French is different in this regard, because it permits *CjV* (heavy onset) but not *CCjV* (superheavy onset). The reviewer adds that Armenian shows the same behavior as French (see Vaux 1998).

Even though (6a) violates *Complex(Onset) (because *trio* has two consonants: *tr*), it is still the winner since it fares better than the other candidates: in (6b) *Complex(Onset) is violated twice, and in (6c–e) Max(Seg) is violated. In addition, the presence of [j] violates V-Nuc, which penalizes glides. However, appealing to V-Nuc in (6) rather than to *Complex(Onset) would not be the correct solution. The point is that Slavic languages standardly use gliding as a way of resolving hiatus in *VV* strings containing high vowels. For example, the pan-Slavic word for 'I' is *ja*, illustrated in (7).

(7) //ia//

	Onset	V-Nuc
☞ a. ja		*
b. i.a	**!	

To summarize, gliding is permitted in *#iV* but not in *CiV* strings (*ja* vs. *Rio* and *trio*). The latter generalization follows from the dominant position of *Complex(Onset) shown in (6).

Another strategy for resolving the *i.o* hiatus in *Rio* would be to syllabify the second vowel (i.e., *o*) into the coda. Notice that here, unlike in *CiV* strings, *Complex(Onset) cannot block gliding. However, this option is never exploited in Slavic languages, a generalization that is true in equal measure for both codas and onsets. Thus, *Rio* could not be pronounced [riọ]. Neither could *eolit* 'eolith' become [ẹo.lit], with *e* being in the onset. Given a scale where low, mid, and high vowels constitute an ordered series of decreasing sonority, this generalization is expressed as a constraint on permissible margins (Prince and Smolensky 1993). The cutoff point for syllable margins in Slavic is after mid vowels; that is, only high vowels may be syllabified into onsets and codas and function as glides.

(8) **M(V[−high])*
Nonhigh vowels cannot be margins.

Constraint (8) is undominated in Slavic languages.

In (7) we saw that hiatus resolution via gliding is used for *iV* strings and *i* is syllabified into the onset. The mirror image *Vi* hiatus is resolved in a parallel fashion: all Slavic languages have words such as the Slovak *raj* 'paradise'. This means that it is worse to violate Onset than to violate V-Nuc and No-Coda by permitting a glide in the coda.

(9) //rai//

	Onset	V-Nuc	No-Coda
☞ a. raj		*	*
b. ra.i	*!		

The situation with *Vu* and *uV* strings is more complex than with *Vi* and *iV* strings. Some Slavic languages (e.g., Russian) do not have surface phonetic [w] at all. Other Slavic languages permit [w] in the coda but not in the onset (e.g., Slovak: *Europa* [ew] 'Europe' but *január* [u.a:] 'January').

Looking at the codas for the moment, we see that the absence of [w] in Russian but not in

Slovak means that *CODA([u]) is a violable constraint. (Note: [w] means that the melodic segment [u] is part of the syllable margin; see Halle and Vergnaud 1980, Levin 1985, Hayes 1989.)

(10) **CODA([u])*
[u] cannot be in the coda.

Thus, the relevant candidates for the word *pauza* 'pause', which exists in both Slovak and Russian, are evaluated as in (11).

(11) Slovak //pauza//

	ONSET	*CODA([u])
☞ a. paw.za		*
b. pa.u.za	*!	

The syllabification in (11a) is the optimal candidate in Slovak. In Russian the optimal candidate is (11b), which means that the ranking in (11) must be reversed. Notice that (11b) could not be selected as optimal in Russian by the generic NO-CODA since Russian has words such as *raj* 'paradise' (see (9)). The occurrence of [u] rather than [w] in *pauza* is thus a fact about *u* and not some general property characterizing the vowel-glide relation. I conclude that constraint (10) is necessary.

The mirror image of (10) is also necessary.

(12) **ONSET([u])*
[u] cannot be in the onset.

Words such as the Slovak *január* 'January' might not seem to be convincing evidence since the potential but in fact nonoccurring *[ja.nwa:r] is excluded by the earlier-established ranking *COMPLEX(Onset) ≫ ONSET. Also, as I point out in section 6, Polish has the ranking ONSET ≫ *COMPLEX(Onset) and yet words such as *ewentualnie* (Polish) and *eventuálne* (Slovak) 'perhaps' as well as foreign acronyms such as UEFA (both Polish and Slovak) are realized in the same way with regard to *u*: the *u* is not permitted to glide to [w]. In sum, Russian, Slovak, and Polish each independently motivate *ONSET([u]) as a constraint. The peculiarity of Russian lies in the fact that both *ONSET([u]) and *CODA([u]) are undominated, which means that *u* can never be realized as [w].

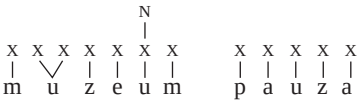
Returning to the data in (4), we observe that *Vi* in (4b) and *Vu* in (4d) do not resolve their hiatus by gliding; that is, *altruizmus* 'altruism' and *múzeum* 'museum' have [u.i] and [e.u], respectively, rather than [uj] and [ew].[11] This is inconsistent with the prevailing pattern exemplified in (9) and (11). The *Vi* and *Vu* instances that resist gliding are therefore exceptions. The question is how this exceptional behavior can be encoded in the grammar.[12] An attractive solution to the

[11] It is not possible to force [u.i] and [e.u] by invoking constraints on complex codas. Slovak *VCCCV* is syllabified *VC.CCV;* hence, the candidate *[al.truj.zmus] could not be banned. Neither could we exclude the candidate *[mu:.zewm] for *múzeum,* because [w] may occur in complex codas (e.g., *Faust* [fawst] (name); see Král' 1988).

[12] The pattern is unpredictable and there are near minimal pairs. For example, Král' (1988) permits [w] in *Europa* 'Europe' and *teutónsky* 'Teutonic' but not in *eunuch* 'eunuch' and *feudálny* 'feudal'.

treatment of exceptions in OT has been proposed by Inkelas, Orgun, and Zoll (1997), who, building on earlier work by Borowsky (1986), suggest that exceptions should be prespecified phonologically.[13] Translating this proposal into the realities at hand, I assume that the high vowel in *Vi* and *Vu* strings is prespecified as a syllable nucleus in the underlying representation. Thus, *Vi* and *Vu* strings contrast with the regular cases shown in (9) and (11), which are not prespecified in the underlying representation. Compare *múzeum* [mu:.ze.um] 'museum' and *pauza* [paw.za] 'pause'. The underlying representations are given in (13).

(13)



The gliding of /u/ to [w] can now be blocked by faithfulness: IDENT(Nuc) mandates that the nucleus must be preserved.

Returning to the original example *trio,* I would like to mention one further way of circumventing the hiatus problem: changing the feature composition of the vowel. Notice that raising, the change from /o/ to [w] (melodic [u]) in *trio,* would eliminate the violation of ONSET: [triw]. However, Slavic languages never use raising as a hiatus-resolving strategy. This restriction follows straightforwardly from the ranking of IDENT([−high]) above ONSET. Changing //o// into [w] violates this constraint; consequently, the undesired candidate [triw] is eliminated since the [−high] of //o// is not preserved in the output.[14]

3 Excursus

An unanswered question in section 2 is why ONSET does not induce diphthongization. Notice that *di.a.lekt* 'dialect', which violates ONSET (*a* has no onset), could avoid this violation if *i.a* turned into a diphthong: *dia.lekt.* An obvious answer is that Rosenthall's (1994) constraint NO-DIPHTHONG (NO-DIPH) is undominated. This is correct for Bulgarian, Polish, and Czech, but not for Slovak, which has diphthongs. Thus, *di.a.lekt* contrasts with *ria.sa* 'cassock' in terms of the syllable nuclei: *i.a* (vowel sequence) versus *ia* (diphthong).[15] This intriguing contrast has a simple explanation: diphthongs derive from underlying long vowels and not from vowel sequences. The generalization is based on evidence from several different sources (see Rubach 1993a). In particular, the following

[13] Inkelas, Orgun, and Zoll (1997) adduce compelling evidence against the view that exceptional behavior could be analyzed in terms of co-phonologies and constraint reranking, a position advocated by Itô and Mester (1993).

[14] Another option would be to delegate the responsibility to the markedness constraint *[+high] (''Do not be [+high]''). This is possible because, by introducing a new [+high], the change of //o// into [w] adds to markedness. (The [+high] on //i// is preserved by IDENT([+high]) ≫ *[+high].) A reviewer points out that this indeterminacy of analysis is a weak point of OT.

[15] Slovak diphthongs are heavy; that is, they have two X-slots. This is shown by, among other things, the Rhythmic Law, a process that shortens vowels after heavy nuclei. For example, the dat.pl. ending of neuter and feminine nouns has a long //a://, which is found on the surface in *zlat+ám* [a:m] 'gold'. The //a:// shortens by the Rhythmic Law not only after a long vowel but also after a diphthong: *stád+am* [am] 'flock' and *rias+am* [am] 'cassock'. Further, the diphthong *ia* contrasts with the sequence *i.a* in that the former but not the latter triggers the Rhythmic Law: *rias+am* [ria.sam] 'cassock' versus *pian+ám* [pi.a.na:m] 'piano' (see Rubach 1993a).

two deserve mentioning. First, diphthongs behave like long vowels with regard to the operation of the Rhythmic Law (see footnote 15). Second, when vowels lengthen (e.g., in the genitive plural), the mid vowels *e* and *o* and the low front vowel *ä* [æ] diphthongize (see Dvonč et al. 1966, Isačenko 1966).

(14) a. //i u a// → [i: u: a:]
slin + a 'saliva' (nom.sg.) – slín (gen.pl.), where the accent over the vowel means 'long'
pokut + a 'repentance' (nom.sg.) – pokút (gen.pl.)
par + a 'steam' (nom.sg.) – pár (gen.pl.)
b. //e o æ// → [ie uo ia], which are rising diphthongs
adres + a [e] 'address' (nom.sg.) – adries [ie] (gen.pl.)
bomb + a [o] 'bomb' (nom.sg.) – bômb [uo] (gen.pl.)
pat + a [æ] 'heel' – piat [ia] (gen.pl.)

In what follows I focus on the diphthong [ia], which parallels [ie] and [uo] but presents an additional challenge: in [ia], unlike in [ie] and [uo], the quality of the onglide is not surface-predictable. (Notice that the occurrence of the [i] in [ie] and the [u] in [uo] follows from the source vowels, //e// and //o//, respectively. The [i] occurs with a front vowel and the [u] with a back vowel.) But why do we find [i] in [ia], where the head of the diphthong is a back vowel [a]? I begin with some preliminary generalizations.

The alternation [æ] – [ia] in *päť + a* 'heel' – *piat* (gen.pl.) and the parallel behavior of the data in (14a) and (14b) show that [ia] derives from long //æ://. Since long [æ:] is never attested on the surface, there must be a markedness constraint that prohibits [æ:]—namely, *[æ:] (''Do not be long [æ:]''). The short [æ] is found on the surface, but it occurs only after labial consonants. We see it in *päť + a* [pæť + a] 'heel' but not *žab + a* [žab + a] 'frog'. Yet *žab + a* must have an underlying //æ// rather than //a//. The reason is that *žab + a* has [ia] in a lengthening context (*žiab* (gen.pl.)) and thus contrasts with words that have an underlying //a// (cf. *šacht + a* 'shaft' – *šácht* [ša:xt] (gen.pl.): //žæb// → /žæ:b/ (lengthening) → /žiæb/ (diphthongization) → [žiab] (*æ*-Backing)). The last change, effected by *æ*-Backing, occurs if the preceding sound is not a labial (see Rubach 1993a). That is, [æ] is found phonetically only after labials. In all other contexts //æ// is changed into [a]. This generalization is supported by direct alternations such as those in the diminutive nouns *holúb + ä* [b + æ] 'pigeon' versus *páň + a* [ɲ + a] 'master' and *pachol' + a* [l' + a] 'boy'.

The suffix [æ] alternates with [a], but //æ// is also underlying where we find surface [a]. The reason is that the relevant forms show an effect of palatalization: *pán* [n] 'master' – *páň + a* [ɲ + a] (dimin.). The //æ// is therefore backed to [a] after nonlabials. In terms of OT, *æ*-Backing is a matter of two constraints: a markedness constraint prohibiting [æ], *[æ] (''Do not be [æ]''), and an identity constraint requiring the preservation of //æ// after labials, IDENT(labæ). With the ranking IDENT(labæ) ≫ *[æ], [æ] may occur after labials. In what follows I will simplify the presentation by referring to these two constraints as *æ*-BACKING. To summarize, the diphthong [ia] comes from /æ:/, which is forced to diphthongize by the markedness constraint *[æ:]. The occurrence of [a] in [ia] is an effect of *æ*-BACKING.

We can now return to the initial question: how do we account for the contrast between *dialekt* [i.a] and *riasa* [ia]? Given the above reasoning, there is a difference in the underlying representations, //ia// versus //æ://, but how do we obtain the surface forms [di.a.lekt] and [ria.sa]?

Answering this question is not problematic if we adopt Derivational Optimality Theory (DOT), a variant of OT that permits derivational levels, which I will argue for, on the basis of independent evidence, in sections 5–8. Given DOT, Slovak is like Czech in that it has three derivational levels. Level 1 accounts for the distinction between vowel sequences and diphthongs. Level 2 focuses on diphthongization. Finally, level 3 addresses the question of *æ*-Backing in [ia].

