Impoverishment

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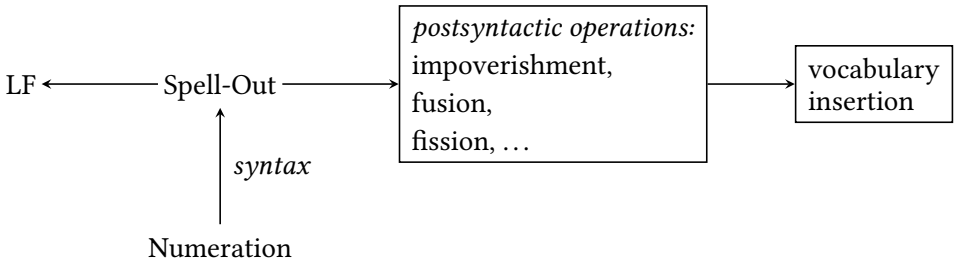
1. Introduction: Impoverishment and its effects

Impoverishment is one of the central postsyntactic operations employed in Distributed Morphology (DM). It was first proposed by Bonet (1991), and has been adopted, in varying forms, by much subsequent work (e.g., Noyer 1992, 1997, Halle and Marantz 1993, 1994, Halle 1997, Harris 1997, Bobaljik 2002, Frampton 2002, Harley 2004, 2008, Embick and Noyer 2007, Arregi and Nevins 2012). Broadly speaking, impoverishment is an operation that deletes morphosyntactic features postsyntactially, a process that affects morphological exponence in systematic ways. Impoverishment in this sense is made available by the core assumption in DM that morphology is postsyntactic, or realizational in Stump's (2001) terminology.[1] According to this assumption, syntax operates on abstract feature structures that lack phonological information.[2] This phonological information is added postsyntactically, at the PF branch of the grammar, a process called *vocabulary insertion*. Thus, in this view, morphology realizes, rather than forms, syntactic feature bundles. Impoverishment modifies the syntactic feature bundles at PF but prior to vocabulary insertion, thus affecting morphological exponence.

Impoverishment is part of a broader class of postsyntactic operations, which also encompasses fusion rules, fission rules, and the like, all of which modulate syntactic feature structures prior to vocabulary insertion. This general placement of impoverishment rules is depicted in (1).

(1) *Grammatical architecture assumed in Distributed Morphology*



[1] As a reviewer notes, presyntactic or lexicalist theories of morphology could in principle allow postsyntactic operations that delete exponents. Such operations would differ from impoverishment in a number of important respects, however. Because impoverishment deletes morphosyntactic features, not exponents, it does not necessarily result in the wholesale absence of an otherwise expected exponent. Instead, impoverishment frequently gives rise to the emergence to another overt exponent. Postsyntactic deletion of exponents are therefore more limited in their empirical scope: they could be used to reanalyze the effects of impoverishment only in cases it which an overt exponent disappears altogether, not cases in which one exponent is replaced by another.

[2] At least in the case of functional morphemes. For lexical morphemes, see Marantz (1996).

The placement of impoverishment in (1) has important consequences. While it applies before, and hence affects, vocabulary insertion, it is part of the PF branch of the grammar. Consequently, it affects neither the LF nor narrow syntax (though see section 4.1 for an alternative). Both syntax and semantic interpretation operate on complete, unimpoverished feature representations.

As a concrete example of an impoverishment rule, let us consider Norwegian adjectival inflection (Sauerland 1996, Harley and Noyer 2002). As in many other Germanic languages, adjectives inflect in either the strong or the weak inflection. The choice is conditioned by the determiner of the DP: the weak inflection is used if the D head of the DP that contains the adjective has an inflectional ending. The exponence in the two paradigms is provided in (2).

(2) *Adjectival inflection in Norwegian*

a. *Strong*

	[−neuter]	[+neuter]
SINGULAR	-∅	-t
PLURAL	-e	-e

b. *Weak*

	[−neuter]	[+neuter]
SINGULAR	-e	-e
PLURAL	-e	-e

We first consider the strong inflection in (2a). Here the distinction between [±neuter] gender is morphologically expressed in the singular but not in the plural. The standard analytical tool for syncretism of this sort in DM involves *underspecification* of and *competition* between vocabulary items (VIs). To illustrate, consider the three VIs in (3). The element to the left of the arrow represents the phonological information of the VI. The morphosyntactic features that this VI is associated with are given on the right.

(3) *Vocabulary items*

/-t/ ↔ [singular, +neuter]
/-∅/ ↔ [singular, −neuter]
/-e/ ↔ [ ]

Vocabulary insertion is determined by the *Subset Principle* (4) (also known as the *Elsewhere Condition* or *Pāṇini's Principle*), which imposes two requirements. First, only VIs whose morphosyntactic features form a subset of the features on a syntactic head may be inserted into this head (compatibility). Second, if more than one VI meets this requirement, then the most specific VI is chosen (specificity). One straightforward way of determining specificity is in

terms of feature cardinality (5): a VI with more morphosyntactic features is more specific than one with fewer (e.g., Halle 1997:428).[3]

(4) *Subset Principle*
A vocabulary item V is inserted into a functional head H iff (i) and (ii) hold:
(i) *Compatibility requirement:*
The morphosyntactic features of V are a subset of the morphosyntactic features of H.
(ii) *Specificity requirement:*
V is the most specific vocabulary item that satisfies (i).

(5) *Specificity*
A vocabulary item V_1 is more specific than a vocabulary item V_2 iff V_1 contains more morphosyntactic features than V_2.

Applied to (3), consider a syntactic head in the strong inflection that bears the features [singular, +neuter]. Both the morphosyntactic feature sets of /-t/ and /-e/ form a subset of this set and hence satisfy (4i). Because /-t/ is associated with more morphosyntactic features than /-e/ (i.e., [singular, +neuter] ⊃ [ ]), /-t/ is more specific and hence inserted.

(6) [singular, +neuter] $\xrightarrow[insertion]{vocabulary}$ /-t/

Impoverishment deletes morphosyntactic features on heads prior to vocabulary insertion. This has the effect that highly-specified VIs that would otherwise be inserted no longer fulfill the Subset Principle and that, as a result, a less specific VI is inserted instead. To illustrate, let us now turn to the weak inflection in Norwegian in (2b). Here, all number and gender distinctions are leveled, and the VI /-e/ is used throughout. Sauerland (1996) analyzes this shift as the result of an impoverishment that deletes the gender feature in weak environments, which we formulate in (7).[4]

(7) [±neuter] ⟶ ∅ / ___ [weak]

Consider again a syntactic head that bears the features [singular, +neuter] but this time in the weak inflection. Application of (7) yields the feature set [singular], to which vocabulary insertion applies. Out of the three VIs in (3), /-e/ is now the only one that fulfills the subset requirement (4i), and it is hence inserted.

[3] (5) defines specificity in terms of set cardinality. Alternatives include determining specificity through an extrinsic ordering of VIs (Bierwisch 1967, Halle 1994), by referring to a hierarchy of features (Lumsden 1992, Noyer 1992, 1997, Müller 2004), or some other metric (e.g., in Arregi and Nevins's 2012 account, context features take priority over other features).

[4] For the sake of simplicity, we formulate this rule in (7) with reference to a syntactically defined feature [weak] but this is an oversimplification. In fact, Sauerland (1996) argues against the existence of a feature [±weak]. As such, [weak] in (7) should be understood as an abbreviation for "in the context of a D that bears an inflectional ending."

(8) [singular, +neuter] $\overset{(7)}{\Longrightarrow}$ [singular] $\xrightarrow[insertion]{vocabulary}$ /-e/

More generally, because both /-t/ and /-∅/ are specified for gender, the application of (7) bleeds the insertion of both. This accounts for their complete absence in the weak inflection. The key effect of impoverishment is thus a syncretism pattern in which a highly specified VI is replaced by a more general one (a result that Halle and Marantz 1994 refer to as a "retreat to the general case"). Put differently, impoverishment results in the *neutralization* of a contrast: the gender distinction present in the strong inflection is neutralized in the weak inflection, leading to the systematic absence of gender distinctions.

All else equal, it is possible to emulate the effects of the impoverishment rule (7) through a more detailed specification of the VIs in (3). If both /-t/ and /-∅/ additionally bore the feature [strong], then their distribution would be confined to the strong inflection without recourse to impoverishment. The principal disadvantage of such an account is that it treats the overarching generalization that the weak inflection is morphologically poorer than the strong inflection as an accident. It would be simply a coincidence that Norwegian has VIs that are limited to the strong inflection but no VIs that are limited to the weak inflection. An impoverishment analysis provides a more principled account of the asymmetry: because (7) deletes feature distinctions, fewer morphological distinctions can be drawn in the weak inflection. Specifically, because (7) neutralizes the [±neuter] distinction in the weak inflection at the level of the morphosyntactic features, there is no possible specification of VIs that would give rise to gender distinctions in the weak inflection. As such, an impoverishment account states the generalization at a level that is more abstract—and hence more general—than the individual VIs involved.

This generality has an important consequence. Syncretism that is brought about by impoverishment differs from syncretism that is the result of simple underspecification of VIs in that it is independent of the individual VIs, and hence system-wide. We illustrate this property using the syncretism between 1PL and 3PL in German verb inflection. As shown in (9), the two cells are syncretic not only in the regular conjugation paradigm (9a), but also in irregular paradigms like that of the verb *werden* 'will' in (9b), or the suppletive paradigm of the verb *sein* 'be' in (9c), as well as all other verbal inflection patterns.

(9) *German verb inflection* (present tense)

a. *Regular inflection*

	SINGULAR	PLURAL
1	-e	**-en**
2	-st	-t
3	-t	**-en**

b. *werden* 'will'

	SINGULAR	PLURAL
1	werde	**werden**
2	wirst	werdet
3	wird	**werden**

c. *sein* 'be'

	SINGULAR	PLURAL
1	bin	**sind**
2	bist	seid
3	ist	**sind**

The 1PL–3PL syncretism is thus independent of the specific VIs that realize it for specific verbs. It is possible to implement such meta-syncretism via piecemeal underspecification of individual VIs, but doing so would fail to express the generality of the syncretism in a principled way (Williams 1994, Bobaljik 2002, Harley 2008). As Bobaljik (2002) points out, impoverishment offers a more systematic account. Consider the impoverishment rule in (10), which deletes a 1st or 3rd person feature in the context of a plural feature on T. As shown in (11), this process neutralizes the person distinction between 1PL and 3PL on the syntactic head that is subsequently targeted by vocabulary insertion. As a result, the morphosyntactic features that condition vocabulary insertion are identical in the two cases (i.e., just [PL]), and whatever VI is inserted into one is necessarily also inserted into the other and vice versa, regardless of the specification of the VIs. This captures the pervasive syncretism pattern in (9) (also cf. Frampton 2002 and Müller 2006b).[5]

(10) $[1]/[3] \longrightarrow \emptyset \,/\, T_{[\_\_,\ PL]}$

(11) a. $1PL\ T\ [1, PL] \overset{(10)}{\Longrightarrow} [PL]$

b. $3PL\ T\ [3, PL] \overset{(10)}{\Longrightarrow} [PL]$

In sum, impoverishment neutralizes feature distinctions postsyntactically, which leads to insertion of a more general VI and results in system-wide syncretism patterns. Relatedly, Frampton (2002) argues that syncretism that is the result of impoverishment is diachronically more stable than syncretism that results from underspecification of VIs.