As mentioned earlier, the absence of diphthongs from coalesced vowel sequences, **i.a → ia*, is mandated by NO-DIPH. Specifically, it is better to violate ONSET in *di.a.lekt* than to have the diphthong [ia]. In (15) I display the candidates that are directly relevant to the issue of vowel sequences versus diphthongs. Other candidates, such as those involving insertion or deletion, are disregarded because they are banned by the undominated DEP(Seg) and MAX(Seg). (Note: *segment* means an X-slot in the X-skeletal theory.) Also undominated is *COMPLEX(Onset); hence, the candidate [dja] has no chance to win. For compactness, I leave out irrelevant structure and show the initial syllable only.

(15) a. Level 1 //d i a//, *dialekt*

	NO-DIPH	ONSET
☞ i. d i a		*
ii. d i a	*!	

b. Level 1 //r æ//, *riasa*

	NO-DIPH	ONSET
☞ i. r æ		
ii. r i æ	*!	
iii. r i æ		*!

At level 2 NO-DIPH ≫ ONSET is reranked as ONSET ≫ NO-DIPH. The constraint IDENT(Nuc), introduced in section 2, now plays a role. This constraint mandates that the nucleus of the input

be preserved in the output. Since the input to level 2 is the optimal output of level 1, the new ''underlying representations'' have nuclei assigned at level 1.[16] Diphthongization cannot occur in *dialekt,* which has two simple nuclei in the input to level 2 (see candidate (15ai)); diphthongization would create a single complex nucleus, a situation prohibited by IDENT(Nuc). However, *riasa* is free to undergo diphthongization because the input to level 2 (candidate (15bi)) has a complex nucleus and the structure of this nucleus is not affected by changes at the melodic level (*æ*: → i*æ*). Two further constraints become relevant at level 2. First, *[æ:] (''Do not be the long vowel nucleus *æ*:'') induces diphthongization. (This constraint had no force at level 1 because of the dominant NO-DIPH.) Second, IDENT([−back]) bans the candidate [ra:] in (16biv).[17] *æ*-BACKING is low-ranked and hence irrelevant, but I include it in (16) for the sake of completeness. Two points need to be clarified.[18] First, diphthongization (fission) does not affect correspondence; that is, both elements of the diphthong in (16bi) are correspondents of /æ:/. Second, at this level there is no way to obtain the ultimately desired output [ria], candidate (16bii). The reason is that IDENT([−back]) must be ranked high in order to ban candidate (16biv), [ra:], which would otherwise be the winner. The correct phonetic output [ria] defeats [riæ] at level 3 because of the reranking of *æ*-BACKING above IDENT([−back]). This reranking does not affect *di.a.lekt,* so in (17) I display *riasa* only. The new ''underlying representation'' is the optimal output from level 2.[19]

(16) a. Level 2 /d i a/, *dialekt*

	IDENT (Nuc)	*[æ:]	IDENT ([−back])	ONSET	NO-DIPH	*æ*-BACKING
☞ i. d i a				*		
ii. d i a	*				*!	

[16] At level 1 IDENT(Nuc) is ranked in the same way as at level 2, but it has no effect because syllable nuclei are not encoded in the underlying representation. Their presence in the outputs of level 1 is a consequence of V-NUC saying that [−cons] segments must be linked to N.

[17] It played the same role at level 1, but, to simplify matters, I did not consider [ra:] as a candidate at level 1.

[18] Candidates such as [ræi] or [rai] are excluded since Slovak does not admit falling diphthongs, a generalization that is regulated by an undominated constraint.

[19] Candidates other than those considered in (17) are not viable contenders. The reason is that now, with /riæsa/ being the underlying representation, candidates such as [ræ:sa] or [ra:sa] that do not preserve the underlying /i/ of /riæsa/ violate a host of faithfulness constraints.

b. Level 2 /r æ/, *riasa*

	IDENT (Nuc)	*[æ:]	IDENT ([−back])	ONSET	NO-DIPH	*æ*-BACKING
☞ i. N: X X X; r i æ					*	*
ii. N: X X X; r i a			*!		*	
iii. N: X X X; r æ		*!				*
iv. N: X X X; r a			*!			
v. N N; X X X; r i æ	*!			*		

(17) Level 3 /r i æ/, *riasa*

	IDENT (Nuc)	*[æ:]	*æ*-BACKING	ONSET	NO-DIPH	IDENT ([−back])
☞ i. N: X X X; r i a					*	*
ii. N: X X X; r i æ			*!		*	

æ-BACKING (''No [æ] after nonlabials'') provides an argument for level distinctions not only in the analysis of diphthongization but also in the analysis of palatalization. In diminutives, mentioned earlier in this section, both the vowel and the consonant display alternations.

(18) holub 'pigeon' – holúb + a [b + æ] (dimin.), pán [n] 'master' – páň + a [ɲ + a] (dimin.), osol [l] 'donkey' – osl' + a [l' + a] (dimin.)

Labials do not palatalize in Slovak, so *holúb + ä* has a plain [b], but *páň + a* and *osl' + a* have

prepalatals, [ɲ] and [l'] (see Rubach 1993a). The palatalization is understandable because there is a front vowel in the underlying representation in the relevant portion of the string: //n + æ// and //l + æ//. The surface forms are opaque owing to *æ*-BACKING.

DOT has no difficulty providing an analysis of these facts. At level 1 the optimal output has the front vowel [æ] rather than [a]; hence, palatalization is unproblematic. In (19) we look at the final syllable of *páň + a*.

(19) Level 1 //n+æ//

	PALATALIZATION	IDENT([−back])	*æ*-BACKING
☞ a. ɲ+			*
b. n+æ	*!		*
c. n+a		*!	
d. ɲ+a		*!	

IDENT([−back]) must be high ranking because it is the only constraint that can exclude the incorrect output [n + a]. However, the consequence is that the ultimately desired output (19d), [ɲ + a], loses to (19a), [ɲ + æ]. The analysis is therefore carried on to level 2, which is necessary in any event, because it is required by the analysis of diphthongization (see earlier in this section). The winner from level 1 is the ''underlying representation'' at level 2. The constraints IDENT([−back]) and *æ*-BACKING are now reranked, as in (20).

(20) Level 2 /ɲ+æ/

	PALATALIZATION	*æ*-BACKING	IDENT([−back])
☞ a. ɲ+a			*
b. ɲ+æ		*!	
c. n+a			**!
d. n+æ	*!	*	

Candidate (20b) is fully faithful, but it violates *æ*-BACKING. In (20a) IDENT([−back]) is violated by the unfaithfulness to the underlying vowel: /æ/ corresponds to [a]. This is the least serious of the potential violations, and thus (20a) is the winner. Candidate (20d) is a mirror image of (20a) since the vowel is faithful but the consonant is not, because /ɲ/ corresponds to [n]. Candidate (20c) loses on both counts: it is unfaithful to the vowel and to the consonant.

I conclude that diphthongization and palatalization support level distinctions and thus argue for DOT and against OT. (DOT and OT are compared in section 9.) The arguments for DOT will accumulate as we proceed (sections 5–8).

In the remainder of this article, with the exception of section 6, I will limit discussion to glide and glottal stop insertion as a strategy to avoid onsetless syllables. DEP(Seg), illustrated in (5), which accounts for the lack of insertion in standard Slovak, will be shown to be a violable constraint. The complexity of DEP(Seg) violations will increase as we move from one language to another. I begin with colloquial Slovak, whose pattern of insertion is rather straightforward.

4 Colloquial Slovak

Colloquial or low standard Slovak differs from standard Slovak by permitting *j*-insertion as a hiatus-resolving strategy. The facts are the same as those for standard Slovak summarized in (4), with the exception of *iV* and *Vi* strings in (4a) and (4b), respectively. These strings are represented as follows:

(21) a. /iV/ → [ijV] trio [tri.jo] 'trio', diéta [di.je:.ta] 'per diem'
b. /Vi/ → [Vji] intuitívny [in.tu.ji.ti:w.ni] 'intuitive', altruizmus [al.tru.jiz.mus] 'altruism'

Normative grammarians ban the insertion of *j* (see, e.g., Král' 1988). Yet this insertion exists, as shown by the fact that many children have difficulty with the spelling of *iV* and *Vi* words (Martin Votruba, personal communication). This is not surprising when one realizes that standard Slovak has *ijV* and *Vji* strings in instances in which *j* comes from the underlying representation.

(22) a. kyj + a [ki.ja] 'stick' (gen.sg.); [j] is not from insertion, compare *kyj* [kij] (nom.sg.)
b. kraj + in + a [kra.ji.na] 'region'; [j] is not from insertion, compare *kraj* 'edge'

The difference between standard Slovak (no insertion at all) and colloquial Slovak (*j*-insertion) is accounted for by the different rankings of DEP(Seg) and ONSET: DEP(Seg) ≫ ONSET in standard Slovak versus ONSET ≫ DEP(Seg) in colloquial Slovak.[20] The matter is more complicated, however. We must make sure that the segment that is inserted in *dialekt* is [j] and not some consonant, in particular, not the glottal stop [ʔ]. This is easily done by appealing to markedness constraints (Keer 1995, a suggestion attributed to Alan Prince, personal communication). An obvious choice is the feature [constricted glottis] ([cg]).

(23) **[cg]*
Do not have the feature [constricted glottis].

In Slovak *[cg] is undominated because the glottal stop does not occur at all.[21] The analysis is now summed up in (24), which displays the relevant portion of the word *dialekt*.[22]

[20] Here and below I assume that glide insertion is segmental and not subsegmental; that is, it involves the insertion of an X-slot. This is motivated by the fact that glide insertion is controlled by ALIGN, which counts segments (see footnote 25).

[21] Slovak, like other Slavic languages, does not have glottalized consonants; hence, the function of *[cg] is to penalize glottal stops. The constraint *[cg] is undominated in Slovak and Polish but not in other Slavic languages (see below).

[22] The analysis would be no different even if we assumed that the glide is in the underlying representation (Lexicon Optimization). The point is that we would still need to explain why [j] occurs systematically in *iV* strings (absolute productivity). We therefore need constraints that select the [di.ja] candidate as optimal. Let me also note that there are three instances of alternation between zero and [j]. They all occur in suffixes: *Marks – marks + ist + a* [ist] 'Marxist' versus *Mao – mao + ist + a* [jist] 'Maoist', *marks + izmus* [izmus] 'Marxism' versus *mao + izmus* [jizmus] 'Maoism', and *žen + a* 'woman' – *žen + y* [i] (nom.pl.) versus *ide + a* 'idea' – *ide + y* [ji] (nom.pl.). These observations are true not only in the case of colloquial Slovak, but also in the cases of glide and glottal stop insertion discussed below. The reasoning is the same: we need to account for the glides and, as noted later, also for the glottal stops, no matter whether they could or could not be included in the underlying representation.

(24) //dia//

	*[cg]	ONSET	DEP(Seg)
☞ a. di.ja			*
b. di.a		*!	
c. di.ʔa	*!		*

It is clear now that only glides can be inserted.[23] Yet care must be taken to exclude the following two options: (a) the glide is inserted to break up a hiatus that has no *i* vowel, and (b) the glide is [w].

As it stands now, the proposed analysis does not preclude the selection of *VjV* candidates where none of the vowels is /i/. Consequently, *neandertálec* 'Neanderthal man' could have *[ne.jan] as the optimal candidate, which is incorrect. The generalization is that [j] can be inserted only in *iV* and *Vi* strings. This means that [j] is an effect of spreading from /i/. The representations of /ea/ and /ia/ as [eja] and [ija] are shown schematically in (25).

(25) a.

b.

The representation in (25b) does not increase markedness in terms of the number of Root nodes since no new Root node has been added. In contrast, the representation in (25a) does increase markedness, because the Root node for [j] was not present in the underlying representation and has now been inserted. Formally, the penalty for inserting a Root node is expressed by the markedness constraint *RT ('Do not be a Root node').[24] The high-ranking *RT excludes glide insertion that does not come from spreading, as in (25a). Therefore, in (26) I focus only on /ia/, the input given in (25b). Syllabification is indicated by the syllable node σ. For compactness, reference to the nuclear node N has been omitted. The inserted [j] in (26a) and (26c) is in the onset, but, in contrast to (26a), (26c) is an instance of *j*-insertion that is independent of the presence of [i]. This happens if [j] does not come from spreading. Candidate (26c) loses, as would the output [e.ja] from /ea/ in (25a). Since all inserted glides in Slavic come from spreading, I will simplify the discussion by omitting the contender exemplified in (26c).

[23] Insertion of a consonant other than [ʔ] will never be optimal, since, assuming a theory of full specification, consonants are specified for more features than [ʔ] is. For example, the insertion of [t] in *dialekt* incurs markedness violations such as *CORON ('Do not have Coronal specification'), *[+anter] ('Do not have [+anter] specification'), and others.

[24] *RT must be dominated by IDENT(Root), which guarantees that the Root coming from the underlying representation will be preserved faithfully in the output. Let me add that using a faithfulness constraint such as DEP(Root) ('Do not insert a Root node') would be an extension of the standard theory. The point is that MAX and DEP are limited to operations in terms of full segments rather than in terms of nodes or features. Both (25a) and (25b) have an inserted segment (an X-slot in the X-skeletal theory), so they both violate DEP(Seg).

(26) x x
| |
//i a//

	*Rt	Onset	Dep(Seg)
☞ a. σ σ / x x x / Rt Rt / i a	**		*
b. σ σ / x x / Rt Rt / i a	**	*!	
c. σ σ / x x x / Rt Rt Rt / i i a	***!		*

A reviewer points out that the analysis of insertion in terms of X-slots, as in (25b), is superior to the treatment of the same facts in the moraic theory. The argument is that the glide from spreading is a full copy of the high vowel. This is captured in (25b) since the glide and the vowel share a Root node. In the moraic theory, segments are represented as Root nodes rather than as X-slots. Since Slavic glides are segments rather than subsegments (when inserted, they cause misalignment at word edges), the insertion in (25b) means that a Root node has been added. Obviously, it must be a vocalic Root node (i.e., one with the features [−cons, +sonor]), but then it is an accident that the inserted Root node and the Root node of the /i/ that spawns the glide are identical. The difference in representation between the X-skeletal theory and the moraic theory is shown in (27a) and (27b), respectively, where the Root nodes have been spelled out in terms of the constituting features. The example is the same as in (25b): [ija].

(27) a. x x x
[−cons, +sonor] [−cons, +sonor]
i a

b. μ μ
[−cons, +sonor] [−cons, +sonor] [−cons, +sonor]
i a

I conclude that glide insertion is an argument for the X-skeletal theory and against the moraic theory.

Finally, let us look at *intuitívny* ‘intuitive’, the relevant portion of which is pronounced [in.tu.ji]. The first question is the one raised earlier: why doesn’t *w*-insertion take place instead, *[in.tu.wi]? Notice that [w] would satisfy all the constraints that we reviewed in connection with *j*-insertion: [w] fills the onset and comes from spreading, the source vowel being /u/. This dilemma is solved by observing that Slovak does not permit [w] in the onset; that is, *Onset([u]), the

constraint discussed in section 2, is undominated. The second question refers to the initial *i*. The candidate *[jin.tu.ji] from /intui/ is more optimal than [in.tu.ji] because all syllables, including the initial syllable, have onsets. This candidate is excluded by invoking ALIGN-LEFT (McCarthy and Prince 1994; see also the discussion in Zoll 1996). The relevant instantiation of this constraint is the following.[25]

(28) *ALIGN-L(stem, σ)*
The left edge of the stem must coincide with the left edge of the syllable.

A partial summary of this discussion is presented in (29), where I consider some of the principal contenders for the string /intui/. For compactness, I omit the representation of the skeleton and the syllable.

(29) //intui//

	*[cg]	*ONSET([u])	ALIGN-L	ONSET	DEP(Seg)
☞ a. in.tu.ji				*	*
b. in.tu.wi		*!		*	*
c. jin.tu.ji			*!		**
d. in.tu.ʔi	*!			*	*
e. in.tu.i				**!	

In the next section I look at Bulgarian, which is the reverse of colloquial Slovak in two essential ways. First, ONSET is satisfied by glottal stop insertion, and, second, misalignment at the left edge is tolerated.

5 Bulgarian

Consider the following data, which, in terms of distributional environments, parallel those given in (4) for Slovak.[26]

(30) a. *iV* dialekt [di.a] 'dialect', patriot [i.o] 'patriot'
b. *Vi* hinduist [u.i] 'Hinduist', egoist [o.i] 'egoist'
c. *uV* januari [u.a] 'January', eventualen [u.a] 'possible'
d. *Vu* triumf [i.u] 'triumph', kontinuum [u.u] 'continuum'
e. *VV* poet [e.a] 'poet', teatar [e.a] 'theater'
f. *#V* urnata [ʔu] 'the urn', Amerika [ʔa] 'America'

Like standard Slovak, Bulgarian has no glide insertion at all,[27] but it differs from Slovak in having glottal stop insertion. The restriction on glottal stops is that they can only occur word-initially.

[25] Alignment is calculated in terms of segments; that is, it looks at X-slots. If [j] is inserted into the initial syllable of *intuitívny*, then the X-slot for [j] rather than the X-slot for [i] is at the left edge of the syllable. This causes misalignment because the leftmost segment of the stem is the X-slot for [i].

[26] The data come from native speaker consultants, the Bulgarian linguists Veronica Gerassimova, Georgi Jetchev, and Atanas Tchobanov. For general discussion of Bulgarian phonology, see Scatton 1975, 1984.

[27] The reader should not be misled by words such as *Bulgarija* 'Bulgaria'. The *i.ja* is in fact two morphemes: *ij* for

We thus arrive at the following generalization: no segment is inserted word-internally, and vowel hiatus is tolerated. This generalization is expressed by CONTIGUITY (Kenstowicz 1994), which is undominated in Bulgarian.

(31) *CONTIGUITY*
The output form standing in correspondence forms a contiguous string.

The role of CONTIGUITY is to penalize insertion everywhere except for the context at the edges of the string where insertion could not affect the contiguity of segments.[28]

I summarize the proposed analysis in (32) with the relevant portion of the word *dialekt.*

(32) //dia//

	CONTIGUITY	ONSET
☞ a. di.a		*
b. di.ja	*!	
c. di.ʔa	*!	

Word-initial insertion shows that ONSET must dominate ALIGN-L(stem, σ). Furthermore, we must make sure that it is a glottal stop rather than a glide that is inserted word-initially. This is taken care of by NO-MULTIPLE-LINK (*MULT-LINK), a constraint that bans candidates in which one melodic segment is linked to more than one X-slot, as in (25b) and (27a). The effect of this constraint is that glides but not glottal stops are prohibited from insertion because the former but not the latter are spawned by a vowel and hence are multiply linked.

With the system of constraints developed so far, the evaluation of *Irak* 'Iraq' proceeds as shown in (33).

(33) //irak//

	*MULT-LINK	ONSET	ALIGN-L	*[cg]
☞ a. ʔi.rak			*	*
b. i.rak		*!		
c. ji.rak	*!		*	

The interest of these data goes beyond the typological observation that Bulgarian stands out among Slavic languages by having glottal stop insertion as the sole mechanism for filling onsets. More intriguing is the fact that glottal stops trigger voice assimilation and provide an argument for level distinctions. Consider the data in (34), where the relevant portion of the string is transcribed.

abstract nouns and *a* for the feminine nom.sg.; compare *Bulgar* + *in* 'Bulgarian' (masc.), *Bulgar* + *k* + *a* 'Bulgarian' (fem.). The *ij* comes from medieval Latin and is found in all Slavic languages, including those that have no glide insertion in *iV* strings (e.g., Bulgarian, Macedonian, and Russian). As pointed out by Priestly (1993), *ij* can be productive with Slavic roots (cf. *slepar* 'cheater' and *sleparija* 'act of cheating' in Slovene). In sum, the existence of *ij* does not constitute evidence for glide insertion.

[28] The relevant instantiation here is CONTIGUITY(Stem) rather than CONTIGUITY(Root), which means that there is no insertion anywhere word-medially.

(34) a. nad masata [nad . m] ‘over the table’, ot masata [ot . m] ‘from the table’
b. nad kilima [nat . k] ‘over the rug’, ot kilima [ot . k] ‘from the rug’
c. nad urnata [nat . ʔu] ‘over the urn’, ot urnata [ot . ʔu] ‘from the urn’

The contrast of [d] and [t] in *nad* ‘over’ and *ot* ‘from’ in (34a) shows a voiced–voiceless opposition. This opposition is neutralized before voiceless obstruents in (34b); that is, Bulgarian is subject to voice assimilation. Interestingly, devoicing is found also in (34c), where the trigger is a glottal stop.[29] The intriguing cases are those involving the prepositions *s* ‘with’ and *v* ‘in’.[30]

(35) a. s Marica [sma.ri.tsa] ‘with Marica’, s mesoto [sme.so.to] ‘with the meat’, v mesoto [vme.so.to] ‘in the meat’
b. s Amerika [sʔa.me.ri.ka] ‘with America’, v Amerika [fʔa.me.ri.ka] ‘in America’, s obed [sʔo.bet] ‘with dinner’

The observation is that prepositions made up of a single consonant do not inhibit glottal stop insertion in vowel-initial words. In this regard, Bulgarian contrasts with Russian, which, like Bulgarian, has glottal stop insertion, but, unlike Bulgarian, does not permit it with prepositions.

(36) Amerika [ʔa] ‘America’ *but* s Amerikoj [sa] ‘with America’, v Amerike [va] ‘in America’

My Russian consultants are unanimous in their judgment that there cannot be a glottal stop after *s* and *v* in (36) and that /v/ can never devoice to [f]. The analysis is that *s* and *v* are in the onset in (36), which obviates the need for glottal stop insertion. But then why are glottal stops inserted in the Bulgarian examples in (35b)? There, the prepositional *s* and *v* are also in the onset, as in Russian. The answer is simple if we recognize the fact that word phonology may be different from sentence phonology. Specifically, the former is evaluated earlier and independently of the latter. Then, at the word level, Bulgarian *Amerika* has no chance to have an onset other than a glottal stop. The selection of the optimal candidate proceeds as in (33). At the postlexical level, faithfulness (specifically, MAX(Seg)) prohibits deletion and thus the glottal stop is maintained.[31] This word- and postlexical-level analysis does not involve reranking of constraints since MAX(Seg)

[29] My consultants agree on these facts. Georgi Jetchev points out that the pronunciation of the words in (35b) without a glottal stop and hence without devoicing would be unnatural.

[30] These prepositions also have the long forms /səs/ and /vəv/, respectively. The long forms occur under emphasis (e.g., [səs ʔamerika] ‘with America’, [vəf ʔamerika] ‘in America’).

[31] The derivational distinction between the word level (word phonology) and the postlexical level (sentence phonology) does not strike me as controversial. On the contrary, it seems natural, and OT is out of step with long-standing phonological tradition by not permitting this derivational stage. Bulgarian is certainly not alone in requiring the distinction between the word level and the postlexical level. The further inquiry into glottal stop and glide insertion in the remainder of this article robustly substantiates these levels. We have already seen some evidence (Slovak diphthongization and *æ*-Backing); other evidence will come later. Massive support for the derivational step at the word-sentence interface will become evident, once certain subtheories of OT are rejected, in particular, output-output theory, MAX(Feature) theory, and sympathy theory (see section 9). For example, Polish stress must be calculated first at the word level. At the sentence level it is minimally adjusted to accommodate proclitics (Rubach and Booij 1985). Flemming and Kenstowicz (1996) propose base-identity theory, which is motivated by, among other things, the facts of Polish stress. If this theory is rejected, and I suggest that it should be (see section 9), then Polish stress adds to the body of evidence requiring a derivational step at the word-sentence interface.

is undominated not only at the postlexical level but also at the word level, an assumption that is in keeping with the observation made in section 2 that Slavic languages do not solve the problem of onsetless syllables by deletion.

In the next section I consider Polish, which is typologically different from both Slovak and Bulgarian because it has glide insertion involving both [j] and [w]. Another point of interest is level distinctions and the fact that such distinctions are supported by evidence entirely different from that found in Bulgarian.

6 Standard Polish

Polish stands out among Slavic languages because it uses gliding as a hiatus-resolving strategy in the environment of consonants. To be more precise, whereas all Slavic languages solve the problem of *#iV* and *ViV* by gliding (recall syllables such as *ja* and *aja* in section 2), Polish extends this solution to *CiV* strings (37a). Thus, the word for 'biologist' is *biológ* [bi.o] in Slovak and *biolog* [bjo] in Polish.[32] Likewise, strings consisting of a vowel followed by a high vowel avoid hiatus by gliding the high vowel (37b). In this regard Polish is like other Slavic languages.

(37) a. /iV/ → [jV] biolog [bjo] 'biologist', dialog [dja] 'dialogue', tiara [tja] 'tiara'
b. /Vi/ → [Vj] bojkot [boj] 'boycott', slajdy [slaj] 'slides', kraj [kraj] 'country'
/Vu/ → [Vw] pauza [paw] 'pause', Europa [ew] 'Europe', Lindau [daw] 'Lindau'

The distinct treatment of *CiV* in Slovak and Polish is accounted for by assuming that *COMPLEX(Onset) and ONSET are ranked differently in these languages: *COMPLEX(Onset) ≫ ONSET in Slovak and ONSET ≫ *COMPLEX(Onset) in Polish.[33] Then, [bi.o] wins in the Slovak *biológ* 'biologist' and [bjo] wins in the Polish *biolog* 'biologist'.

The Polish strategy of gliding the high vowel in order to avoid onsetless syllables is systematically suspended in *uV* strings.[34] The *u* is *always* realized as a vowel, a point exemplified in (38). (More on these data will be said in and below (40).)

(38) Papuas (three syllables) 'Papuan', sytuacja (four syllables) 'situation', punktualny (four syllables) 'punctual', dualizm (three syllables) 'dualism', Uele (three syllables) (name of a river)

The behavior of /u/ and /i/ in prevocalic contexts is systematically different. This is apparent from foreign acronyms (39a), foreign names (39b), and the behavior of /i/ and /u/ in derived environments (39c).

[32] The [b] is a palatalized [b'], but here and below I will disregard surface palatalization; for an analysis see, for example, Rubach 1984.

[33] This difference accords well with the general observation that Polish tolerates much more complex onsets than does Slovak. Let me add that Polish onsets are extra-complex and, contra Kuryłowicz (1952), are not sequences of two simplex onsets (see Rubach 1996).

[34] Casali (1996, 1997) observes that languages glide front vowels only if they glide round vowels and claims that this is a ''universal or near universal'' (1997:523). Since Polish /i/ glides freely but /u/ does not, I note this fact as an exception to Casali's observation.