A second consequence of impoverishment noted by Bobaljik (2002) is that it may obviate the need for an extrinsic ordering of exponents. Bobaljik (2002:57) considers the Russian

[5] As it stands, the formulation of the rule in (10) is really an abbreviation for two rules—one that deletes [1] on T, and one that deletes [3] on T. It is possible to combine both cases into a single rule if person features are decomposed. For example, if person features are decomposed into [±1], [±2], one could replace (10) with (i), which deletes [±1] on T in the context of [−2, PL], leaving only the latter.

(i) $[\pm 1] \longrightarrow \emptyset \,/\, T_{[\_\_,\ -2,\ PL]}$

pronominal declension in (12). Gender distinctions are expressed in the singular but leveled in the plural.

(12) *Russian 3rd person nominative pronouns*

	SINGULAR	PLURAL
MASCULINE	on	on-i
FEMININE	on-a	on-i
NEUTER	on-o	on-i

This is a meta-syncretism in the sense above, i.e., it also holds for other pronominal paradigms (e.g., nonnominative forms). Bobaljik (2002) proposes that it is the result of the impoverishment rule in (13).

(13) [gender] $\longrightarrow \emptyset$ / ___ [PL]

Apart from expressing the generality of the neutralization of gender distinctions in the plural, Bobaljik (2002) notes that (13) also resolves a problem with vocabulary insertion. He suggests the set of VIs in (14).

(14) *Russian vocabulary items*

/-i/ $\leftrightarrow$ [plural]
/-a/ $\leftrightarrow$ [feminine]
/-o/ $\leftrightarrow$ [neuter]
/-∅/ $\leftrightarrow$ [ ]

Without the impoverishment rule in (13), the VIs in (14) give rise to indeterminacy. Given an input feature set [feminine, plural], both /-a/ and /-i/ satisfy the subset requirement (4i). But at least in terms of feature cardinality, neither is more specific than the other. To trigger insertion of /-i/ over /-a/, some additional ordering would need to be imposed (e.g., by referring to a hierarchy of features such that realization of number trumps realization of gender). Bobaljik (2002) points out that no such device is necessary if the impoverishment rule in (13) is in place. Because this rule changes [feminine, plural] to [plural], only /-i/ fulfills the subset requirement, and no further mechanism is required to determined the output of vocabulary insertion.

A third important difference between an analysis that employs impoverishment and one that only avails itself to underspecification and competition is that there are syncretism patterns that resist the latter type of analysis but not one in terms of impoverishment. Harley (2008:269–274) discusses case marking on nouns and 1st and 2nd person pronouns in the Mongolian language Baoan, shown in (15).[6] Here, genitive is consistently realized by *-ne*, and dative/locative by *-de*. On nouns, the accusative form is syncretic with the genitive form; on pronouns, accusative is syncretic with the dative/locative.[7]

[6] Other cases, which do not employ *-ne* or *-de*, are not shown in (15).

[7] Baerman, Brown and Corbett (2005:136–139) refer to this kind of syncretism pattern as "convergent bidirectional syncretism."

(15) *Baoan case suffixes*

	NOUN	1/2 PRONOUN
GENITIVE	-ne	-ne
ACCUSATIVE	-ne	-de
DATIVE/LOCATIVE	-de	-de

Harley (2008) shows that a purely underspecification-based analysis is unable to capture this syncretism pattern. Either *-ne* is the elsewhere marker (accounting for the syncretism in the nominal pattern), but then the spreading of *-de* on pronouns is surprising; or *-de* is the elsewhere marker, in which case the spreading of *-ne* with nouns is unaccounted for. Harley's (2008) analysis of this pattern involves decomposing the case features as in (16), the VI specifications in (17), and the impoverishment rule in (18).

(16) *Case decomposition*
GENITIVE: [+structural, −dependent, +oblique]
ACCUSATIVE: [+structural, +dependent, −oblique]
DATIVE: [−structural, +dependent, −oblique]

(17) *Vocabulary items*
/-ne/ ↔ [+structural]
/-de/ ↔ [+dependent]

(18) *Impoverishment rule*

$$\begin{bmatrix} \text{+structural} \\ \text{+dependent} \\ \text{−oblique} \end{bmatrix} \rightarrow \begin{bmatrix} \text{+dependent} \\ \text{−oblique} \end{bmatrix} \Big/ \begin{matrix} \text{D}^0 \\ \text{[+participant]} \end{matrix} \_\_$$

For genitive and dative case, only /-ne/ and /-de/ fulfill the subset requirement, respectively. For accusative case on nouns, where both /-ne/ and /-de/ are applicable, an extrinsic ordering determines that /-ne/ wins out. In the case of accusative 1st or 2nd person pronouns, the impoverishment rule (18) applies, deleting [+structural]. This change bleeds the insertion of /-ne/, leaving only /-de/, which is hence inserted. The syncretism pattern in (15) is thus the result of impoverishment-induced spreading of a default form.

From a more general perspective, impoverishment is involved both in *transparent* and *opaque* rule interaction (Kiparsky 1973, Chomsky 1975). On the one hand, it transparently bleeds the insertion of the maximally specific compatible VI and transparently feeds the insertion of a more general compatible VI. On the other hand, impoverishment gives rise to opacity since it counter-bleeds syntactic processes that depend on the features it deletes (and potentially counter-feeds syntactic processes that depend on the absence of the features it deletes). We will return to these issues in section 4.1 below.

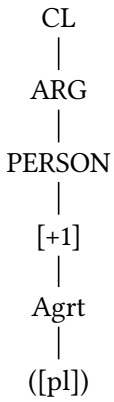
2. Implementations of impoverishment

The preceding section presented the general effects of impoverishment rules within DM. The actual theoretical implementation so far involves rules that delete a given feature in the context of other features. The literature on impoverishment offers a varieties of alternative implementations of impoverishment. Many of these implementations impose immediate empirical restrictions on the expressive power of impoverishment and derive that only certain impoverishment patterns are attested. This section presents on overview of such implementations and their empirical consequences.

2.1. Delinking in feature hierarchies

In her seminal work that, among other things, first proposed impoverishment, Bonet (1991) also notes asymmetries in the direction of feature neutralizations. She proposes a theory in which features are organized in hierarchies (also see Harley and Ritter 2002) and deletion is the result of autosegmental delinking. As an example, Bonet (1991) analyzes syncretism patterns in reflexives and notes that there is an asymmetry: languages might neutralize (some) person distinctions in the plural and maintain them in the singular, but no language neutralizes person distinctions in the singular that are present in the plural. In Walbiri, for instance, the 1SG form of the reflexive is *-tju* and all other cells are realized by the invariant marker *-njanu* (Hale 1973:337, Bonet 1991:28). Put differently, the distinction between 1st person and non-1st person is drawn only in the singular, not the plural. Bonet (1991:33–36) analyzes this pattern in terms of impoverishment, brought about by delinking. She proposes that the 1SG reflexive *-tju* realizes the feature structure in (19a). The default reflexive form *-njanu* realizes the hierarchy in (19b).

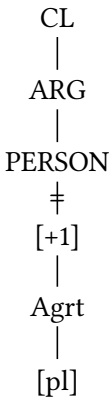
(19) a. *-tju:*



b. *-njanu:*

Note that (19a) is compatible with both 1SG and 1PL reflexives. The fact that it does not appear in 1PL forms is the result of delinking as in (20). After delinking, the specification in (19a) no longer forms a subset of (20), and the default form (19b) is employed instead.

(20) *Delinking in 1PL:*



As Bonet (1991) emphasizes, this analysis accounts for the asymmetry just noted. Because by assumption, singular is represented as the absence of the feature [pl], it is possible for person delinking to apply only in the plural (i.e., by making this delinking rule sensitive to the presence of [pl]), but it is not possible to let delinking apply solely in the singular. As a consequence, languages may neutralize person distinction in the plural, but no language neutralizes person distinctions in the singular without also doing so in the plural. See Harley (1994) for additional discussion and application of a delinking theory of impoverishment.

That said, this account still contains a potential loophole. Because syncretism can in principle be the result of impoverishment or simple underspecification of VIs, restricting impoverishment does not constrain the range of syncretism patterns that are the result of underspecification. With respect to the case at hand, if [1PL] configurations got mapped to a specific VI and all other configurations got mapped to a default VI, the system would contain a person distinction in the plural but not the singular. Because this syncretism does not result from impoverishment, constraints on impoverishment do not bear on it. As far as we can tell, this is a general property of analyses that allow syncretism through underspecification of VI.[8]

2.2. Feature-cooccurrence restrictions

Noyer (1992, 1997) argues that the use of geometric feature representations is unsuitable to account for attested neutralization patterns. He proposes that impoverishment is the result of feature-cooccurrence restrictions (see Gazdar et al. 1985), which are taken to be universal but can be turned on or off in individual languages. Consider as an example the Arabic conjugation paradigm in (21), from Noyer (1992:40), ignoring dual forms.

[8] Still, assuming that systematic patterns of syncretism, which involve an identical behaviour of several morphological exponents, always suggest impoverishment rather than mere underspecification of vocabulary items, Bonet's approach can at least derive that there will be no *systematic* neutralization of person in the singular that is absent from the plural.

(21) *Arabic prefix conjugation (k t b* 'write')

	SG	PL
1	ʔ-aktub-u	n-aktub-u
2MASC	t-aktub-u	t-aktub-uuna
2FEM	t-aktub-iina	t-aktub-na
3MASC	y-aktub-u	y-aktub-uuna
3FEM	t-aktub-u	y-aktub-na

One generalization is that there are no gender distinctions in the 1st person. Noyer (1992, 1997) proposes that this is the result of a prohibition against the cooccurrence of a 1st person feature and a feminine feature (*[1 feminine]). Feature deletion is employed to circumvent this restriction (constraint-driven impoverishment is also envisaged by Bonet 1991:156). Which of the two features is deleted is determined by the universal hierarchy of features in (22), from Noyer (1992:46, 1997:lxxvii). Because [feminine] is ranked lower than [1], it is [feminine] that is deleted to satisfy *[1 feminine].

(22) 1 > 2 > plural > dual > feminine

Noyer (1992, 1997) furthermore provides arguments that this hierarchy cannot be reduced to a geometric representation of morphosyntactic features, though see Harley (1994) for a reappraisal.