(39) a. UEFA [u] – IATA [j][35]
b. Ueda [u] – Ionesco [j]
c. ewaku +ować [ku], not *[kw], 'evacuate' – Visconti + ego [tj], not *[ti], 'Visconti' (gen.sg.)

In sum, we are looking at a significant generalization: the *uV* hiatus can never be resolved by gliding. This generalization is easy to capture by assuming an undominated *ONSET([u]) ([w] is not a possible onset; recall the discussion in section 2). Although this generalization is also true in other Slavic languages, it comes across most clearly in Polish because, in contrast to other Slavic languages, Polish permits the gliding of /i/ in *CiV* contexts. That is, in other Slavic languages the absence of **CuV → CwV* follows from the absence of **CiV → CjV* (*COMPLEX(Onset) ≫ ONSET).

Given the conclusion that *ONSET([u]) is undominated in Polish, we predict that [w] can never be in the onset. But this prediction is evidently false, as shown by thousands of words such as [ško.wa] 'school' and also by words such as *Papuas* 'Papuan', a point I will clarify in (40). How can this be? Before addressing this question, let us look at glide insertion more generally.

The very fact that Polish has glide insertion is mysterious because it conflicts directly with the gliding strategy in (37). I begin with the standard list of high vowel plus vowel configurations that I used in the case of Slovak and Bulgarian.

(40) a. VV poet + a [o.e] 'poet', seans [e.a] 'show'
b. #V aromat [a] 'aroma', Iren + a [i] 'Irene'
c. /Vi/ → [Vji] kokain + a [ka.ji] 'cocaine', Hanoi [no.ji] 'Hanoi'
d. /iV/ → [ijV] trio [tri.jo] 'trio', Priam [pri.jam] 'Priam'
e. /Vu/ → [Vwu] muze + um [ze.wum] 'museum', lice + um [tse.wum] 'high school'
f. /uV/ → [uwV] aktual + n + y [tu.wa] 'current', ewentual + n + ie [tu.wal] 'perhaps'

Glide insertion (40c–f) occurs morpheme-internally, which is a typical situation. There are, however, a few instances of zero – glide alternations. A complete list is given in (41).

(41) a. zero – [j]
the suffix *-izm:* Marks 'Marx' – marks + izm [izm] 'Marxism' versus Mao 'Mao' – mao + izm [jizm] 'Maoism'
the suffix *-ist:* marks + ista [ist] 'Marxist' versus mao + ista [jist] 'Maoist'
the suffix *-i:* sieć 'net' (fem.nom.sg.) – siec + i [i] (gen.sg.) versus Salome + a 'Salome' (fem.nom.sg.) – Salome + i [ji] (gen.sg.)
b. ewolu + cj + a [lu] 'evolution'[36] – ewolu +ować [lu.wo] 'evolve'
konstytu + cj + a [tu] 'constitution' – konstytu + owa + ć [tu.wo] 'constitute'

[35] These acronyms are read as if they were words and not sequences of letters: [uwefa] and [jata]. This follows the pattern of native Polish acronyms, for example, UOP [uwop] 'Department of National Security'.

[36] It is not clear whether *cj* is really a suffix, that is, whether there is a morpheme boundary before it in this noun and in the noun *konstytucja* below. Historically, the nouns and the verbs were derived from independent bases in the foreign source forms (nominal and verbal, respectively).

It may also be interesting to note that borrowings from French that have [Cw] in the original pronunciation are rendered with [u] in Polish; that is, French *w* → *u*. The *u* causes glide insertion.[37]

(42) *French* *Polish*
trot*toir* [twar] tro*tuar* [tu.war] 'sidewalk'
bou*doir* [dwar] bu*duar* [du.war] 'sitting-room'
bour*geoisie* [žwazi] bur*żuazja* [žu.wa.zja] 'capitalist class'

Pulling these facts together, we note that Polish, like Slovak and Bulgarian, does not do anything to resolve a hiatus of mid and low vowels (40a). Word-initial onsetless syllables stay intact: there is no glide or glottal stop insertion (40b).[38] Hiatus involving a high vowel is eliminated by inserting a glide (40c–f), (41), and (42). In terms of Slavic typology, the novelty is that the glide is either [j] or [w], and both are an effect of spreading; compare (40c–d), (41a) and (40e–f), (41b), (42). Glide insertion is a pervasive process and it emerges as interference when Poles speak foreign languages. Thus, the English *doing* and *cruel* are mispronounced as *[dujiŋk] and *[kruwel]. Similarly, the French *tuer* 'kill' and *pirouette* 'pirouette' come out as *[tju.we][39] and *[pi.ru.wet].

The data in (40c–e) and (41a), that is, the strings *iV*, *Vi*, and *Vu*, raise the question of why hiatus is not resolved by gliding: *i, u* → *j, w*. There is no general explanation. These words are simply exceptions. As mentioned in section 2, exceptions are analyzed as instances of prespecification (Inkelas, Orgun, and Zoll 1997; see footnote 13). In particular, the nucleus node of the nongliding high vowel is prespecified in the underlying representation. The undominated IDENT(Nuc) (''The input nucleus node must be preserved in the output'') disqualifies any candidate that shows gliding.[40] For compactness, in (43) and in later tableaux in this section I omit the X-slots and the rhyme node.

In contrast, prespecifying the syllable node in *uV* words such as those in (40f) would be a serious error. The occurrence of [u] rather than [w] is an exceptionless generalization, and it follows from the undominated *ONSET([u]). But now we face a paradox. *ONSET([u]), whose status as an operative constraint is beyond doubt, will disqualify all candidates that show *w*-insertion in (40e–f), (41b), and (42). In other words, whereas *ONSET([u]) does a good job of explaining the absence of *u*-gliding, it does a terrible job for *w*-insertion by banning this process altogether. This is surprising when we realize that [w] onsets are commonplace in Polish because

[37] The alternative that [w] in (42) is the original French [w] and that [u] is a Polish innovation cannot be motivated. Polish has a productive pattern of *w*-insertion, as independent data demonstrate, but not one of *u*-insertion.

[38] In general, a glottal stop is not unknown in Polish. It may occur for emphasis (e.g., *Ależ leje!* [ʔa.leš] 'What rain!', *Adam to zrobił?* [ʔa.dam] 'Don't tell me Adam did it!'). The curious fact is that a glottal stop may also appear in the coda: *nie* [ɲeʔ] 'no' (emphatic), *no* [noʔ] 'come on'. I have no analysis for these data, but the descriptive facts are clear: a glottal stop is an emphasis marker.

[39] Note that the French rounded vowel is decomposed into a sequence of [j] and [u], a development that pays homage to both the [−back] and the [+round] properties in the French source form.

[40] The existence of gliding entails that V-NUC is low ranking in Polish.

(43) //t r i o//

	*[cg]	IDENT(Nuc)	ONSET	DEP(Seg)
☞ a. t r i j o				*
b. t r i o			*!	
c. t r j o		*!		
d. t r i ʔ o	*!			*

they come from underlying //ɬ//. When not palatalized to [l'] before a front vowel, //ɬ// vocalizes to [w], as shown by many alternations.

(44) a. szkoł + a [ško.wa] 'school' – szkol + i + ć [ško.l'itɕ] 'to educate'
(Note: [tɕ] is a voiceless prepalatal affricate.)
b. mał + y [ma.wɨ] 'small' (nom.sg.) – mal + i [ma.l'i] (nom.pl.)
c. da + ł + a [da.wa] 'she gave' – da + l + i [da.l'i] 'they gave' (masc.)

The dilemma of how to ban *u*-gliding and at the same time permit *w*-insertion is solved easily if there are two levels in Polish that differ in the ranking of *ONSET([u]).[41]

(45) a. Level 1: ALIGN-L, *[cg], IDENT(Nuc) ≫ *ONSET([u]) ≫ ONSET ≫ DEP(Seg)
b. Level 2: ALIGN-L, *[cg], IDENT(Nuc) ≫ ONSET ≫ *ONSET([u]) ≫ DEP(Seg)

At level 1 *ONSET([u]) dominates ONSET, so there is neither *u*-gliding nor *w*-insertion. (The insertion of [j] is of course not affected by this ranking and it takes place.) At level 2 ONSET dominates *ONSET([u]), so *w*-insertion is possible. The nucleus *u* from level 1 cannot become a glide because IDENT(Nuc) dominates ONSET, which is ranked in the same way as at level 1. (Recall

[41] The argument is not that standard OT cannot account for the absence of *u*-gliding without levels. Since there is no theory of what is a possible constraint, one could always add a constraint saying, ''No *u*-gliding.'' Rather, the argument is that such a constraint would be unenlightening, to say the least. First, it would simply restate the facts rather than explain them. Second, postulating ''No *u*-gliding'' would overlap in a disturbing way with the already existing and well-motivated constraints *ONSET([u]) and *CODA([u]) (see section 2). Third, the exact statement of ''No *u*-gliding'' would be difficult and is unlikely to look attractive. Since /u/ *can* glide into the coda (see (37b)) and since in this account *ONSET([u]) does not play a role, the constraint would have to say, ''Assign a nucleus to the *u* that is followed by a vowel in the underlying representation.'' Such markedness output constraints that peep into the underlying representation are unheard of, and for good reason. If they existed, the power of the grammar would increase so much that it would deprive OT of all insight.

that IDENT(Nuc) ≫ ONSET is motivated by words such as *trio* 'trio' in (40c), which, unlike *biolog* 'biologist' in (37a), have a prespecified nucleus.) Tableaux (46)–(48) summarize the analysis by comparing the evaluation of *bio(log)* 'biologist', *trio* 'trio', and *(Pa)puas* 'Papuan' at level 1.

(46) Level 1 //b i o//

	IDENT(Nuc)	*ONSET([u])	ONSET	DEP(Seg)
☞ a. b j o				
b. b i o			*!	
c. b i j o				*!

(47) Level 1 //t r i o//

	IDENT(Nuc)	*ONSET([u])	ONSET	DEP(Seg)
☞ a. t r i j o				*
b. t r i o			*!	
c. t r j o	*!			

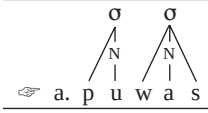
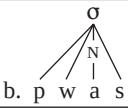
(48) Level 1 //p u a s//

	IDENT(Nuc)	*ONSET([u])	ONSET	DEP(Seg)
☞ a. p u a s[42]			*	
b. p w a s		*!		
c. p u w a s		*!		*

[42] In fact, the *s* is under the Rhyme, but I omit this node here and below.

Level 2 evaluation is irrelevant for *biolog* and *trio* since the winners from level 1 will be the winners at level 2 because the reranking of *ONSET([u]) and ONSET can have no effect on the evaluation of these words. The only relevant input is *Papuas.* The optimal candidate from level 1 is now the new ''underlying representation.''

(49) Level 2 /p u a s/

	IDENT(Nuc)	ONSET	*ONSET([u])	DEP(Seg)
 ☞ a. p u w a s			*	*
 b. p w a s	*!			
 c. p u a s		*!		

Notice that IDENT(Nuc), which was motivated originally in (40c–e) and (41a) by the need to stop the gliding of the prespecified high vowels, now has a beneficial effect for the evaluation of *Papuas* and all *uV* words at level 2. The *u* was specified as a nucleus at level 1 and is part of the ''underlying representation'' in (49). IDENT(Nuc), which imposes faithfulness, has the desired consequence of disqualifying candidate (49b).

An analysis of the dark *ɫ* vocalization in (44), *ɫ* → *w* when not palatalized, fits into the two-level scenario in a natural way. At level 1 the constraint *[ɫ] (''Do not be a dark *ɫ*'') and the associated constraint IDENT(Dorsal) have no effect because *ONSET([u]) is high and the faithfulness constraints keep //ɫ// in place. At level 2, with the constraint *[ɫ] overriding faithfulness and IDENT(Dorsal) requiring that the features it dominates (specifically [+back] and [+high]) be preserved, the dark *ɫ* has [w] as its optimal output. The [w] is not prohibited in the onset because *ONSET([u]) is low ranked at level 2, an assumption that was motivated by the analysis of *Papuas* in (48)–(49).[43]

[43] The dark-*ɫ* scenario is technically not an argument for level distinction because OT can force the vocalization of *ɫ* without levels. This is achieved if *[ɫ] is ranked above *ONSET([u]). The effect is that the surface [w] from the underlying //ɫ// is optimal and thus [w] is a legitimate onset. This scenario does not affect the arguments about the absence of *u*-gliding and the occurrence of *w*-insertion, which still argue for a level distinction. But if [w] onsets are attested at both level 1 (*ɫ* → *w*) and level 2 (*w*-insertion), then why are the French borrowings in (42) nativized with [u] rather than with [w]? That is, why do words such as *trottoir* come out as *trotuar* [trotuwar] rather than simply as [trotwar]? An analysis that forces *ɫ* → *w* at level 1 has no answer to this question. The answer proposed here is simple: *trottoir* and the like are words and not sentences. Consequently, they are subject to the word-level constraints. At the word level (level 1), [w] is not a legitimate onset; hence, the French [w] is reanalyzed as [u].

Finally, one may want to ask what happens if *j*-insertion and *w*-insertion compete in the same candidate. The answer is that [j] wins, regardless of whether the configuration is *iu* or *ui.* Thus, we find [i.ju] in *triumf* 'triumph' and [u.ji] in *altruista* 'altruist'. The victory of [j] over [w] fits well with the idea that the theory admits two levels and that *ONSET([u]) makes *w*-insertion suboptimal at level 1. The option of inserting [w] is preempted by the fact that these words have onsets (specifically, [j] onsets) when they enter level 2. Furthermore, the unconditional surrender of *w*-insertion vis-à-vis *j*-insertion finds support in foreign accents. Polish speakers mispronounce *doing,* for example, as [dujiŋk] rather than as [duwiŋk].