The hierarchy-driven view of impoverishment renders impoverishment rules asymmetric. Given a hierarchy of features $\alpha > \beta$, it is possible to delete β in the context of α (23a), but deletion of α in the context of β is ruled out (23b).

(23) a. $\beta \rightarrow \emptyset$ / ___ α
b. $^{*}\alpha \rightarrow \emptyset$ / ___ β

2.3. Morphotactic filters

The view that impoverishment is triggered by feature-cooccurrence restrictions is further developed in much detail by Arregi and Nevins (2012). As part of a detailed study of the morphology of auxiliaries across Basque dialects, Arregi and Nevins (2012) develop a fine-grained theory of impoverishment operations. One of their key findings is that impoverishment rules across Basque dialects vary considerably over the structural change they bring about, but are fairly stable in the structural description that triggers them. In the spirit of Noyer (1992, 1997), they propose that impoverishment applies in response to markedness constraints, viz., feature-cooccurrence restrictions. These markedness constraints thus determine when impoverishment will apply and thereby determine the structural description of impoverishment rules. They argue that these constraints (and hence the structural descriptions of the impoverishment rules) are robust across Basque dialects, but that there is significant crossdialectal variation in how violations of these markedness constraints are repaired, hence in the structural change brought about by specific impoverishment operations across dialects. For ex-

ample, Arregi and Nevins (2007, 2012) observe a constraint against two [+participant] clitics within an auxiliary M-word (roughly, a complex X^0).

(24) *Syntagmatic Participant Markedness*
An auxiliary M-word cannot contain two clitics Cl_1 and Cl_2 such that Cl_1 is specified as [+participant, Φ] and Cl_2 is specified as [+participant, Ψ] (where Φ and Ψ range over dialect-particular feature sets). [Arregi and Nevins 2012:214]

Arregi and Nevins (2007, 2012) document a variety of impoverishment responses that various dialects employ to circumvent a violation of (24). In some dialects, the [+participant] feature on one of the two clitics is impoverished. In others, one of the two clitics is deleted altogether (a process that Arregi and Nevins 2007, 2012 refer to as *obliteration*, for which see section 3.1). They conclude that impoverishment operations are crossdialectally variable repairs to crossdialectally stable morphological markedness constraints.

Arregi and Nevins (2012) also document feeding and bleeding relations that can arise between impoverishment rules. As an example of the latter, the Ondarru dialect of Basque employs the rule in (25), which deletes a 1st person clitic in the context of a [+participant] ergative clitic. Note that the structural description in (25) corresponds to the configurations ruled out by the constraint in (24).

(25) *1PL obliteration in Ondarru Basque*

a. Structural description: an auxiliary M-word with two clitics Cl_1 and Cl_2 such that Cl_1 is [+participant, +author] and Cl_2 is [ergative, +participant].

b. Structural change: delete Cl_1. [Arregi and Nevins 2012:216]

Due to the presence of another operation, first singular clitic impoverishment in (26), the feature [+participant] is deleted on 1SG clitics. Because (26) is ordered before (25), a clitic to which (26) has applied no longer violates the constraint in (24). The rule in (25) therefore no longer applies, effectively limiting the application of (25) to 1PL clitics.

(26) *First singular clitic impoverishment*

a. Structural description: a clitic Cl specified as [+participant, +author, +singular]

b. Structural change: delete [+participant] in Cl [Arregi and Nevins 2012:214]

Arregi and Nevins (2012) impose additional constraints on the expressive power of impoverishment rules. First, they argue that impoverishment applies before linearization. This implies that impoverishment operations cannot be sensitive to linear-order information. Second, they propose that while impoverishment rules can be triggered by features on other syntactic terminals (like the participant dissimilation rules above, which only apply if two clitics cooccur), they may only be sensitive to elements within the same M-word, roughly the complex syntactic head. As such, impoverishment rules are quite local on this view.[9]

[9] Also see Halle and Marantz (1993:162), who propose that impoverishment on head H_1 can only be conditioned by a structurally adjacent head H_2 that governs H_1.

2.4. Markedness constraints

A prevalent assumption underlying the proposals discussed in the previous subsections is that certain kinds of features in certain kinds of environments may qualify as illegitimate in the morphological component of some language, and that these features may therefore have to be deleted by impoverishment operations. On this view, impoverishment emerges as a *repair*, or *last resort* operation. Such a repair remains implicit in Arregi and Nevins's (2012) approach, where impoverishment is implemented by a deletion transformation (with the illicit context in need of repair encoded in the structural description of the transformation); but it is more or less explicitly presupposed in Noyer's (1992) and Bonet's (1991) approaches. That said, it is not actually clear how the concept of repair can be reconciled with standard assumptions about the nature of grammar as they are adopted in DM: a repair operation, by its very nature, must come at a price; it can only apply to remove some illicit configuration and must be precluded from pxapplying in other contexts (e.g., [feminine] is deleted in 1st person environments in the analysis of the Arabic prefix conjugation proposed by Noyer 1992, but not in, say, 2nd person environments). Closer inspection reveals that even though the concept of repair (or last resort) has been widely adopted in this general approach to morphology and syntax, there are hardly any full-fledged proposals that formally integrate it.[10]

Against this background, it is worth noting that the concept of repair is inherent to optimality theory (OT; Prince and Smolensky 1993/2004): a lower-ranked constraint B can only be violated by a grammatical candidate if this is the only way to respect a higher-ranked constraint A. Accordingly, it does not come as a suprise that there are quite a few OT approaches to inflectional morphology that rest on constraint interactions giving rise to impoverishment effects. Assuming as before a realizational approach to (inflectional) morphology (see Stump 2001), OT approaches postulate a higher-ranked markedness constraint (or, sometimes, a set of constraints) A which precludes certain features in certain environments from being realized by a morphological exponent, and a lower-ranked faithfulness constraint B which demands such realization (but has to be violated in the optimal output, thus yielding the repair/last resort profile).

Closer inspection reveals that two different kinds of OT approach to impoverishment effects can be distinguished that both instantiate this general pattern; let us call them *direct analysis* and *indirect analysis*. An indirect analysis works more or less like the DM approaches just discussed: A (set of) higher-ranked markedness constraint(s) A bans the presence of some feature, and given that the faithfulness constraint that requires this feature to be present is lower-ranked, the feature is deleted, and consequently inaccessible for subsequent realization by an inflectional exponent (which may then proceed exactly as standardly assumed in DM). The indirect approach to impoverishment in OT presupposes an architecture of grammar as in DM. There has to be a level of representation that follows syntactic operations but precedes morphological exponence; this level is subject to optimization based on the ranking A $\gg$ B. Thus, the relation between the features of syntactic contexts and the (typically underspecified) features of morphological exponents is an indirect one, mediated by actual feature

[10] Goal-driven rules (also known as defect-driven rules) as developed by Frampton (2008, 2009) potentially qualify as a relevant candidate.

deletion. In contrast, a direct approach to impoverishment effects in OT does not postulate an intermediate level where features of the syntactic environment are deleted. Here, a (set of) constraint(s) A does not per se ban the presence of some feature in the environment, but rather its realization by morphological exponence in output forms; similarly, B is viewed as a constraint that directly demands the realization of this feature. In a nutshell, then, the difference between the two approaches is this: If one wants to ensure that an exponent α cannot realize a certain feature X, this can be achieved either by explicitly prohibiting exponence of X (direct analysis), or by removing X (indirect analysis).[11] In what follows, we will address the two approaches in turn, starting with the direct approach because this has been much more widely pursued in OT.

2.4.1. Direct OT analyses

In OT approaches to inflectional morphology, the compatibility and specificity requirements that together constitute the Subset Principle (cf. (4i), (4ii)) are typically taken to follow from independently motivated faithfulness constraints (Grimshaw 2001, Trommer 2001, Stiebels 2006): First, IDENT constraints block non-matching feature values of syntactic context (or paradigm cell) and inflectional exponent, and DEP constraints militate against morphosyntactic features on the exponent that are not present in the syntactic context (paradigm cell); a high ranking of these constraints derives the compatibility requirement. And second, MAX constraints demand features of the syntactic environment to be realized by the inflectional exponent, thereby producing specificity effects. Thus, selection of the most specific compatible exponent is accomplished purely by high-ranked faithfulness constraints relating features of the syntactic context with features of the inflectional exponent. However, suppose now that there is a higher-ranked markedness constraint which precludes the realization of features of the syntactic environment by morphological exponents. In that case, an impoverishment effect will be automatically derived.

As a simple example, consider again the case of strong and weak adjectival inflection in Norwegian (cf. (2)). To see how Sauerland's (1996) approach based on a postsyntactic impoverishment rule can be faithfully transferred to a direct OT analysis, let us maintain all substantial assumptions of the original analysis; in particular, let us assume that the feature specifications of the inflectional exponents are those in (3), and that the source of the strong/weak asymmetry is that [±neuter] cannot be realized in weak syntactic contexts. In the original analysis, this is brought about by an impoverishment rule that deletes [±neuter] in this environment (cf. (7)). In a direct OT reconstruction, the markedness constraint in (27) can be postulated instead.

(27) *[±neuter] / ___ [weak]

If (27) outranks MAX(Neut) (which demands that a [±neuter] feature of the syntactic contexts is realized by the inflectional exponent), the optimal output will fail to bear [±neuter] (i.e., both

[11] To use an analogy from real life: If the Federal Railway Authority wants to ensure that some place cannot be reached by train anymore, they can either revoke the permission and block all railroad companies from operating the route by decree (direct strategy), or they can have the tracks removed (or rendered inoperable), in which case the question of legitimate service becomes moot (indirect strategy).

/-t/ and /-∅/ will be blocked), and a retreat to the general case is effected (i.e., the elsewhere exponent /-e/ will become optimal). The tableau in (28) illustrates the competition in a strong neuter singular context, where the markedness constraint (27) is vacuously satisfied.[12]

(28) *Strong adjectival inflection in Norwegian: neuter singular*

I: [sing], [+neut], [strong]	IDENT	DEP	*[±neut]/ __ [weak]	MAX (sing)	MAX (neut)
☞ O_1: /-t/↔[sing,+neut]					
O_2: /-∅/↔[sing,–neut]	*!				
O_3: /-e/↔[ ]				*!	*

In (28), O_1 (/-t/) is optimal because it maximally satisfies both compatibility (IDENT, DEP) and specificity (MAX); O_2 (/-∅/) is blocked because of a fatal compatiblity (IDENT) violation; and O_3 is blocked because of a fatal specificity violation (the elsewhere exponent /-e/ realizes neither [singular], nor [+neuter], in violation of both MAX(sing) and MAX(neut)). It can easily be verified that the system also correctly predicts the optimal output in the other strong contexts, with non-neuter singular inputs (where /-∅/ emerges as optimal) and with plural inputs (where /-e/ is the only exponent that can satisfy IDENT and DEP).