To summarize, Polish has *u*-gliding, but it is restricted to codas (*pauza* [pawza] 'pause'). In prevocalic position *u* never glides (an effect of *ONSET([u])); but, paradoxically, because it does not glide, it triggers *w*-insertion, so that ultimately [w] (i.e., [u] at the melodic tier) is in the onset (*Papuas* [pa.pu.was] 'Papuan').

We could not assume that the inserted *w* (melodic *u*) is a consonant rather than a glide. There is no evidence for such an assumption outside the desire to solve the paradox of *u*-gliding versus *w*-insertion in the classical version of OT. Phonetically, the inserted [w] is no different from the [w] from gliding in *pauza* 'pause'. The latter can be shown to alternate in words that exhibit variation. Thus, *hydraulik* 'plumber' has two alternative pronunciations: [xɨdrawúlik] and [xɨdráwlik] (where the accent shows stress), and both can be found in the speech of a single informant. The evidence is extremely clear since gliding has an effect on stress (penultimate stress pattern). The pronunciation [xɨdrawúlik] must have a prespecified nucleus. The other variant, [xɨdráwlik], shows that speakers tend to remove this prespecification from the underlying representation. Once this is done, the //u// glides into the coda as it does in *pauza* [pawza].[44]

The evidence for the vocalic status of [j] is parallel but stronger. In addition to the variation found in cases such as *bio-prądy* 'biological currents' [bijo]/[bjo], there are direct alternations between [i] and [j] as shown in (39c): *Visconti* [i] – *Visconti + ego* [j] (gen.sg.). Given these facts, the assumption that glides are consonantal would be an instance of diacritic use of phonological features in the sense of Kiparsky (1973).

In the next section we look at a rural dialect of Polish that differs minimally from standard Polish. This dialect is of interest because, first, it shows a new type of onset-providing strategy, and, second, it supports the conclusion of this section that glide insertion requires two derivational levels.

7 Rural Polish

A characteristic feature of uneducated Polish is the occurrence of [j] in word-initial syllables that begin with *i.*

(50) *#i → #ji* Irena [ji] 'Irene', idę [ji] 'I go', inny [ji] 'other'

[44] *Paulina* 'Pauline' is another such word: [pa.wu.li.na] or [paw.li.na].

The insertion of [j], which is very common in Poland, is known as *prejotacja* (*j*-preposing). It may but need not be a regional dialect feature (Wierzchowska 1971). It is nonregional in the sense that it is widely attested throughout Poland and is typical of uneducated speech commonly referred to as *rural* speech. The point of interest is that the strategy of filling in a word-initial onset is limited to [j] and it occurs only before *i*.[45] The widespread occurrence of *j*-preposing is best documented by Karaś and Madejowa's (1977) dictionary of Polish pronunciation. This prescriptive dictionary issues a warning of the type ''Say [i], not [ji]'' under every entry that begins with *i* but no such warning under entries that begin with *u;* that is, it does not give the instruction ''Say [u], not [wu].''

Important to note is the fact that rural Polish has the same phonology as standard Polish with regard to glide insertion word-internally: both [j] and [w] are inserted as described in section 6.[46] The analysis of rural Polish is therefore the same as that of standard Polish with the sole difference that ALIGN-L is dominated by ONSET. Thus, standard Polish has the ranking ALIGN-L $\gg$ ONSET and rural Polish the ranking ONSET $\gg$ ALIGN-L.

Rural Polish supports the two-level distinction. The dialectal difference expressed by the difference in the ranking of ALIGN-L and ONSET is limited to level 1. At level 2 the dialects are the same: ALIGN-L dominates ONSET, and, consequently, [w] is not inserted in *udo* [udo] (*[wudo]) 'thigh'. If we analyzed rural Polish in terms of classical OT, which does not recognize serial evaluation (levels), we would face serious difficulty. The point is that the ranking ONSET $\gg$ ALIGN-L would open words such as *udo* to glide insertion. Since *w*-insertion occurs word-internally, there would be no way of blocking it word-initially, short of introducing a heavy-handed ad hoc constraint such as ''[w] is not permitted word-initially.''[47]

The Czech data discussed in the next section are interesting in two ways. First, Czech is a new type of Slavic language in the sense that it has both glottal stop insertion, like Bulgarian, and glide insertion (more specifically, *j*-insertion), like Polish. Second, Czech provides an argument for a three-level analysis. It thus strengthens the contention that limited derivationalism must be permitted in OT.

8 Czech

Czech stands out among Slavic languages in the sense that its glide and glottal stop insertion have been described in a clear and detailed way in the traditional literature (e.g., Petr 1986, Kučera 1961, de Bray 1980). These sources and the data obtained from my consultants converge. The results are summarized in (51).

[45] There are regional dialects that have both *j*-preposing and *w*-preposing. The latter is found in words beginning with *u* and *o: udo* [wu] 'thigh', *ojciec* [wo] 'father'. Glide preposing (both *j* and *w*) is a historical process that is no longer active in the standard dialects of Slavic languages. However, it has left its traces. The *j* is found in educated Czech (e.g., *jiný* 'other'). The words with historical *j*-preposing contrast in today's Czech with words that begin with an onsetless *i* (e.g., *inserát* 'announcement'). The historical [w] is found in Lusatian (e.g., *woko* 'eye', *wucho* 'ear'; de Bray 1980).

[46] This is exactly how my neighbor speaks.

[47] Such a constraint would be a statement of fact rather than an explanation. Note also that the [w] from //ł// occurs initially with no restriction (e.g., *łuk* [wuk] 'bow').

(51) a. *iV* → *ijV* dialekt [i.ja] ‘dialect’, patriot [i.jo] ‘patriot’
b. *Vi* → *Vji* kokain [a.ji] ‘cocaine’, hinduista [u.ji] ‘Hinduist’
c. *uV* silueta [u.e] ‘silhouette’, situovat [u.o] ‘place’
d. *Vu* muzeum [e.u] ‘museum’, liceum [e.u] ‘high school’
e. *VV* poeta [o.e] ‘poet’, neandertálec ‘Neanderthal man’
f. *#V* → *#ʔV* Amerika [ʔa] ‘America’, ulice [ʔu] ‘street’

In Czech, as in all Slavic languages, hiatus of nonhigh vowels is tolerated (51e). The hiatus involving /u/ shown in (51c–d) is a consequence of the fact that [w] cannot appear in onsets. This is captured by assuming that *Onset([u]) is undominated. The front vowel /i/ spawns [j] before a vowel (51a) or after a vowel (51b); that is, spreading occurs both to the right and to the left: *i.V* → *i.jV* and *V.i* → *V.ji.* To permit *j*-insertion, Onset must outrank Dep(Seg).[48] In sum, the ranking is *Onset([u]) ≫ Onset ≫ Dep(Seg). This clear picture is complicated by the fact that vowel-initial words obligatorily begin with a glottal stop, as shown in (51f), and the glottal stop is never suppressed in connected speech, regardless of the tempo and style (Petr 1986). I conclude that Onset dominates Align-L, which permits initial insertion. The difficulty is how to make glottal stop insertion suboptimal word-medially. For example, if [ʔ] provides an onset to the [a] syllable in *Amerika* [ʔa] ‘America’, then why doesn’t it also provide an onset to the [a] syllable in *neandertálec* *[ʔa] ‘Neanderthal man’? With Align-L dominated by Onset, we find minimal pairs such as *poet* [o.e] ‘poet’ versus *tento experiment* [o.ʔe] ‘this experiment’, where the same hiatus /oe/ is treated in two different ways: it is tolerated word-medially but not at word boundaries. An apparent solution to this problem is to introduce a new constraint banning the occurrence of [ʔ] word-internally. This is ad hoc and unattractive, since (a) such a constraint merely restates the problem rather than solving it, and (b) it fails to address the question of why words beginning with *i* do not choose *j*-insertion as an onset-providing strategy, that is, why *idiot* ‘idiot’ is pronounced [ʔi.di.jot] rather than *[ji.di.jot]. This question is particularly significant because Czech contrasts word-initial *i* and *ji*, an effect of the historical process of *j*-preposing, now long inactive (see footnote 45). The difference between *i* and *ji* is lexical because there are contrasts such as *jiskra* ‘spark’, *jit* ‘go’ versus *inserát* ‘announcement’.

Given the earlier result that levels are needed (Slovak, Bulgarian, Polish), the Czech problem is easy to solve. At level 1 Align-L outranks Onset and thus there is no insertion word-initially. Glottal stops are banned at this level by the ranking *[cg] ≫ Onset; hence, internal *VV* hiatus is tolerated. *Mult-Link is violated in the environment of /i/ as this type of hiatus is resolved by *j*-insertion: Onset ≫ *Mult-Link. At level 2 *Mult-Link is undominated and hence there is no glide insertion at all. Consequently, *inserát* ‘announcement’ has [i] rather than [ji]. With Onset ≫ Align-L, and Onset ≫ *[cg], glottal stops fill onsets in vowel-initial words.

(52) Level 1: *Onset([u]), *[cg], Align-L ≫ Onset ≫ Dep(Seg), *Mult-Link
Level 2: *Onset([u]) *Mult-Link, Onset ≫ *[cg], Dep(Seg) ≫ Align-L

[48] Of course, the pan-Slavic restriction that inserted glides can only come from spreading holds as well (see section 2).

I summarize this analysis by displaying the case of *idiot* [ʔi.di.jot] 'idiot' in (53).

(53) a. Level 1 //idiot//

	*[cg]	ALIGN-L	ONSET	DEP(Seg)	*MULT-LINK
☞ i. i.di.jot			*	*	*
ii. i.di.ot			**!		
iii. ʔi.di.ʔot	**!	*		**	
iv. ji.di.jot		*!		**	**

b. Level 2 /i.di.jot/

	*MULT-LINK	ONSET	*[cg]	DEP(Seg)	ALIGN-L
☞ i. ʔi.di.jot	*		*	*	*
ii. i.di.jot	*	*!			
iii. i.di.ot		**!			
iv. ji.di.jot	**!			*	*

Candidate (53biii) additionally violates MAX(Seg) because /j/ has been deleted from the new ''underlying representation'' (the winner from level 1).

The Czech data are of special interest because the two-level analysis just presented is compounded by the devoicing and the syllabification of monoconsonantal prepositions, a situation that calls for yet another level of evaluation. In this fragment of analysis, Czech coincides with Bulgarian but is a clearer case than Bulgarian because monoconsonantal prepositions trigger vowel insertion under circumstances that are governed contextually rather than stylistically, as I explain below.

Consider the data in (54).

(54) a. nad mostem [nad] 'over the bridge', bez mostu [bez] 'without the bridge'
b. nad prahem [nat] 'over the threshold', bez prahu [bes] 'without the threshold'
c. nad oknem [nat ʔok] 'over the window', bez okna [bes ʔok] 'without the window'

The underlying voiced obstruent of the preposition (54a)[49] is devoiced before voiceless obstruents (54b). The devoicing is also obligatory before vowel-initial words such as *okn + o* 'window' (neut.nom.sg.). This is not surprising, given that [ʔ] is obligatory in (54c), a fact on which all the sources and my consultants agree (see, e.g., Petr 1986). The interesting cases are those involving monoconsonantal prepositions: *v* 'in', *z* 'from', *s* 'with', and *k* 'to'. These prepositions are unable to constitute syllables by themselves. One would therefore expect them to syllabify into the onset of the following vowel-initial word; *v oknĕ* 'in the window', *z okna* 'from the window', *s oknem* 'with the window', *k oknu* 'to the window'. This is exactly what happens, and Czech provides compelling evidence for this contention. The background facts are as follows.

[49] The obstruent must be voiced in the underlying representation because Czech has no voicing of obstruents before sonorants.

The monoconsonantal prepositions trigger *e*-insertion when they cannot syllabify into the onset of the following word.[50] Such is the case when a cluster of two identical or almost identical consonants would arise. (The voicing contrast does not play a role.)

(55) a. ve vodě //v vo// → [ve vo] 'in the water', ve Francii //v fran// → [ve fran] 'in France'
b. ze zlata //z zla// → [ze zla] 'from gold', ze soli //z so// → [ze so] 'from salt'
c. se solí //s so// → [se so] 'with salt', se zlatem //s zla// → [se zla] 'with gold'
d. ke koni //k ko// → [ke ko] 'to the horse', ke generálovi //k ge// → [ke ge] 'to the general'

The details of *e*-insertion are not essential to the argument. Suffice it to say that an instantiation of the Obligatory Contour Principle (which prohibits geminates here) is dominated by MAX(Seg) (''Do not delete a segment''). With the high-ranking STRICT-LAYER (here: ''Segments are grouped into syllables''; see, e.g., Nespor and Vogel 1986), the prepositions *v, z, s,* and *k* must be parsed into the syllables. Since MAX(Seg) prohibits deletion, the strategy is to insert *e,* a default vowel, and thus to syllabify *v, z, s,* and *k,* as exemplified in (55).

Returning now to the prevocalic context, notice that there is no *e*-insertion in *v okně* 'in the window', *z okna* 'from the window', *s oknem* 'with the window', *k oknu* 'to the window'. We therefore know that *v, z, s,* and *k* must have syllabified into the onset. We would expect to find [vo], [zo], [so], and [ko], as is exactly the case in the corresponding Russian phrases (see (36)), but we do not. The correct phonetic outputs are those listed in (56a). The examples in (56b) show that monoconsonantal prepositions syllabify into the onset of words that do not begin with a glottal stop. Before looking at (56a), let us note that Czech, like other Slavic languages, admits fricative-stop and stop-stop onsets. Voice assimilation is obligatory. Judging from the absence of *e*-insertion, the prepositional consonant in (56a) must have syllabified into the onset.[51]

(56) a. v okně [fʔok] 'in the window', z okna [sʔok] 'from the window', s oknem [sʔok] 'with the window', k oknu [kʔok] 'to the window'
b. v noze [vno] 'in the leg', v peci [fpe] 'in the oven', z boku [zbo] 'from the side', z tábora [sta:] 'from the camp', s tebou [ste] 'with you', s biskupem [zbis] 'with the bishop', k chatě [kxa] 'to the house', k ženě [gže] 'to my wife'

The mystery is why we find [fʔo], [sʔo], and [kʔo] rather than simply [vo], [zo], [so], and [ko] in (56a). The answer is simple if we formally recognize that word phonology is determined before postlexical phonology. The postlexical level (here level 3) takes as its input (i.e., as its ''underlying representation'') the output of the word level (level 2, given the two-level distinction for which I argued above). The earlier example *idiot* is now analyzed further in (57), as part of the phrase

[50] Alternatively, if we assume that the prepositions end in an underlying yer *E* (an X-slotless vowel; see Kenstowicz and Rubach 1987, Rubach 1986), then we are looking here at prosodically driven yer vocalization: the yers are vocalized in order to permit the syllabification of the prepositions. Whatever the interpretation, the structure of the argument is the same.

[51] Another option such as syllabifying the consonant into an appendix would not be able to distinguish between the contexts that force *e*-insertion (55) and those that do not (56). The reason is that syllable well-formedness constraints refer to the structure of syllables and not to the relation between syllables and appendices.

s idiotem ‘with the idiot’. The difference between levels 2 and 3 is merely a matter of the domain of evaluation: *idiotem* at level 2 and *s idiotem* at level 3. There is no evidence for the reranking of constraints at level 3.[52] STRICT-LAYER is ranked high and in the same way at all three levels; I simply did not look at it earlier because it was not relevant. (Note: the preposition /s/ is a new segment at this level. Consequently, it has not been syllabified in the input representation.)

(57) Level 3 /s ʔi di jo tem/

	STRICT-LAYER	MAX (Seg)	*MULT-LINK	ONSET	*[cg][53]	DEP (Seg)	ALIGN-L
PW (σ σ σ σ) ☞ a. sʔi di jo tem			*		*		**
PW (σ σ σ σ σ) b. se ʔi di jo tem			*		*	*!	*
PW (σ σ σ σ) c. ʔi di jo tem		*	*!		*		*
PW (σ σ σ σ) d. si di jo tem		*	*!				*
PW (σ σ σ σ) e. s ʔi di jo tem	*		*!		*		*
PW (σ σ σ σ) f. i di jo tem		**!	*	*			
PW (σ σ σ σ) g. sji di jo tem			**!				**

Incidentally, it is now clear that DEP(Seg) must dominate ALIGN-L, a fact that was not evident at level 2 (see (53b)).

[52] However, it may be the case that other constraints that govern the phonology of Czech are reranked at this level.

[53] *[cg] is a markedness and not a faithfulness constraint. Consequently, any occurrence of a glottal stop, no matter whether it comes from the underlying representation or from insertion, violates this constraint.

I conclude that Czech provides evidence for distinguishing three levels of evaluation. The first two do not exceed the domain of the word; the third is postlexical. This conclusion is also true for rural Polish. With regard to word-initial *i* syllables, the problem is the same as the one just discussed for Czech, the sole difference being that the inserted segment is [j] rather than [ʔ]. Thus, *j*-preposing is found not only in *inn+ym* [ji] 'another' (instr.sg.) but also in *z inn+ym* [zji] 'with another'.

9 Nonderivational Alternatives

Current OT insists on parallel evaluation and does not admit derivational levels (serialism).[54] The hypothesis is that all instances seemingly calling for derivational steps can be analyzed in some other way. Most significantly, three approaches have been advanced toward this end. The first builds on faithfulness to a related output (output-output theory). The second permits features to dock on segments that do not stand in correspondence (MAX(Feature) theory). The third assumes faithfulness to an unsuccessful candidate (sympathy theory). In this section I review these approaches and consider whether they can deal with the evidence presented here for derivationalism.[55]

9.1 Output-Output Theory

Output-output theory (OO theory), which has been developed most fully in Benua 1995, 1997, permits faithfulness constraints to refer not only to the correspondence between inputs and outputs (IO correspondence) but also to the correspondence between outputs themselves (OO correspondence).

OO theory can be used successfully to eliminate the derivational step posited for Bulgarian in section 5. Recall that this step is motivated by the occurrence of glottal stops in phrases such as *s obedi* [sʔo] 'with dinners' (see the data in (35)). I accounted for this as follows: At the word level *obedi* receives [ʔ]. At the postlexical level, where the phrase *s obedi* is evaluated, the [ʔ] is already there and thus the incorrect *[so] can be eliminated, which follows from MAX(Seg) (here: ''Do not delete ʔ'').

The same result can be obtained in OO theory, which builds on the fact that the phrase *s obedi* is founded on the base *obed* [ʔobet] 'dinner'. The choice of *obed* [ʔobet] as the base is

[54] However, the early work of McCarthy and Prince (1993) allowed for a derivational cut at the interface between the stem and the prefix-stem morphology. In his analysis of Massachusetts *r,* McCarthy (1993) admitted the possibility of a rule of *r*-insertion in what was then regarded as a phonetic spell-out component. Booij (1997) also argues for level distinctions; but the evidence is amenable to reanalysis in terms of sympathy theory (McCarthy 1998). Orgun (1996) suggests that there are phonological levels, but they are rooted in morphological constituency. These levels are not derivational because phonological operations are carried out simultaneously and not in steps. Cole and Kisseberth (1995) avoid derivations by arguing for abstract (i.e., unrealized) feature domain structures in the output. Most recently, Sprouse (1998) proposes a theory of enriched inputs that permits one intermediate representation. Baltazani (1998) goes in the direction advocated here because her proposal permits reranking at the sentence level. Kiparsky (1997) proposes that OT should be constructed in a stratal way on the model of Lexical Phonology.

[55] I do not discuss the standard rule approach, which is derivational and consequently has no difficulty accounting for the data adduced here.

straightforward because this is the citation form of the word. To obtain the correct surface form of *s obedi*, [sʔobedi], we need an OO constraint that requires the preservation of the glottal stop: either IDENT$_{OO}$([cg]) or MAX$_{OO}$(Seg). The relevant evaluation is shown in (58).

(58) underlying representation: //s obed+i//
surface base: [ʔobet]

	IDENT$_{OO}$([cg])	ALIGN-L	*[cg]
☞ a. sʔobedi		**	*
b. sobedi	*!	*	

The surface analogy between *obed* and *s obedi* is limited to the initial syllable. Crucially, it is only the glottal stop of *obed* [ʔobet] that is forced to occur in the phrase *s obedi*. The other property of [ʔobet]—the final devoicing of //d// to [t]—must be ignored; otherwise, we would predict *[sʔobeti], which is incorrect. To avoid the incorrect form, we simply assume that IDENT$_{IO}$([voice]) outranks IDENT$_{OO}$([voice]). Now for FINAL-DEVOICING to have an effect in the singular *obed* [ʔobet], the actual ranking of constraints must be FINAL-DEVOICING ≫ IDENT$_{IO}$([voice]) ≫ IDENT$_{OO}$([voice]). Given the OT tenet that language-particular phonologies differ in constraint ranking, OO theory opens a possibility of generating systems that are unattested. Thus, for sound change, the IO part of the theory predicts the attested possibility that a language may restructure by losing the effect of FINAL-DEVOICING: FINAL-DEVOICING ≫ IDENT$_{IO}$([voice]) at stage X (FINAL-DEVOICING is reflected in the outputs) versus IDENT$_{IO}$([voice]) ≫ FINAL-DEVOICING at stage Y (no surface effects of FINAL-DEVOICING, which corresponds to rule loss in the rule-based system). OO theory adds a new possibility here that is unattested. With the ranking IDENT$_{OO}$([voice]) ≫ FINAL-DEVOICING ≫ IDENT$_{IO}$([voice]), we predict that a language may restructure all of its final voiced obstruents into voiceless obstruents, which is unheard of.[56] In the instance at hand, *obedi* 'dinners' would change into *obeti*, and so would all other words with voiced final obstruents. I conclude that the introduction of OO constraints, although successful in (58), adds too much power to the theory and is therefore a controversial development.

The added power is not the only controversial element in OO theory. The concept of the base on which OO evaluation is founded is also problematic. Recall (see section 6) that the inserted glide in the Polish verb *ewolu+ować* [lu.wo] 'evolve' alternates with zero in *ewolu+cj+a* [lu.tsja] 'evolution'. Assuming that *ewolu+cj+a* is the base and that IDENT$_{OO}$(Nuc) is dominant, the evaluation of *ewolu+ować* is unproblematic. In (59) I show the relevant portions of both the underlying representation and the surface base. The analysis is successful without the ranking *ONSET([u]) ≫ ONSET, which was an argument for a derivational step (see section 6). The success is short-lived, however. Only two words show an alternation between the inserted [w] and zero: *ewolu+ować* 'evolve' – *ewolu+cj+a* 'evolution' and *konstytu+ować*

[56] Such a restructuring is known to occur only with individual morphemes, particularly if no alternations exist. Thus, German *weg* has restructured its historical //g// into //k// in Lithuanian Yiddish; see Kiparsky's (1973) famous analysis of this problem.

(59) underlying representation: //lu+o//

surface base: [lu]

	IDENT$_{OO}$(Nuc)	ONSET	*ONSET([u])
☞ a. lu . wo			*
b. lu . o		*!	
c. lwo	*!		*

'constitute' – *konstytu+cj+a* 'constitution'.[57] All the other words (e.g., *Papuas* 'Papuan' and *all* its derivatives: *Papuas+ik* (dimin.), *papuas+k+i* (adj.), and others) invariably have [uwa] in the output. Consequently, [uwa] is in the base, regardless of which of these forms we assume to be the base. The number of words like *Papuas* is unlimited since, as noted in section 6, glide insertion is entirely productive. It occurs in names, acronyms, and nonce forms. Furthermore, it transfers as a ''Polish accent'' when Poles speak foreign languages. In sum, it is an accident that *ewolu+ować* has a base without [w]. On a more general level, the exceptionless generalizations that /uV/ does not glide to [wV] and that hiatus is resolved by *w*-insertion have nothing to do with surface analogy. OO theory is unable to account for these facts.[58]

The Czech data show that the generalizations found independently in Bulgarian and Polish (with regard to *j*-insertion) can be combined in the system of a single language. The phrase *s idiotem* [sʔi.di.jo.tem] 'with the idiot' can be accounted for by OO theory on the condition that the base is [ʔi.di.jot]. The syllabification of the *s* into the onset is then analyzed in the same way as the syllabification of *s* into the onset of *obedi* in Bulgarian (see (58)). But how can we generate the base [ʔi.di.jot] in parallel OT? With regard to the inserted [j], the difficulty is the same as in Polish: no alternations.[59] This difficulty is compounded by the fact that the initial vowel (here *i*) triggers *ʔ*-insertion whereas the word-medial *i* triggers *j*-insertion.[60]

With regard to the Slovak data discussed in section 3, OO theory has similar difficulties. The diphthongization in *riasa* 'cassock' cannot be accounted for because there are no alternations and yet the analysis requires derivational steps. In contrast, *páň+a* 'master' (dimin.) (recall //paːn+æ// → [paːɲ+a]) shows alternations, but they are of the wrong kind from the OO perspective. The opacity is seated not in the stem but in the suffix. The fact that the suffix has alternations

[57] With regard to *j*-insertion, which is a massively attested process, the alternations are limited to three suffixes.

[58] Flemming and Kenstowicz's (1995) base-identity theory faces exactly the same problems as OO theory in this case.

[59] As noted earlier, appealing to Lexicon Optimization cannot help, the point being that [ʔ] and [j] cannot be *crucially* present in the underlying representation.

[60] The fact that the [j] in the initial syllable would be a matter of leftward spread whereas the [j] in the second syllable would be an effect of rightward spread is irrelevant. There are strings, such as the potential name *Ikair* [ʔika.jir], in which leftward spread would be true in equal measure about both instances of *i*.

is of little help. (Recall [æ] in *holúb + ä* 'pigeon' (dimin.) and [a] in *páň + a.*) With the OO assumption that we analogize to an actually occurring form, the base for *páň + a* must be *holúb + ä* or any number of words that end in a labial and hence retain the underlying //æ// on the surface. This is an odd assumption. Even if the analysis could be made to work, the fact that the choice of the base is unprincipled must be regarded as a flaw, which makes OO theory unattractive.

To sum up, OO theory extends the power of the grammar and predicts unattested types of sound change. Furthermore, it runs into difficulty with the concept of the base. Sometimes the base is available (rather few instances in the data) and sometimes it is not, yet there is a generalization that needs to be accounted for. At still other times the base is attested, but it is of the wrong kind (suffixes, not words). I conclude that OO theory, with its insistence on surface analogy, is not a promising line of research in the area of glottal stop and glide insertion in Slavic languages.