A different picture emerges in weak contexts, where the markedness constraint (27) becomes active, and where the otherwise expected exponent /-t/ fatally violates this constraint (as does, irrelevantly, the exponent /-∅/ that continues to fatally violate IDENT). As shown in (29), the MAX violations incurred by the elsewhere marker /-e/ are now tolerable in the optimal output. More generally, it is clear that /-e/ is correctly predicted to be optimal in all weak contexts.

(29) *Weak adjectival inflection in Norwegian: neuter singular*

I: [sing], [+neut], [strong]	IDENT	DEP	*[±neut]/ __ [strong]	MAX (sing)	MAX (neut)
O_1: /-t/↔[sing,+neut]			*!		
O_2: /-∅/↔[sing,–neut]	*!		*		
☞ O_3: /-e/↔[ ]				*	*

Direct OT approaches to impoverishment effects along these lines have been developed by Grimshaw (2001), Kiparsky (2001), Trommer (2001, 2003b), Don and Blom (2006), Wunderlich (2001, 2004), Opitz (2008), and Lahne (2009), among others. In what follows, we consider two case studies, from Trommer (2003b) and Don and Blom (2006).

Impoverishment effects in Ainu argument encoding. Trommer's (2003b) analysis of subject and object agreement in Ainu envisages two kinds of impoverishment effects: on the one hand, there can be participant reduction in certain configurations, such that only one of the

[12] Some remarks on notation. Here in and what follows, "I" stands for the input (which for present purposes we can assume to be a syntactic context in need of morphological realization), "O_i" stands for a competing output exponent, ☞ represents the optimal exponent, and "!" signals a fatal violation incurred by an output exponent.

two core arguments can be encoded by agreement morphology on the verb, and on the other hand, in particpant reduction scenarios, a more general exponent must be used than one might initially expect. A first markedness constraint that is relevant is Participant Uniqueness (PU) in (30).

(30) *Participant Uniqueness (PU)*
For two adjacent [−3] agreement heads in the input, number is not expressed in the output.

PU is a two-level markedness constraint, in the sense that both input and output properties must be taken into account. In transitive scenarios with two speech act participants, PU precludes the use of exponents bearing a number feature. Relevant data illustrating the effect of participant reduction with subject nand object agreement in Ainu are given in (31) and (32). In 2⟶1 environments such as (31a) and (31b), both an exponent encoding the external argument and an exponent encoding the internal argument can appear. In contrast, in all 1⟶2 environments, there is an effect of participant reduction: Only the single exponent /eci/ can show up here; cf. (32).

(31) a. eci-un-kore
2-acc.1.pl-give
"You (pl) give us"

b. e-en-kore
2.sg-acc.1.sg-give
"You (sg.) give me"

(32) a. *ci-e-kore
1.nom.pl-2.sg-give
'We give you(sg)'

b. eci-kore
2-give
'We give you(sg)'

The emergence of *eci-* does not seem to be not the result of inverting the two prefixes because it arises in all 1⟶2 configurations, regardless of what the otherwise expected exponents are, as shown in (33).

(33) **ku-e-* 'I-you.sg' **ci-e-* 'we-you.sg'
**ku-eci-* 'I-you.pl' **ci-eci-* 'we-you.pl' ⟹ *eci-*

Trommer (2003b) accounts for this pattern by postulating an interaction of (relativized) Max constraints on the one hand, and markedness constraints on the other hand: first, left-alignment constraints for exponents bearing [+nom] and [+2], and second, a low-ranked PU.[13] The specifications for the relevant inflectional exponents are given in (34). Importantly, /eci/ does not realize number (unlike the other exponents in (34)), and so use of /eci/ does not violate PU.

[13] The relativized Max constraint $\text{Max(Per)}_{[+2]/[+1]}$ is violated if the person feature of a [+2] argument of the syntactic context is not realized by an exponent in the presence of a [+1] that is also present in the syntactic context; it is not violated if there is no [+1] feature present; similarly, $\text{Max(Num)}_{[+1]/[+2]}$ demands realization of the number feature of a [+1] argument in the presence of a [+2] argument; etc. Also note that [*+h(igh)*] in (35) and (36) stands for an external argument of a transitive V or an internal argument of an intransitive (unaccusative) V, whereas [*+l(ow)*] stands for an external argument of an intransitive (unergative) V or an internal argument of a transitive V (see Trommer 2003b:103).

(34) *Vocabulary items*

/en-/ ↔ [+1+acc−pl]
/ci-/ ↔ [+1+nom+pl]
/ku-/ ↔ [+1+nom−pl]
/eci-/ ↔ [+2]
/e-/ ↔ [+2−pl]

The tableau in (35) illustrates the a priori expected situation in (31b) where there is no participant reduction effect.

(35) *2⟶1 contexts: no participant reduction*

I: [+nom+2−pl]$_1$, [+acc,+1−pl]$_2$	Max (Per)$_{[+2]/[+1]}$	L⇐ [+nom]	L⇐ [+2]	Max (Num)$_{[+1]/[+2]}$	Max(Num) $_{[+2+h]/[+1+l]}$	P U	Max [F]
O_1: eci$_1$ en$_2$					*!	*	**
☞ O_2: e$_1$ en$_2$						**	*
O_3: en$_1$ eci$_2$			*!		*	*	**
O_4: en$_1$ e$_2$			*!			**	*
O_5: en$_1$	*!				*	*	***
O_6: eci$_2$				*!	*		*****
O_7: e$_2$				*!		*	****

In (35), high-ranked left-alignment constraints are active for both the feature [+nom] and the feature [+2]. However, these two features characterize one and the same argument, viz., the external one. It is therefore unproblematic to realize them both via left-alignment of a particular exponent (/e/). The exponent faithfully encoding the remaining argument (/en/) can fail to be left-aligned without problems.

The competition in the more interesting scenario of participant reduction in 1⟶2 environments (cf. (32)) is shown in (36).

(36) *1⟶2 contexts: participant reduction*

I: [+nom+1+pl]$_1$, [+acc,+2−pl]$_2$	Max (Per)$_{[+2]/[+1]}$	L⇐ [+nom]	L⇐ [+2]	Max (Num)$_{[+1]/[+2]}$	Max(Num) $_{[+2+h]/[+1+l]}$	P U	Max [F]
O_1: e$_2$ ci$_1$		*!				**	**
O_2: eci$_2$ ci$_1$		*!				*	**
O_3: ci$_1$ eci$_2$			*!			*	**
O_4: ci$_1$ e$_2$			*!			*	**
O_5: ci$_1$	*!					*	**
☞ O_6: eci$_2$				*			**
O_7: e$_2$				*		*!	**

In (36), the features [+nom] and [+2] characterize two different arguments in the input; and consequently (since there is no suitable portmanteau exponent) they are located on two different exponents. It is therefore impossible to satisfy both these constraints in an output; and

since the requirement that 2nd person information is realized in the presence of a 1st person argument is highest-ranked, the optimal output will be /eci/; /eci/ realizes [+2] at the cost of violating lower-ranked MAX(Num)$_{[+1]/[+2]}$, which demands realization of the number of a 1st person argument in the presence of a 2nd person argument. In this competition, markedness constraints bring about *two* kinds impoverishment effects. First, the interaction of the left-alignment constraints for [+nom] and [+2] (plus the highest-ranked MAX(Per)$_{[+2]/[+1]}$ constraint) ensures that [+nom] cannot be realized by an exponent in an optimal output at all in this context; i.e., participant reduction is derived essentially as an *obliteration* effect (see, again, Arregi and Nevins 2012; and below). And second, PU plays a minor but important role: It blocks the use of the more specific exponent /e/ (that emerged as optimal in (35)) because here the PU violation automatically incurred by /e/ (and all other exponents bearing a number feature in the presence of two speech act participants) is fatal (since /eci/ can avoid it and the two exponents otherwise give rise to the same constraint profile).

Interestingly, there is a substantial difference between this approach and one in terms of standard impoverishment rules: the constraint PU that brings about the impoverishment effect for number in the particant reduction context in (36) is in fact violable by the optimal output (i.e., does not give rise to number impoverishment) in (35). Implementing this in a standard rule-based approach to impoverishment that does not envisage violability would not be straightforward. It seems that one would have to modify PU in such a way that it only triggers number deletion in the presence of [–3] agreement heads in the input if this does not give rise to a scenario where MAX(Num)$_{[+2+h]/[+1+l]}$ would be violated, i.e., where number marking is required since there is a transitive verb taking a [+2] nominative argument and a [+1] accusative argument; thus, the effects of a higher-ranked constraint in Trommer's direct OT analysis would have to be integrated as an exception clause into the definition of (a rule-based version of) PU in a rule-based approach.

Impoverishment effects in Dutch verb inflection. Don and Blom (2006) set out to derive the generalization that person differences can never be marked morphologically by exponents in the plural in Dutch (see (37a)), and can also never be marked morphologically by exponents in past tense contexts in this language (see (37b)), irrespective of which conjugation (weak, strong, or *zijn* 'to be') the verb stem belongs to.

(37) *Dutch verb inflection*

a. *Present tense*

	noem ('call')	loop ('walk')	zijn ('be')
1SG	noem	loop	ben
2SG	noem-t	loop-t	ben-t
3SG	noem-t	loop-t	is
1PL	**noem-en**	**loop-en**	**zijn**
2PL	**noem-en**	**loop-en**	**zijn**
3PL	**noem-en**	**loop-en**	**zijn**

b. *Past tense*

	noem ('call')	loop ('walk')	zijn ('be')
1SG	**noem-de**	**liep**	**was**
2SG	**noem-de**	**liep**	**was**
3SG	**noem-de**	**liep**	**was**
1PL	**noem-de-en**	**liep-en**	**war-en**
2PL	**noem-de-en**	**liep-en**	**war-en**
3PL	**noem-de-en**	**liep-en**	**war-en**

This is a kind of scenario for which impoverishment suggests itself, and has in fact been postulated (recall the discussion of the systematic 1st and 3rd person syncretism in present tense plural environments in German shown in (9), which also shows up in all past contexts). The constraints that Don and Blom adopt are given in (38). As concerns the MAX constraints, the features [plural] and [past] are both taken to be privative. *COMPLEX is a markedness constraint that bans exponents which are associated with more than one morphosyntactic feature. Finally, the markedness constraint *AF-TO-AF states that only one exponent can be attached to the verb stem as a suffix (but of course, the constraint is violable). The ranking of the constraints corresponds to the order in which they are presented in (38).

(38) a. MAX([PLURAL]):
Realize a [plural] feature in the input by a [plural] exponent in the output.

b. MAX([PAST]):
Realize a [past] feature in the input by a [past] exponent in the output.

c. *COMPLEX:
Avoid exponents that realize more than one morphosyntactic feature.

d. MAX([αPERSON]):
Realize an [αperson] feature in the input by an [αperson] exponent in the output.

e. *AF-TO-AF:
Do not add affixes to affixed stems.