9.2 MAX(Feature) Theory

The problems encountered by OO theory in the analysis of *páň + a* 'master' (dimin.) and *riasa* 'cassock' are easily solved in an expanded version of OT that includes the concept of MAX(Feature) (MAX(F)). This expansion, suggested by Lombardi (1998), treats features on a par with segments in the sense that features are subject to the MAX family of constraints. Thus, for example, next to the standard IDENT([−back]) we now also have MAX([−back]).[61] The difference between the two constraints is clear. IDENT([−back]) requires that [−back] be attested in the output segment that corresponds to the [−back] input segment. In contrast, MAX([−back]) requires merely that [−back] be attested in the output; crucially, it does not matter where in the string it is attested. The output segment with [−back] may but need not correspond to the input segment with [−back]. That is, the idea of MAX(F) theory is to permit features to move around (Lombardi 1998). This is exactly what we need in order to avoid a derivational step in *páň + a.* Tableaux (19)–(20) of the DOT analysis in section 3 can now be folded into one, as shown in (60) and no derivational step is needed.

(60) //n+æ// *páň+a* 'master' (dimin.)

	MAX([−back])	PALATALIZATION	*æ*-BACKING	IDENT([−back])
☞ a. ɲ+a				*
b. ɲ+æ			*!	
c. n+a	*!			*
d. n+æ		*!	*	

In (60a) the [−back] from //æ// is found on [ɲ] that corresponds to the underlying //n//. This movement of [−back] violates IDENT([−back]) but not MAX([−back]), which does not care about correspondence. Candidate (60c), [pa:n + a], which was the reason for a derivational step in DOT (see section 3), is now banned by the high-ranking MAX([−back]) because the output [pa:n + a] has no [−back] feature.

[61] Lombardi (1998) discusses MAX([voice]) only, but the model that she proposes extends to all features.

A MAX([− back]) analysis of *riasa* (underlying //ræ:sa//) 'cassock' is also successful. Recall that the derivational step was forced by the inability to exclude the candidate [ra:sa] in (16b). This is not a problem if we admit MAX([− back]) as a constraint and rank it above IDENT([− back]). Tableaux (16b) and (17) can now be collapsed into one; that is, no derivational step is needed. I document this contention in (61).

(61) //r æ// *riasa* 'cassock'

	*[æ:]	*æ*-BACKING	MAX([− back])	IDENT([− back])
☞ a. r i a				*
b. r i æ		*!		
c. r æ	*!	*		
d. r a			*!	*

The crucial contender, candidate (61d), has no [− back] at all and thus violates both MAX([− back]) and IDENT([− back]). Candidate (61a), the correct surface form, satisfies MAX([− back]) but violates IDENT([− back]) because the second part of the diphthong, here [a], does not have [− back].[62] However, given the ranking in (61), this violation is a minor offense and (61a) wins, which is correct.

MAX(F) theory raises two essential questions, one theoretical and the other empirical. On the theoretical side, MAX(F) is a very significant extension of OT. First, it doubles the number of constraints referring to features, since every feature will now appear not only in an IDENT constraint but also in a MAX constraint, as shown above for [− back]. Second, in order to be different from IDENT(F), MAX(F) does not mandate where in the output string the feature should surface, which leads to a very unconstrained theory. On the empirical side, MAX(F) runs into difficulty with the Slovak data, as I show below.

The analyses shown in (60) and (61) are successful because, for independent reasons, the [− back] set in motion by MAX([− back]) could land only on the nasal in *páň + a* and not on any other segment. In particular, the [− back] from the melodic segment //æ// could not dock on the vowel of the root morpheme because it would produce [æ:], which is prohibited by *[æ:]. The

[62] Note that both the [i] and the [a] in the output [ia] are correspondents of the underlying melodic segment //æ//.

labial corresponding to //p// could not be [p'] in the output because Slovak does not permit the palatalization of labials, a fact that is expressed by an undominated constraint. In sum, the only licit landing site for [−back] was the nasal, as prepalatal nasals exist in Slovak. This led to the selection of the correct output in (60).

The facts relating to *riasa* are parallel. The [−back] from the //æ// of //ræ:sa// could not appear on the final vowel because we would then have [æ] after [s], which is prohibited by *æ*-BACKING ([æ] can occur only after a labial consonant). Similarly, [−back] could not land on the [r] or the [s] because Slovak coronal palatalization is limited to noncontinuants (dental *t d n l* → prepalatal *t' d' ɲ l'*). All these independent generalizations are fundamental to the success of MAX([−back]) in (60) and (61). But what happens if there are [−back] segments somewhere else in the string? Such instances are plentiful in Slovak.

Consider *tel'* + *a* [t'el' + a] 'calf', which is parallel to *páň* + *a* 'master' (dimin.) and *osl'* + *a* 'donkey' (dimin.) but differs from these words by virtue of the fact that the sounds in the first syllable are [−back]: [t'] and [e]. These sounds satisfy MAX([−back]). Consequently, in *tel'* + *a*, unlike in *osl'* + *a*,[63] there is no way of forcing the underlying //l// to palatalize to [l']. Since turning the plain //l// in *tel'* + *a* into [l'] is a faithfulness violation, the optimal output will be [t'el + a] rather than the correct [t'el'a]. In sum, MAX([−back]) is mute on the *l* → *l'* problem because it is satisfied by the occurrence of [−back] on [t'] or [e]. I conclude that MAX([−back]) fails on empirical grounds.[64]

This conclusion is supported by the facts relating to the diphthong [ia]. The problem is fully parallel to that discussed in connection with [t'el' + a], so I will merely point to one or two examples. Alongside *riasa* [riasa] 'cassock' we find words such as *dial'* [d'ial'] 'distance' derived from //dæ:l'//. There are also near minimal pairs (e.g., *nitársky* [ta:r] 'stapler' (adj.) vs. *nitiarsky* [t'iar] 'threader' (adj.)).

If MAX(F) theory is not a viable alternative to DOT, then the question is how to account for the facts adduced by Lombardi (1998). Briefly, the problem is that in Japanese underlying //kag + ta// 'sniffed' turns into surface [kai + da], where the voiced obstruent //g// has been deleted but has left its trace by passing on its voicing to the suffix *t:* //g + ta// → [da]. Clearly, IDENT([voice]) cannot do the job because //g// corresponds to [i] and not to [d]. Lombardi therefore proposes MAX([voice]), which requires that ''a voiced autosegment in the input must be represented in the output'' (p. 47). (Note: Lombardi assumes that [voice] is a privative feature.) Given this constraint,

[63] This word is unproblematic because, as mentioned earlier, [s] cannot palatalize. The vowel //o// cannot accommodate [−back] since [o] does not exist in Slovak. Given that [æ] is prohibited after nonlabials (*æ*-BACKING), the only licit docking site for [−back] is the lateral. We thus obtain [l'], which is correct.

[64] One might observe that the [−back] on the [t'] and on the [e] comes from an independent source and not from //æ//. However, given the architecture of OT, there is no way to tell if the [−back] on the [e] in the output is from the underlying representation or from MAX([−back]) or possibly from both of these sources. The point is that no segment has been deleted and indexing refers to segments rather than to features. (The indexing of features would be an extension of the theory.) Along the same lines, since palatalization is categorical and not gradient, there is no distinction between one versus two [−back] features sitting on the [t'] in [t'el' + a]. Like the medieval attempt to determine how many angels could sit on the head of a pin, an attempt to make a theoretical issue of the problem of ''one versus two [−back] features on a single segment'' is unlikely to be rewarded.

the [voice] of the //g// must surface in the output. It attaches to /t/ and turns it into [d]: *kag + ta → kai + da.*[65]

This analysis is crucially based on the assumption that there cannot be a derivational step. But if such a step is allowed, and I have argued that it should be, then the whole argument for MAX([voice]) collapses. The analysis is straightforward: at level 1 //kag + ta// has [kag + da] as its optimal output (voice assimilation); at level 2 /g/ is replaced by [i].

9.3 Sympathy Theory

The difficulties that OO theory and MAX(F) theory encounter with *páň + a* 'master' (dimin.) and *riasa* 'cassock' all disappear when we recast the analysis in terms of sympathy theory (McCarthy 1997, 1998). The idea is that we work with two or more bases in parallel: the standard underlying representation and one or more sympathetic bases. The latter are recruited from among the failed candidates. Specifically, the sympathetic base (or bases) must contain the information that is missing in the output of the desired winner because of surface opacity. Thus, we have the best of both worlds: we can access the failed candidate in the same way as DOT would access an intermediate representation but we do not need a derivational step. The benefits of this approach are illustrated by the analysis of *páň + a* 'master' (dimin.).

To clearly identify the problem, the worksheet in (62) will be helpful. I use the constraints familiar from section 3 but add IDENT([+anter]), which becomes relevant when we look at the details of palatalization: //n//, which is [+anter], corresponds to [ɲ], which is [−anter].

(62) //n+æ// *páň+a* 'master' (dimin.)

	PALATALIZATION	*æ*-BACKING	IDENT ([−back])	IDENT ([+anter])
a. ɲ+a			*	*!
b. ɲ+æ		*!		*
*☞ c. n+a			*	
d. n+æ	*!	*		

We now see the problem: the system selects [pa:n + a] (62c) instead of the correct [pa:ɲ + a] (62a). Notice that no manipulation of the ranking can solve the problem because [pa:n + a] has a subset of the violations accrued by [pa:ɲ + a]. We need sympathy theory.

The analysis follows from two assumptions. First, it is permitted to select one of the failed candidates and assign it a special status, that of the sympathetic base. Second, OT is expanded by permitting a new class of constraints: the sympathetic faithfulness constraints that mandate the preservation of the properties of the sympathetic base in the optimal output. Given these two assumptions, the analysis is straightforward.

The sympathetic base is not selected in an ad hoc way. Rather, one of the constraints, called

[65] A reviewer points out that in fact this analysis does not work because the [voice] of //g// can be assumed to be represented in [i]. Thus, to salvage the analysis, additional stipulations would have to be made.

a *selector*, evaluates the candidates and picks the one that has the smallest number of violations. The selector scans all the candidates to make its choice. Obviously, the candidates that violate the selector itself are not viable contenders for the status of a sympathetic base. The difficult part of the whole procedure is to appoint the correct selector. This decision is aided by McCarthy's (1997, 1998) principle that selectors are chosen from among the faithfulness constraints, a principle not accepted by Itô and Mester (to appear), who assume that all constraints are potential selectors.

Accepting McCarthy's principle leaves us with two choices: IDENT$_{IO}$([+anter]) and IDENT$_{IO}$([−back]), since these are the only faithfulness constraints in (62). IDENT$_{IO}$([+anter]) would not be a good choice. It is violated by (62a) and (62b), so the selection is limited to (62c) and (62d), of which (62c) has a smaller number of violations and hence would become the sympathetic base. But this choice makes things worse rather than better. Candidate (62c), [pa:n+a], is exactly the candidate that we are trying to ban. Giving it the special status of the sympathetic base would be counterproductive. Consequently, IDENT([−back]) must be the selector. Now everything works. Candidates (62a) and (62c), [pa:ɲ+a] and [pa:n+a], respectively, are not considered as contenders for the sympathetic base because they violate the selector. Of the remaining candidates, (62b) fares better than (62d) as it has only one violation of the high-ranking constraints. It is therefore [pa:ɲ+æ] that is our sympathetic base.

We need two further assumptions. First, I introduce ✿IDENT([−back]), a faithfulness constraint that measures violations between the sympathetic base, marked ✿, and the candidates submitted by Gen. Second, ✿IDENT([−back]) must be ranked below *æ*-BACKING but above IDENT$_{IO}$([−back]), which measures violations between the underlying representation and these candidates. The analysis is given in (63), which is the only relevant evaluation. Emphatically, the evaluation in (62) is not part of the grammar; hence, there are no derivational steps. We used (62) only as a worksheet to aid us through the reasoning leading to the discovery of the sympathetic base.

(63) underlying representation //n+æ// *páň+a* 'master' (dimin.)
sympathetic base ✿[ɲ+æ]

	PALATALIZATION	*æ*-BACKING	✿IDENT ([−back])	IDENT ([−back])	IDENT ([+anter])
☞ a. ɲ+a			*	*	*
b. ɲ+æ		*!			*
c. n+a			**!	*	
d. n+æ	*!	*	*		

The analysis of *riasa* 'cassock' is parallel to the analysis of *páň+a* just presented. To save space, I will not go through all the reasoning. Recall (see section 3) that the problem is how to exclude [ra:sa] and obtain [riasa], the correct surface form. With the underlying representation being //ræ:sa//, both of these candidates violate IDENT$_{IO}$([−back]), but [ra:sa] fares better since it avoids violating NO-DIPH. The solution is to pick [riæsa] as the sympathetic base, a decision that is made by IDENT$_{IO}$([−back]), which is the same selector as in (63). The sympathetic IDENT

constraint is also the same: *IDENT([− back]). For compactness, I minimize the representations in (64) and look at the first syllable only.