Furthermore, the list of available morphological exponents is shown in (39). The exponents /en/, /t(de)/, /∅/, and /t/ all exist, and can become optimal in certain contexts. In contrast, /tu/, /tup/, and /tul/ are made-up exponents for 2nd person environments that do not actually occur in Dutch verb inflection. It is the main goal of the analysis to derive the fact that such exponents, even if they were to exist in the lexicon, could never emerge as optimal in plural or past environments because of an impoverishment effect that results from the ranked constraints in (38).

(39) *Vocabulary items*

/-en/	↔	[plur]
/-t(de)/	↔	[past]
/-∅/	↔	[1]
/-t/	↔	[ ]
/**tu**/	↔	[2]
/**tup**/	↔	[plur,2]
/**tul**/	↔	[past,2]

Consider first the competition in a 2nd person plural present tense environment; see (40).

(40) *Person neutralization in the plural (present tense)*

I: *noem*-[plur,2]	Max([plur])	Max([past])	*Compl	*Af-to-Af	Max([pers])
☞ O_1: noem-en					*
O_2: noem-tup			*!		
O_3: noem-∅	*!				
O_4: noem-t	*!				*
O_5: noem-tu	*!				
O_6: noem-en-tu				*!	

Since, by assumption, [past] is privative and thus does not occur in present tense contexts, we can ignore this feature here. The relevant ranking is then that of Max([plur]), *Complex, and Max([pers]). The high ranking of Max([plur]) vs. the low ranking of Max([pers]) ensures that the optimal exponent bears a plural feature rather than a person feature, given that only one of the two features can be realized, and *Complex derives just this latter state of affairs. In this sense, *Complex directly brings about an impoverishment effect: Person is not accessible for morphological realization if plural needs to be realized. Furthermore, *Af-to-Af guarantees that this restriction cannot be circumvented by providing an additional exponent.

The category of person can also not be distinguished in past contexts even if the number is singular. The reasoning is completely analogous here. A maximally faithful exponent /tul/ that realizes both past tense and 2nd person fatally violates *Complex: Person is not realizable by morphological exponence in this environment. This is illustrated in (41).

(41) *Person neutralization in the past (singular)*

I: *noem*-[2,past]	Max([plur])	Max([past])	*Compl	*Af-to-Af	Max([pers])
O_1: noem-en		*!			*
O_2: noem-tup		*!	*		
O_3: noem-∅		*!			*
☞ O_4: noem-de					*
O_5: noem-tu		*!			
O_6: noem-de-tu		*!		*	
O_7: noem-tul			*!		

Finally, it is clear that the same impoverishment effect is obtained if [past] and [plural] co-occur: Again, an exponent realizing person can never become optimal; this feature is not available for inflectional exponence in this environment; see (42).[14]

(42) *Person neutralization in the plural (past tense))*

I: *noem*-[plur,2,past]	MAX([PLUR])	MAX([PAST])	*COMPL	*AF-TO-AF	MAX([PERS])
☞ O_1: noem-de-en				*	*
O_2: noem-tup		*	*		
O_3: noem-∅	*!	*			*
O_4: noem-de	*!				*
O_5: noem-tu	*!	*			
O_6: noem-de-tu	*!			*	
O_7: noem-de-en-tu				**!*	
O_8: noem-tul	*!		*		

More generally, it follows that the only environment where person can be realized by an exponent is a present tense singular context (thus, it is indeed accidental that there is no exponent like /tu/↔[2] in (39) for *this* environment); in all other environments, *COMPLEX enforces an impoverishment effect for person. Note that *COMPLEX, due to its extremely general formulation, does so only in interaction with the higher-ranked MAX constraints for number and tense. Consequently, a transfer of this analysis to a standard DM approach would again not be entirely straightforward. Moreover, even if one were to adopt a more specific markedness configuration as the trigger of a standard impoverishment operation that intrinsically bans person features (rather than a co-occurrence of morphosyntactic features), it seems that two separate impoverishment rules would still be required: one that deletes person in plural contexts, and one that deletes person in past contexts.[15]

2.4.2. Indirect OT analyses

In contrast to direct OT approaches to impoverishment effects, indirect OT approaches envisage an actual deletion of morphosyntactic features in syntactic representations before morphological exponence takes place, exactly as in DM. Such approaches have been developed in Keine and Müller (2011, 2015). The triggers for feature deletion are markedness constraints that outrank counteracting faithfulness (MAX) constraints; but this time, the MAX constraints do not relate the features of a syntactic context (or paradigm cell) and the features of an exponent; rather, they relate the features of a syntactic context ('syntactic input structure,' end of the syntactic derivation) with the same features of a syntactic context ('syntactic output structure,' input to morphological realization). After deletion, the inflectional exponents find a reduced feature matrix, and a retreat to the general case results (whether vocabulary inser-

[14] In principle, one would also need to consider an even more complex exponent like hypothetical /tulp/ ↔ [plur,past,2] here. This marker would satisfy MAX([PLUR]) and MAX([PAST]), but its satisfaction of MAX([PERS]) would again imply a fatal violation of *COMPLEX.

[15] At least, this holds as long as the complement of a natural class (capturing singular, present tense contexts, which could be obtained by postulating binary instead of privative number and tense features) does not also qualify as a natural class; but see Zwicky (1970).

tion itself is handled by the Subset Principle, as in DM, or also by faithfulness constraints, as in standard OT approaches to inflectional morphology, is orthogonal to the question how impoverishment effects are generated in an indirect approach).

Consider, as a case study, the analysis of differential encoding of objects in the Tacanan language Cavineña spoken in Bolivia (see Keine and Müller 2015, based on data from Guillaume 2008). In Cavineña, two suffixal dative/genitive markers can appear: /kwe/ and /ja/. The choice depends on person and number features of the stem—/kwe/ can only be attached to local person (i. e., 1st or 2nd person) pronouns in the singular. All other combinations require /ja/. This constitutes a case of differential object marking since singular 1st or 2nd person objects are highly marked. The other combinations are less marked in terms of Hale/Silverstein scales (see Hale 1972 and Silverstein 1976). The distribution of morphological exponents is illustrated in (43).

(43) *Dative/genitive exponents in Cavineña*

Person	SG	DL	PL
1	e-∅-kwe	ya-tse-ja	e-kwana-ja
2	mi-∅-kwe	me-tse-ja	mi-kwana-ja
3	tu-∅-ja	ta-tse-ja	tu-na-ja
3PROX	riya-∅-ja	re-tse-ja	re-na-ja

According to the analysis in Keine and Müller (2015), there is massive impoverishment in dative/genitive contexts (which are assumed to be characterized by the features [+obl(ique), +gov(erned)]), with the feature [+obl] removed in all contexts except the most marked ones (viz., local person singular object environments). Therefore, given the exponent specifications in (44), only /ja/ can satisfy compatibility and specificity in the non-marked environments; and /kwe/ shows up only where [+obl] is protected by the highest-ranked relativized faithfulness constraint.

(44) *Vocabulary items*
/-kwe/ ↔ [+obl,+gov]
/-ja/ ↔ [+gov]

The constraints that underlie the analyis are given in (45); the order of presentation corresponds to their ranking.

(45) a. *OBJ/LOC/SG & MAX-C:
A case feature in a syntactic input representation must be preserved in object contexts with singular local (first or second) person.

b. *[+OBL]:
A [+obl] feature must not show up in a syntactic output representation.

c. *Obj/Loc/Non-sg & Max-C:
A case feature in a syntactic input representation must be preserved in object contexts with non-singular local (first or second) person.

d. *Obj/Nloc/Sg & Max-C:
A case feature in a syntactic input representation must be preserved in object contexts with singular non-local (third) person.

e. *Obj/Nloc/Non-sg & Max-C:
A case feature in a syntactic input representation must be preserved in object contexts with non-singular non-local (third) person.

For each possible scenario involving [+obl,+gov]-marked objects in the syntax, the postsyntactic optimization based on the constraints in (45) is trivial and not be shown here. If *[+obl] outranks the relativized Max constraint demanding case feature preservation (as, e.g., in the case of 3rd person plural objects), case feature deletion will apply, and subsequent morphological realization will find an impoverished case configuration, yielding /-ja/; in contrast, if *[+obl] is outranked by the relativized Max constraint (viz., in 1st or 2nd person singular object environments), the case feature will be preserved in the optimal syntactic output that forms the input to inflectional exponence, and /-kwe/ will be chosen as the most specific compatible inflectional exponent.

As with the direct OT analyses of Ainu argument encoding and Dutch verb inflection, it is not completely obvious how to derive the impoverishment effects underlying differential case-marking in Cavineña in a standard DM approach. More specifically, as with Don and Blom's (2006) proposal, there is a problem related to the concept of natural class: Impoverishment applies if the object is 3rd person *or* non-singular. Since these contexts do not form a natural class, two impoverishment rules would be needed, one for 3rd person environments, and one for non-singular environments.

Finally, as will all analyses deriving impoverishment effects from markedness constraints (and *mutatis mutandis* ultimately all analyses postulating some version of impoverishment), the question arises to what extent the banned feature specifications can be said to be well motivated, and conceptually simple. To wit, at first sight it may look as though the markedness constraints in (45) are anything but principled. However, this impression is misleading. The relativized faithfulness constraints in (45) do not have to be stipulated but follow from the application of the optimality-theoretic operations of *harmonic alignment* of the prominence scales in (46) (see Prince and Smolensky 1993/2004), and *local conjunction* of the results with extremely general Max-C constraints (see Smolensky 2006).

(46) a. *Person scale*
Loc(al) (1/2) ≻ N(on)loc(al)

b. *Number scale*
Sg ≻ Non-sg

c. *GF scale*
Subj ≻ Obj

This technique of accounting for prominence scale effects in differential argument encoding has originally been proposed by Aissen (1999, 2003). The main difference is that whereas Aissen's approach is purely syntactic and merely predicts the presence or absence of case as such, the approach in Keine and Müller (2011, 2015) locates differential argument encoding in the morphological component, and is compatible with two (or more) alternating morphological exponents that are non-zero (like /-kwe/ and /-ja/, in the case at hand), which Aissen's original approach is not.

2.5. Impoverishment through vocabulary insertion

As we have seen, the standard view in DM is that impoverishment effects arise as a consequence of specific deletion transformations that postsyntactically remove morphosyntactic features before morphological realization. However, ideally it should arguably be possible to account for these effects without invoking specific additional operations. Assuming vocabulary insertion to be an indispensible part of inflectional morphology, one might thus try to reduce impoverishment to this more basic operation. This hypothesis is pursued in Trommer (1999, 2003a). A prerequisite of the proposal is that vocabulary insertion into a functional heads can be iterative. On this view, VIs competing for insertion into a given node do not necessarily stand in a disjunctive blocking relation. Rather, Subset Principle-driven vocabulary insertion *discharges* the features in the syntactic head that are shared by the inflectional exponent, and the remaining features are then accessible for further vocabulary insertion (and discharge) by the next-most specific compatible VI, and so on, until no VI can be inserted anymore in accordance with the Subset Principle; this is essentially the concept of fission proposed in Noyer (1992).[16]

On this basis, Trommer's insight is that impoverishment can simply be brought about by highly specific zero exponents. Given the Subset Principle, these must be inserted first into functional heads, thereby discharging the matched feature(s), and thus rendering these latter features unavailable for morphological realization by subsequently inserted (non-zero) VIs. To see how Trommer's (1999) proposal works, let us look at adjectival inflection in Norwegian again. Crucially, instead of the designated impoverishment rule in (7), it can now be postulated that there is yet another highly specific zero exponent in the inventory of adjectival inflection markers; see $\emptyset_1$ in (47).

(47) *Vocabulary items*

/-$\emptyset_1$/	↔	[singular, ±neuter / __ weak]
/-t/	↔	[singular, +neuter]
/-$\emptyset_2$/	↔	[singular, −neuter]
/-e/	↔	[ ]

[16] Here is a somewhat more precise definition of this concept of vocabulary insertion: If insertion of a VI with the morphosyntactic features β takes place into a syntactic head with the morphosyntactic features α, then α is split up into β and its complement set α−β, such that (i) and (ii) hold: (i) α−β is available for further vocabulary insertion; (ii) β is not available for further vocabulary insertion.

To ensure that /-$\emptyset_1$/ is maximally specific in all weak environments, [singular] is also provided as part of its insertion context; furthermore, the contextual feature [weak] can be assumed to tip the scale in favour of /-$\emptyset_1$/ as regards specificity (see Harbour 2003, Arregi and Nevins 2012, and Hanink 2018 for discussion). Under these assumptions, early insertion of /-$\emptyset_1$/ will successfully block subsequent insertion of /-t/ and /-$\emptyset_2$/ in weak contexts, and the elsewhere exponent /-e/ will be inserted instead.[17] In contrast, no such impoverishment effect obtains in strong environments, where /-$\emptyset_1$/ cannot be inserted because of a compatibility violation.

Like the (direct and indirect) OT approaches to impoverishment, impoverishment by insertion of highly specific zero exponents is not merely a notational variant of standard, rule-based impoverishment. In particular, impoverishment by specific zero VIs would in principle seem to be able to induce impoverishment *after* vocabulary insertion of a more specific item has already taken place. At present, we take it to be an open question whether there is empirical evidence for this kind of effect.

Even though exponent-driven impoverishment can be viewed as "appealingly parsimonious" from a conceptual point of view (see Harbour 2003:568), there are some potential drawbacks (see, e.g., Müller 2005, Bierkandt 2006, Siddiqi 2006). For one thing, the approach mixes two notions of underspecification that one might view as conceptually quite distinct (underspecification of syntactic contexts vs. underspecification of inflectional exponents). For another, it is at variance with an iconicity meta-principle that is often presupposed in morphological analysis, and that has been made explicit by Wiese (1999): Similarity of function implies similarity of form (within a certain domain, and unless there is evidence to the contrary); i.e., at least as a strong tendency, the more morphosyntactic features an inflectional exponent is characterized by, the more phonological material it will consist of. From this perspective, zero exponents are expected to be canonical elsewhere markers, and highly specific zero exponents are unexpected.[18]

2.6. Impoverishment by Collateral Feature Discharge

Trommer's (1999) original formalism distinguishes between three different feature matrices in the structure of a VI: (i) *Context* (contextual information outside the node into which insertion takes place); (ii) *Target* (the features located in the insertion site), and (iii) *Deletes* (the features that are discharged by vocabulary insertion). Trommer postulates that *Deletes* must be a subset

[17] Of course, since the empty set is a subset of every set, there has to be an external stopper after insertion of a radically underspecified elsewhere exponent; otherwise infinite application of elsewhere exponent insertion would be predicted.

[18] That said, highly specific zero exponents are also made use of in the analyses of Spanish object clitics and English verb inflection in Halle and Marantz (1993, 1994), which both simultaneously also rely on zero exponents as elsewhere markers (and where rule-based impoverishment is also employed). Here is what Halle and Marantz (1993:127, 133) have to say about this issue: "Since in language there is an arbitrary relation between the morphosyntactic and phonological features of a VI (Saussure's *arbitraire du signe*), it is not surprising that the relationship between morphosyntactic and phonological features is one-to-many. Thus, phonological ∅ is the phonological realization of two distinct sets of features [...] We recognize at least two types of zero morphemes, leaving open the question of whether these are actually distinct. [...] It may be that Universal Grammar provides a zero spell-out as the default phonological realization of a morpheme in the unmarked case. This possibility in no way undermines the existence of zero morphemes."

of *Target*. Suppose now that this condition is abandoned. In that case, vocabulary insertion could directly lead to impoverishment of *other* features. Henze and Zimmermann (2011) pursue this option; evidence for such "collateral feature discharge" is drawn from a peculiar effect in Potawatomi verbal agreement morphology: The 1st person plural exponent /-mən/ can follow other argument encoding suffixes (depending on the features they realize), but (unlike a potentially competing, more specific 1st person plural exponent /-nan/, which requires a 3rd person nominative argument in the context), it can never be followed by another argument encoding suffix.

In Henze and Zimmermann's (2011) analysis, it is first assumed that the two functional heads hosting features for the encoding of the two primary (nominative and accusative) arguments undergo *fusion* postsyntactically. Iterative insertion of suffix exponents into the fused morpheme is then taken to successively discharge the latter's morphosyntactic features (cf. Noyer 1992, Trommer 1999, Frampton 2002); the order of insertion is determined by a concept of specificity that is based on a hierarchy of features (rather than the cardinality of the feature sets associates with underspecified VIs; see footnote 3 above), thereby giving rise to "direct" vs. "inverse" marking, among other things. Crucially, when the exponent /-mən/↔[+1,+pl] is inserted (which need not be the first operation, given that there can be other, more specific exponents, which are then inserted into the fused feature structure prior to /-mən/), subsequent insertion of some other exponent becomes impossible even though it looks as though there should be remaining features in the fused morpheme which have not yet been discharged by intrinsic features of /-mən/ (or some other VI inserted earlier), and which should therefore be available for further morphological exponence. As Henze and Zimmermann observe, to derive this /-mən/ termination effect in a standard DM approach, one would have to postulate the four distinct impoverishment operations in (48) that, taken together, capture the various scenarios in which /-mən/ occurs and where there should still be features left in the fused morpheme that could trigger further vocabulary insertion.

(48) *Impoverishment rules for /-mən/ termination*

$$
\begin{aligned}
[+2+pl] &\rightarrow \emptyset \,/\, \_\_\, [acc,+1,+pl] \\
[+pl] &\rightarrow \emptyset \,/\, \_\_\, [nom,+1,+pl] \\
[+obv] &\rightarrow \emptyset \,/\, \_\_\, [nom,+1,+pl] \\
[-anim] &\rightarrow \emptyset \,/\, \_\_\, [nom,+1,+pl]
\end{aligned}
$$

Instead, Henze and Zimmermann (2011) propose that some exponents can come equipped with a diacritic signalling that as a consequence of regular, Subset Principle-driven vocabulary insertion, *all* remaining features in the functional morpheme are also discharged, and thus inaccessible for further vocabulary insertion (the diacritic is here rendered as "$^{\vee}$ …," though this is not Henze & Zimmermann's notation). On this view, /-mən/ in Potawatomi can be given a lexical specification indicating complete collateral feature discharge after insertion, whereas a minimally different standard exponent like /-nan/ whose insertion does not lead to deletion of other features is not accompanied by the diacritic; see (49).

(49) *Vocabulary items*
/-mən/ ↔ [+1,+pl, ᵛ …]
/-nan/ ↔ [+1,+pl] / __ [nom,+3]

Needless to say, many further questions would have to be explored before such an approach could be viewed as a viable concept, and perhaps even a general alternative to impoverishment. It is an open issue whether—and if so, how—collateral feature discharge could also affect designated individual features rather than the full feature set. Notably, /-mən/ does not block the preterit morpheme *wapunin* from following it (Halle and Marantz 1993:155), so some featural specificity of collateral feature discharge seems required. A second crucial difference between feature discharge and impoverishment is that impoverishment is not tied to specific VIs, but applies system-wide (see the discussion in section 1). By contrast, the concept of collateral feature discharge is inherently VI-specific.

2.7. Locality of impoverishment

In many cases, impoverishment is contextually conditioned in the sense that the features that the impoverishment rule refers to are not necessarily all located on the same head. For example, the Baoan impoverishment rule in (18) impoverishes case in the context of a D head with a [+participant] specification. Other examples include various impoverishment and obliteration rules in Arregi and Nevins (2007, 2012), who propose clitic impoverishment in the context of other clitics. Two questions arise: First, is there a locality restriction on the contextual specification of an impoverishment rule? Second, in the cases seen so far, the context of impoverishment is located on a head different from the target of the rule. Is it possible for an impoverishment rule to simultaneously delete features on multiple heads?

An answer to the first question is given by Božič (2020), who argues based on evidence from Slovenian that the context of an impoverishment is confined to the head targeted by impoverishment and an adjacent node, as formulated in (50).

(50) *Strictly local impoverishment*
Triggering context may be contained in (a) the X^0 targeted for impoverishment, or (b) the closest X^0 that the target of impoverishment c-commands. [Božič 2020:405]

The second question (whether impoverishment may target features on more than a single head) is answered affirmatively in Müller (2006a) in an analysis of argument-encoding verbal morphology in Sierra Popoluca. Here the two core arguments are encoded on the verb by a combination of ergative and absolutive prefixes and person prefixes, all of which have the size of segments. The exponent /i-/ shows up in 2nd and 3rd person ergative contexts, and in 2nd person absolutive contexts. This is accounted for by postulating that /i-/ is a general [−1] exponent; its absence in 3rd person absolutive contexts follows from the existence of the impoverishment rule in (51) (where [−gov] stands for absolutive case, whereas [+gov] represents ergative case).