(64) underlying representation //r æ:// *riasa* 'cassock'
sympathetic base *[riæ]

	*[æ:]	*æ*-BACKING	ONSET	*IDENT ([–back])	IDENT ([–back])	NO-DIPH
☞ a. r i a (N)				*	*	*
b. r æ: (N)	*!	*				
c. r i æ (N)		*!				*
d. r a: (N)				**!	*	
e. r i æ (N N)		*!	*			
f. r i a (N N)			*!	*	*	

*IDENT([− back]) is crucial in (64) because it distinguishes between [ria] (64a) and [ra:] (64d). When compared to the sympathetic base *[riæ], which has two occurrences of [− back], [ria] incurs only one violation of *IDENT([− back]) because only the [a] segment is unfaithful. In contrast, [ra:] incurs two violations because the base *[riæ] has two instances of [− back] and [ra:] has none.

I conclude that sympathy theory can deal successfully with the analysis of *pán̆ + a* and *riasa*, and, unlike DOT, it does so without derivational steps. However, this optimistic conclusion cannot be upheld when we look at evidence involving vowel sequences as well as glottal stop and glide insertion. Let us begin with the contrast *i.a* (vowel sequence) versus *ia* (diphthong).

Recall that the difference between *dialekt* [i.a] and *riasa* [ia] in Slovak is a function of NO-DIPH, which is ranked above ONSET at level 1 and reranked below ONSET at level 2 (see section 3). At level 1 the inputs are //ræ:sa// and //dialekt// for *riasa* and *dialekt*, respectively. The high-ranking V-NUC, which requires a [− cons] segment to be associated with the N node, mandates one nucleus in /ræ:/ but two in /dia/ because the latter has two [− cons] segments. Consequently, the output [di.a] violates ONSET (the *a* has no onset) but the output [ræ:] does not. The violation of ONSET is forced by the ranking NO-DIPH ≫ ONSET. This ranking has no effect on [ræ:], which has a long vowel and not a diphthong in the optimal output at level 1. With the reranking ONSET ≫ NO-DIPH at level 2, the optimal output for *riasa* is [riæ] because [ri.æ] violates ONSET. With regard to *dialekt*, the input to level 2 /di.a/ is faithfully preserved in the optimal output at this level by the undominated IDENT(Nuc). IDENT(Nuc) is mute on the change /ræ:/ → [riæ] because this change does not affect the nuclear configuration: in both /ræ:/ and [riæ] the nucleus dominates

two X-slots. Can this analysis be transferred into sympathy theory without a loss of generalization? The answer is negative.

If there is no derivational step, the only available ranking is ONSET ≫ NO-DIPH because only this ranking will give the correct output [ria.sa] rather than *[ri.a.sa]. But then, by the same token, *dialekt* will have the diphthong [ia] rather than the sequence [i.a]. To stop diphthongization in *dialekt*, we need to rank IDENT(Nuc) above ONSET. However, IDENT(Nuc) is mute if there is no derivational step because syllable nuclei are not encoded distinctively in the underlying representation. Sympathy theory has nothing to say about this analysis since the problem has nothing to do with surface opacity. Standard OT can rectify the situation by fixing the underlying representations. In particular, syllable nuclei must be crucially prespecified in the underlying representation, as only then can IDENT(Nuc) have the desired effect. However, prespecifying all nuclei results in a painful loss of generalization.[66] We lose all insight in this treatment of *dialekt* and *riasa* because we are just stating facts rather than explaining them. The prespecification of what are perfectly regular inputs is a heavy-handed manipulation of the underlying representation, as if we were dealing with exceptions.[67]

The inadequacy of standard OT and sympathy theory in particular is further demonstrated by glottal stop and glide insertion. Let us begin with Bulgarian, which is the simplest case.

Recall that a glottal stop is inserted to provide an onset in word-initial syllables such as *Amerika* [ʔa] 'America'. The [ʔ] persists in phrases, thereby leading to the creation of complex onsets: *v Amerika* [fʔa] 'in America'. I evaluate this phrase in (65). The idea is to look at all constraints that could be potentially relevant. I will not rank the constraints in order to see whether some manipulation of the ranking could help us with the analysis. I limit the evaluation in (65) to the relevant part of the string and treat it as a worksheet that will aid us in the process of discovering the sympathetic base.

(65) //v a//

	MAX(Seg)	ALIGN-L	ONSET	DEP(Seg)	*COMPLEX(Onset)
☞ a. va		*			
b. a	*		*		
c. ʔa		*		*	
d. fʔa		**		*	*

Given McCarthy's (1997, 1998) tenet that the selector must be a faithfulness constraint, the choice is between MAX(Seg) and DEP(Seg). If we choose the former, the competition for designation as

[66] The situation is not helped by Lexicon Optimization, which would show preference for underlying representations that contain all surface details, such as the allophonic facts and hence also the syllable structure. The point is that none of those should be *crucially* present in the underlying representation in the instances that fall under a generalization.

[67] Notice that the problem has nothing to do with the X-skeletal theory adopted in this article. Suppose that in spite of the counterevidence mentioned in section 2, we use a moraic skeleton. We then need to prespecify not only the moras but also the syllable nodes. The reason is that the difference between the *i.a* (sequence) and *ia* (diphthong) exists not at the moraic level of representation but at the syllable node level: two versus one σ. (Recall that diphthongs are heavy, that is, bimoraic, in Slovak; see footnote 15.)

the sympathetic base is between candidates (65a), (65c), and (65d), since (65b) violates the selector. If we choose the latter, the competitors are candidates (65a) and (65b). Candidate (65a) wins in either case because it has the smallest number of violations. It thus becomes the sympathetic base; but this makes things worse rather than better. There is no way in which analogizing to [va] (65a) can lead to selecting [fʔa] as the optimal output, and [fʔa] is the correct surface form.

The analysis cannot be repaired even if we relax McCarthy's tenet and assume with Itô and Mester (to appear) that not only faithfulness constraints but also markedness constraints can act as selectors. ONSET and *COMPLEX(Onset) converge on [va] as the sympathetic base, which is the same incorrect result. ALIGN-L would choose [a] as the base but, as with [va], this makes things worse rather than better.

A review of further options shows that the analysis could in fact be salvaged, but on two conditions. First, a new constraint must be introduced: POSITIVE-*ʔ* (''Have a glottal stop''), which must be available next to the already existing *[cg] that bans glottal stops. Second, this constraint is permitted to act as a selector, even though it is not a faithfulness constraint. Then, candidate (65c), [ʔa], would be the sympathetic base, since it fares better than candidate (65d).[68] With the addition of ✿IDENT([ʔ]) and the ranking MAX(Seg) ≫ ALIGN-L, [fʔa] would correctly be the winner. However, this analysis makes no sense, and it undermines the basic message of OT. The whole idea is that the occurrence of [ʔ] is forced by ONSET, which acts as a driving mechanism. Stipulating that words must have glottal stops loses this insight.

A similar problem is found in rural Polish. Recall that [j] is inserted word-initially to provide an onset in words such as *inny* [ji] 'another'. The phrase *z innym* 'with another' has [zji] and not [zi] as the initial syllable. Thus, in the ways that are relevant here, rural Polish is like Bulgarian, but the difference is that [j] is inserted rather than a glottal stop. For the analysis to work, sympathy theory would have to introduce yet another constraint: POSITIVE-*j* (''Have *j* before *i*'').[69] The objection here is the same as in the case of POSITIVE-*ʔ:* we should account for the occurrence of [j] rather than stipulate it. If posited, constraints such as POSITIVE-*ʔ* and POSITIVE-*j* would be an embarrassment and would deprive OT of all insight.

The Czech data combine the problems encountered in Bulgarian and Polish. Phrases such as *s idiotem* [sʔi.di.jo.tem] 'with the idiot' show both *ʔ*-insertion and *j*-insertion. Even the introduction of the rather absurd POSITIVE-*ʔ* and POSITIVE-*j* would be of no avail because there is no way of making sure that it is the [ʔ] (as in Bulgarian) rather than the [j] (as in rural Polish) that is inserted word-initially, and conversely, that it is the [j] rather than the [ʔ] that is inserted word-medially.

Finally, we must ask whether sympathy theory can deal with *w*-insertion in words of the *Papuas* 'Papuan' type in Polish (see section 6). The answer is negative. Making the failed candidate

[68] Candidates (65a) and (65b) are out of the race because they violate the selector (here the putative POSITIVE-*ʔ*).

[69] This is a particularly odd constraint since both [ji] and [wu] are highly marked structures for articulatory and acoustic reasons. (Thanks to a reviewer for drawing my attention to this point.) Thus, the reverse seems to be true: we might need the negative equivalent of POSITIVE-*j*: **ji* and **wu.* These are exactly the glide-vowel configurations that are avoided in Etsako and many other languages (Rosenthall 1994, based on Elimelech 1976), though not in Slavic languages.

[pa.pu.as] the sympathetic base would correctly predict that the *u* does not glide and hence [w] must be inserted. This would follow from the high-ranking $^{\bullet}$IDENT(Nuc). However, by the same token, [bi.o.lok], *biolog* 'biologist', would be the sympathetic base, but then $^{\bullet}$IDENT(Nuc) would select the incorrect output, that is, *[bi.jo.lok] rather than the actually attested [bjo.lok].

The difficulties encountered by OO theory and sympathy theory show that analogy, regardless of whether it is to a ''concrete'' base (an actually occurring word in OO theory) or to an ''abstract'' base (a failed candidate in sympathy theory), is not the correct strategy. Rather, we should recognize the possibility, afforded by DOT, that the analysis can proceed in steps.

10 Conclusion

The proposed analysis of glottal stop and glide insertion has shown that Optimality Theory needs to be modified to permit derivationalism, albeit on a limited scale. The modified framework, which I call Derivational Optimality Theory (DOT), is governed by the three principles in (66), all of which stem from the general philosophy of Occam's razor.

(66) a. *Level Minimalism*
The number of derivational levels is minimal.
b. *Reranking Minimalism*
The number of rerankings is minimal.
c. *Constraint Minimalism*
The number of constraints is minimal.

Of these three principles, Reranking Minimalism carries the clearest message: reranking of constraints comes at a cost and needs to be argued for.

Level Minimalism assigns cost to postulating intermediate levels. There is one exception, though: word level and postlexical (sentence) level should be regarded as available at no cost. These two levels are robustly substantiated by the languages considered in this article, which is not surprising because word phonology and sentence phonology have been viewed as distinct from time immemorial. I conclude that the word level and the sentence level are an integral part of the DOT model but additional levels require motivation.

McCarthy (1998) objects to any form of derivationalism in OT by pointing out that serial OT would create ''strata of convenience rather than a meaningful correlation of phonological and morphological factors'' (p. 10). This objection is not fully valid. The analysis I have proposed shows that either two or three levels are needed, depending on the language. If two levels are required, then the cut between level 1 and level 2 falls at the interface of word and sentence phonology, a classic example of ''meaningful correlation between phonological and morphological factors.'' Postulating an additional level may indeed lead to a breach between phonology and morphology. Thus, there may be two levels that encompass word phonology. However, this concession is not without its attractions. The upshot is that, as I have shown, OT auxiliary theories—in particular, OO theory, MAX(F) theory, and sympathy theory—become superfluous. Furthermore, given how productive and at the same time complex the phonologies of Slavic languages are, this level distinction is likely to gain support on a large scale from generalizations other than

those referring to glide and glottal stop insertion. For example, as is well known, yers have both triggering and blocking effects vis-à-vis processes such as word domain palatalization and assimilation (see Rubach 1986). These effects are found not only when yers vocalize (i.e., when they occur as regular vowels in output representations) but also when yers do not vocalize and hence are not represented on the surface. Level distinction opens the possibility of accessing the stage at which all yers are present, regardless of whether they will ultimately surface or not. Although the analysis of yer effects in OT awaits further research, the likelihood that it will provide massive support for level distinction is very high.

Unlike the other two principles, Constraint Minimalism might seem to be uncontroversial because it is not at odds with standard OT. However, both the current assumptions and the current practice of OT take this principle seriously only in the case of markedness constraints. Surprisingly, faithfulness constraints seem to be another matter. Both OO theory and sympathy theory have each independently doubled the number of these constraints. Given that it is unclear that sympathy theory can replace OO theory (Benua 1997), the current state of the matter is that every IO constraint entails both an OO constraint and a sympathetic constraint. The number of faithfulness constraints has thus been tripled.

The family of MAX(F) constraints cuts across the whole system in an independent way. Consequently, in addition to IDENT_{IO}(F), IDENT_{OO}(F), and $^{\clubsuit}$IDENT(F), we have MAX_{IO}(F), MAX_{OO}(F), and $^{\clubsuit}$MAX(F), where *F* can stand for any feature in the system or even any feature value, such as [− back] and [+ back], which give rise to independent constraints. This is a formidable number of constraints, and hence OO theory, sympathy theory, and MAX(F) theory gravely offend Constraint Minimalism. They also fail to account for glottal stop and glide insertion in Slavic languages. I conclude that these auxiliary theories should be rejected.[70]

Finally, McCarthy (1998) raises a general objection to serialism in OT by pointing out that nonsurface true and nonsurface apparent generalizations would be captured in two disparate ways: by constraint domination and/or by level ordering. This is true, but the alternatives available in current OT are even more problematic. I have reviewed three such alternatives: OO theory, MAX(F) theory, and sympathy theory. These face the same objection McCarthy raises against OT serialism: they are disparate mechanisms. Moreover, as mentioned earlier, these mechanisms are insufficient to handle all the data. The overall conclusion, then, is that we have two options: either we return to rules and reject OT altogether (the conclusion suggested to me by the reviewers) or we admit limited serialism in OT, as I have proposed.

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[70] See Idsardi 1997 for other arguments showing that sympathy theory should be rejected.

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