(51) *A global impoverishment rule in Sierra Popoluca*
$[-1, -2] \longrightarrow \emptyset$ / __ [−gov] [Müller 2006a:35]

Importantly, (51) is a global impoverishment rule in that it applies not to the *minimal* functional morpheme, but to the *maximal* functional morpheme (perhaps even the phase), which after head movement of v+V to T includes both the slot for absolutive-encoding exponents (T) and the slot for ergative-encoding exponents (v). As a consequence, this impoverishment rule can also be held responsible for participant reduction effects in transitive contexts. For instance, if the ergative argument is 1st person ([+1,**−2**,+gov] in v) and the absolutive argument is 2nd person ([**−1**,+2,−gov] in T), the two feature matrices *together* will provide a [−1, −2] / __ [−gov] specification that triggers the "3rd person" impoverishment rule in (51) and thus accounts for the fact that an otherwise expected /i-/↔[−1] will not occur; therefore, the Sierra Popoluca version of 'I hit you' (1.ERG⟶2.ABS) is *m-aŋ-koˀc-pa* (2.ABS-1.ERG-hit-INC) rather than **m-**i**-aŋ-koˀc-pa*; similar reduction effects are obtained for 2.ERG⟶1.ABS, 3.ERG⟶1.ABS and 3.ERG⟶2.ABS scenarios.[19] Of course, if global impoverishment is to be maintained as an option, its relation to standard, local impoverishment will eventually have to clarified (note that the analysis at hand also relies on another impoverishment rule with a local application domain).

Despite the characterization of (50) as "strictly local" and of (51) as "global," the two are not necessarily in opposition to each other. This is because v and T, which condition the global application of (51), are structurally adjacent in Müller's (2006a) analysis. One possibility that reconciles the two is thus that impoverishment may operate over adjacent heads, both in terms of its contextual specification and in terms of the features it targets.

3. Impoverishment and other operations on features

Impoverishment is related to other morphological operations (both wihin DM and more generally), but crucially differs from these in several respects. In this section, we will focus on (i) category deletion, (ii) rules of referral, and (iii) feature-changing rules.

[19] As shown in Müller (2006a), ceteris paribus the participant reduction effects here cannot be derived by fusion. We also note that while Müller's (2006a) rule in (51) applied to transitive configurations would delete person features from both arguments, it would be possible to let this rule delete [1] in the context of [2], which is possibly located on a different head, as shown in (i).

(i) $[-1] \longrightarrow \emptyset$ / __ [−2, gov]

The reformulation in (i) is possible because in Müller's (2006a) system there is no VI that realizes [2], and so deletion of [2] is not strictly necessary. If such a reformulation is made, the impoverishment rule would still need to be sensitive to a nonlocal configuration, but only contextually and under adjacency. One point of divergence is that the impoverishment rule in (i) can be reanalyzed in terms of insertion of a null VI as proposed by Trommer (1999, 2003a; see section 2.5) as long as vocabulary insertion can be nonlocally conditioned (e.g., Merchant 2015, Moskal and Smith 2016, Svenonius 2016).

3.1. Impoverishment vs. category deletion

As noted in section 2.3, Arregi and Nevins (2007, 2012) propose that in addition to impoverishment, there is also a more drastic postsyntactic operation of obliteration, which leads to a complete deletion of terminal nodes; i.e., it removes whole categories rather than just their features (also see Pescarini 2010, Calabrese 2011, Martinović 2017). Recall that, like impoverishment, obliteration is assumed to be triggered by morphotactic filters. (52) is a slightly different version of the obliteration rule we saw in (25) for the Basque dialect of Ondarru; it is active in the Basque dialect of Zamudio.

(52) *1PL obliteration in Zamudio Basque*

a. Structural description: an auxiliary M-word with two clitics Cl_1 and Cl_2 such that Cl_1 is [+motion, +participant, +author] and Cl_2 is [+participant].

b. Structural change: delete Cl_1. [Arregi and Nevins 2012:217]

(52) brings about participant reduction in cases where one of the two arguments in need of encoding on the auxiliary verb is 1st person plural (1st person singular features have independently been deleted by impoverishment; see (26)) ergative or dative (which are the [+motion] cases, by assumption), and the other one is [+participant] (in practice, 2nd person). In these contexts, the former argument cannot be identified by agreement morphology on the auxiliary. This obliteration effect is shown for a 1st person plural dative in the context of a 2nd person ergative in (53): the otherwise expected 1st person dative plural clitic *ku* is not available.[20]

(53) Sue-k **gu-ri** lagun-du s-endu-e-n /
you.PL-ERG us-DAT accompany-PRF CL.ERG.2-PST.3.SG-CL.ERG.PL-CPST /
*d-o-**ku**-su-e-n
L-PST.3.SG-CL.DAT.1.PL-CL.ERG.2-CL.ERG.PL-CPST
'You(pl) accompanied us.' [Arregi and Nevins 2012:218]

Postsyntactic deletion of entire categories is also envisaged as an option in Harbour (2003:561), who argues that both *impoverishment at the node* (standard impoverishment) and *impoverishment of the node* (postsyntactic deletion of the whole category) are options.

Furthermore, Embick (2003, 2010) argues that there is post-syntactic *pruning* of ∅-affixes; more specifically, he assumes that nodes are removed if the exponents of these elements are null exponents. The underlying rationale is to ensure locality for the purposes of contextual allomorphy as, e.g., in (54), where T allomorphy can be determined by the verb root in English past contexts because the intervening zero v has undergone pruning.

(54) $\sqrt{\text{ROOT}} \frown [_{v}\ \emptyset\ ] \frown \text{T}$ [Embick 2010:59]

Finally, deletion of entire categories in the course of morphological realization also figures prominently in the account of disjunctive blocking based on structure removal developed in

[20] Note that the other differences between the two auxiliary forms boldfaced in (53) result from independently motivated rules and constraints.

Müller (2020:ch. 3). While these approaches can ultimately all be traced back to Ross's (1967) operation of tree pruning, it can also be noted that there are some important differences. Thus, only obliteration and impoverishment of the node delete categories before vocabulary insertion; pruning and structure removal delete categories after their morphological realization (however, Embick 2010:86 speculates that there might also cases of "radical" pruning that apply "early in PF derivations"). These differences notwithstanding, the question can be asked how distinct category deletion and standard impoverishment are from a conceptual point of view. Assuming that categories are nothing more than sets of features (see Gazdar et al. 1985), a case could possibly be made that the difference is a quantative rather than a qualititative one.

3.2. Impoverishment vs. rules of referral

In non-derivational, declarative approaches to inflectional morphology like Paradigm Function Morphology (PFM; see Stump 2001) or Network Morphology (see Brown and Hippisley 2012) that also do not adopt violable constraints, it is a priori unclear how an inherently derivational concept like impoverishment could be formulated. Still, these models also face the challenge of accounting for systematic instances of syncretism that cannot directly be addressed in terms of underspecification in basic rules of exponence (like vocabulary insertion in DM), or that instantiate a general pattern in the language which seems to hold independently of accidental exponence specifications. In view of this, declarative approaches often resort to rules of referral, which were proposed in Zwicky (1985) and have been adopted in work such as Stump (1993, 2001), Corbett and Fraser (1993), Baerman, Brown and Corbett (2005), and Brown and Hippisley (2012). A rule of referral simply states that the morphological realization of some (fully specified) set of morphosyntactic features (the syntactic environment, or paradigm cell) is identical to the morphological realization of some other (fully specified) set of morphosyntactic features, independently of what the basic rules of exponence would predict. This way, systematic syncretism patterns are covered by the theory, but no attempt is made to actually derive them from more elementary assumptions.

For the example of adjective inflection in Norwegian (see (2)) that has already figured repeatedly in the preceding discussions, leaving all other assumptions about features and rules of exponence as before, one could postulate a rule of referral stating that in weak environments, the morphological realization of a feature matrix containing [singular] is identical to whatever the rules of exponence determine to be the morphological realization of a minimally different feature structure *not* containing the feature [singular]. Thus, for, say, a [singular,+neuter] weak adjective inflection context, the rule of exponence would still predict /-t/; but the rule of referral would override the rule of exponence and correctly produce /-e/ as the correct inflection marker. To ensure that rules of referral systematically override competing rules of exponence in a system based on a constraint demanding maximal specificity like the Subset Principle (called Pāṇini's Principle in PFM), Stump (2001) stipulates that a rule of referral is inherently, by *fiat*, maximally specific; technically this is implemented by assuming that a rule of referral always applies in the *expanded mode* (it pretends that it talks about all the features even though it may actually only talk about a subset).

Even though impoverishment and rules of referral can give rise to similar effects, and can both capture systematic patterns of syncretism, the two devices are conceptually very different. Note first that the issue of ensuring override capability does not arise with impoverishment because it always precedes vocabulary insertion in DM.[21] Second, as noted by Stump (2001:238), whereas impoverishment modifies the feature structure in need of realization, rules of referral leave that feature structure fully intact. Most importantly, though, impoverishment differs in its expressive power from rules of referral. Because impoverishment only deletes features, it invariably leads to insertion of a more general VI; rules of referral are not similarly limited (Bobaljik 2002:64–67).

Although it is not really clear that there has to be a fundamental incompatibility of DM and rules of referral, it can be noted that this device is rarely, if ever, used in DM analyses. Things are different with another rule type that is conceptually even closer to rules of referral than standard impoverishment, and that we turn to in the following section.

3.3. Impoverishment vs. feature-changing rules

It has sometimes been argued that postsyntactic feature manipulations that precede vocabulary insertion are not necessarily confined to deletion operations; rather, features can also be *changed.* Noyer (1998) proposes such a feature-changing operation in order to account for number-dependent verb root variation in Nimboran. In dual ([−sg,−pl]) contexts, the elsewhere form occurs; e.g., *betáo* ('pull out'). In singular contexts ([+sg,−pl]), metathesis takes place: *betúa.* And in plural contexts ([−sg,+pl]), there is ablaut: *betaói.* This describes the normal state of affairs. However, in durative environments, the dual form of the root becomes the plural form: It is *betaói* now in both dual and plural. Noyer suggests to account for this by a rule that changes [−pl] to [+pl], so that the dual becomes indistinguishable from the plural.

Similarly, Harbour (2003) shows that there are contexts in Kiowa object agreement where the inflectional exponents indicate the presence of a feature [−sg] of the agent argument even though this argument is uncontroversially [+sg]. Harbour's analysis relies on postsyntactic replacement of [−sg] by [+sg] in these contexts.[22]

In the same vein, it is assumed in Müller (2004) that the emergence of (what looks like) genitive endings with animate nouns in the accusative case in plural and masculine singular environments (e.g., *student-a*, 'student.ACC.SG' instead of **student-*∅, 'student.ACC.SG') can be traced back to a postsyntactic operation that converts [−subj,−obl] (i.e., accusative) feature specifications to [+subj,+obl] (i.e., genitive) feature specifications prior to morphological realization.

Other examples of feature-changing rules include Calabrese (2008), who analyzes crosslinguistic restrictions on case systems (also see Radkevich 2010), and Calabrese (2011), who investigates syncretism patterns in subject clitics in northern Italian varieties.

[21] However, recall that this is not necessarily the case in Trommer's (1999) reconstruction of impoverishment as zero vocabulary insertion.

[22] Technically, both Noyer and Harbour decompose the feature-changing operation into a first part that deletes the original feature via regular impoverishment, and a second part that inserts the feature with the opposite feature value (also see Calabrese 2008, Radkevich 2010).

These postsyntactic feature-changing operations (or "feature-changing impoverishment," as it is sometimes called, perhaps somewhat misleadingly) would seem to be much closer conceptually to rules of referral than standard impoverishment. Indeed, Harley and Noyer (2002:478) claim that "feature-changing impoverishment [...] has approximately the same power as rules of referral." However, the first two differences between impoverishment and referral mentioned at the end of the preceding subsection are still in place (regarding the relevance of specificity and the question of intactness of the original feature matrix in need of realization). Furthermore, Noyer (1998) postulates that feature-changing rules can only replace marked with unmarked values; and Harbour (2003) follows him in this (though no such restriction is imposed in Calabrese 2008, 2011). No comparable restriction can be assumed to hold for rules of referral.

4. Other applications of impoverishment

4.1. Impoverishment and ϕ-agreement

Recall from the architecture in (1) above that impoverishment is standardly taken to apply postsyntactically. On the usual assumption that ϕ-agreement is established syntactically through the operation Agree, it follows that all impoverishment operations necessarily follow all agreement operations. Keine (2010) explores the possibility that impoverishment and Agree apply in the same grammatical module and hence can be interleaved with each other. On this view, impoverishment does not only affect the morphological realization of syntactic terminals, but it also influences operations that are standardly taken to be syntactic in nature, like ϕ-agreement and case assignment.[23] To illustrate this line of approach, we will present one application. Keine (2010) adopts Keine and Müller's (2011, 2015) analysis of differential subject and object marking as the result of impoverishment (see section 2.4.2). He then observes that in at least some languages, differential case marking affects verb agreement, which must hence be sensitive to whether impoverishment has applied or not. One example is differential subject marking in Punjabi (Butt 2005). Here, the case marking of the subject of a transitive clause is subject to both an aspect-based split and a person-based split. The aspect split is illustrated in (55). In the perfective, the subject bears ergative case and does not control verbal agreement (55a); in the imperfective, the subject does not bear morphologically-marked case and does control verb agreement (55b).

(55) *Punjabi aspect split*

a. laṛki=ne muṇḍıā=nũ mar-ıa si
girl.FEM.SG=ERG boy.MASC.PL=ACC hit-PAST.MASC.SG be.PAST.3SG
'The girl has hit the boys.'

b. laṛki muṇḍıā=nũ mar-di ɛ
girl.FEM.SG boy.MASC.PL=ACC hit-PRES.FEM.SG be.PRES.3SG
'The girl is hitting the boys.' [Butt 2005:186]

[23] Though see Bobaljik (2008) for an alternative according to which all of these operations apply postyntactically.

Verb agreement thus appears to be sensitive to the morphological case marking of the subject (Bobaljik 2008). But morphological case does not correlate with verb agreement in all cases. Punjabi also exhibits a person-based case splits on subjects: Local (i.e., 1st and 2nd person) subjects never bear ergative case, even in the perfective (56). Nonetheless, they do not control verb agreement in the perfective. In (56), the verb agrees with the object *kampuṭar.*

(56) tũ kampuṭar bec^{h}-ia
you.FEM/MASC computer.MASC.SG sell-PAST.MASC.SG
'You (male or female) sold the computer.' [Butt 2005:187]

Assuming that the switch from the ergative marker *-ne* to the null marker is the result of impoverishment, Keine (2010) concludes that agreement cannot be determined based on the original case feature (given the contrast in (55)) nor based on the morphological case (given the contrast between (55b) and (56)). He proposes that agreement applies to abstract feature matrices that may have undergone impoverishment. Concretely, he decomposes ergative case into the subfeatures in (57) and proposes the VIs in (58).

(57) *Case decomposition*
ERGATIVE: [+subject, −oblique]

(58) *Vocabulary items*
/-ne/ ↔ [+subject, −oblique]
/-∅/ ↔ [ ]

In the absence of impoverishment, ergative case is realized by the VI /-ne/. The aspect and person splits are the result of the (somewhat simplified) impoverishment rules in (59). First, (59a) deletes [+subject] in the context of a [−perfective] feature, yielding an aspect split. Because aspectual information is not represented on the subject, Keine takes (59a) to apply on the verbal head that assigns ergative case, hence before case assignment takes place. Second, (59b) deletes [−oblique] on local person subjects (i.e., 1st or 2nd person pronouns). This produces the person split.

(59) *Impoverishment rules*
a. [+subject] ⟶ ∅ / ___ [−perfect] (aspect split)
b. [−oblique] ⟶ ∅ / ___ [PERSON: local] (person split)

Both rules in (59) prevent /-ne/ from being inserted and hence lead to the emergence of /-∅/. To account for the agreement pattern in (55) and (56), Keine proposes that DPs that bear the case subfeature [+subject] are inaccessible to the ϕ-probe (60).

(60) *ϕ-transparency*
DP bearing [+subject] are opaque for the verbal ϕ-probe.

While both impoverishment rules in (59) bleed insertion of /-ne/, they differ in their effects on ϕ-agreement. Unimpoverished ergative DPs bear [+subject] and are hence inaccessible to

verbal ϕ-agreement. Because (59b) leaves [+subject] unaffected, DPs that are null-marked as the result of (59b), such as *tũ* in (56), remain inaccessible to ϕ-agreement. By contrast, because (59a) deletes [+subject], it makes a DP accessible to ϕ-agreement. This produces the agreement contrast in (55).

Crucial to this account is that impoverishment can apply before ϕ-agreement is established. Moreover, because Keine takes (59a) to apply on the verbal head that assigns the case, the complete sequence of operations is as in (61).

(61) impoverishment (59a) ⟶ Agree (case assignment) ⟶ impoverishment (59b) ⟶ Agree (ϕ-agreement)

Keine (2010) applies the proposal that Agree and impoverishment are interleaved to a number of other domains and broadly concludes that for an ordering like that in (61) to be possible, impoverishment and Agree need to be part of the same grammatical module. He leaves open whether both are part of narrow syntax or the PF branch.

4.2. Anti-agreement

Baier (2018) proposes an analysis of anti-agreement and wh-agreement in terms of impoverishment. These terms refer to phenomena whereby $\bar{A}$-movement of a DP affects the morphological verb agreement associated with that DP. Baier distinguishes between anti-agreement—in which the agreement associated with an $\bar{A}$-element uses a default agreement marker—and wh-agreement—where $\bar{A}$-elements trigger special agreement morphology. His account unifies the two, so we will use anti-agreement for illustration. To give one example, in Abaza an $\bar{A}$-moved absolutive DP triggers verb agreement in the prefix *y-*, as in (62). Agreement with non-$\bar{A}$-moved 3rd person singular animate DPs is realized by the prefix *d-*.

(62) Izmir *pro* dzač'^{w}əya **yə**-r-bak^{w}az
Izmir 3PL who ABS.WH-3PL-see.PL.PAST
'Who did they see in Izmir?' [Baier 2018:58]

Baier (2018) argues that, contrary to much of the previous literature, it is not $\bar{A}$-movement that induces the agreement switch, but rather the fact that the agreed-with DP bears an $\bar{A}$-feature (which usually induces $\bar{A}$-movement). He furthermore shows that the *y-* agreement prefix is the elsewhere VI in the Abaza inventory of ϕ-agreement markers. As shown in (63), *y-* is not confined to $\bar{A}$-elements, but also arises with a number of non-$\bar{A}$ DPs.

(63) *Abaza absolutive agreement* [Baier 2018:60]

	1	2FEM	2MASC	3FEM	3MASC	3INAN	$\bar{A}$
SINGULAR	s-	b-	w-	d-	d-	y-	y-
PLURAL	h-	ʃ^{w}-	ʃ^{w}-	y-	y-	y-	y-

The generality of the distribution of *y-* leads Baier (2018) to propose that its emergence in (62) is the result of postsyntactic impoverishment of the verbal ϕ-agreement features. Focusing

on the alternation at hand, Baier (2018) proposes the VIs in (64). /d-/ realizes singular animate agreement; /y-/ is a default agreement marker.

(64) *Vocabulary items*
/d-/ ↔ [−plural, +animate]
/y-/ ↔ [Agr]

Ordinarily, /d-/ trumps insertion of /y-/ where its insertion is licensed. Baier (2018) proposes that in the case of agreement with an $\bar{A}$-DP, the ϕ-probe not only copies the DP's ϕ-features but also the DP's [$\bar{A}$]-feature.[24] The presence of this [$\bar{A}$]-feature then triggers impoverishment of the agreed-with ϕ-content on the verbal Agr head (65).

(65) $[\phi] \longrightarrow \varnothing$ / [___, $\bar{A}$, Agr]

After impoverishment, /d-/ no longer fulfills the subset requirement, leading to insertion of /y-/, and hence to anti-agreement.

Baier (2018) furthermore discusses several implications of this analysis for the theory of impoverishment. He argues that feature neutralizations in anti-agreement display an implicational hierarchy, stated in (66). This hierarchy states that if a language neutralizes distinctions for some feature [X] in anti-agreement contexts, then this language also levels distinctions in features to the left of [X]. For example, if a language neutralizes gender distinctions, it also neutralizes person distinctions, etc.

(66) person ≪ gender ≪ number

In the context of an impoverishment analysis, (66) must be encoded as a restriction on possible impoverishment rules. Baier (2018:112) accomplishes this by treating impoverishment as delinking in the hierarchical morphological structure in (67) (cf. section 2.1). ϕ_N, ϕ_G, and ϕ_P encode number, gender, and person features, respectively, whose specific values are encoded on a second dimension of the hierarchy, not shown here.

(67)
$$\left[\begin{array}{c} \phi_N \\ | \\ \phi_G \\ | \\ \phi_P \end{array}\right]$$

By treating impoverishment as delinking, Baier derives the implicational relationship encoded in (66). Because ϕ_G dominates ϕ_P, delinking of ϕ_G in (67) entails that ϕ_G is delinked as well, and that only ϕ_G is retained. As Baier (2018) himself notes, the hierarchy in (66) is not the same as Noyer's (1992, 1997) hierarchy in (22). One specific example where the two conflict is Noyer's (1992, 1997) rule for Arabic (21), which impoverishes [feminine] in the 1st person.

[24] This proposal is embedded in Deal's (2015) distinction between "interaction" and "satisfaction" in agreement, whereby a probe searching for feature α also copies feature β if α and β are part of the same feature class. Correspondingly, Baier proposes that [Φ] and [$\bar{A}$] are part of the same class $\mathcal{F} = \{\Phi, \bar{A}\}$.

Thus, while neutralization patterns in individual domains exhibit intriguing generalizations, the question to what extent these are identical across domains and what this implies about the proper treatment of impoverishment remains open.

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