# Levels in Pāṇini's *Aṣṭhādhyāyī*

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**Abstract.** In 1969 Kiparsky and Staal proposed that Pāṇini's *Aṣṭhādhyāyī* contained a four-level hierarchy of rules. While modifying the interrelation of the levels, Kiparsky (2002) still maintains the four-level hierarchy. R. Rocher (1964: 51) and Cardona (1976: 215-224) argued against such a hierarchy, the former maintaining that Pāṇini operated just with a two-level hierarchy of meaning and speech. Cardona was willing to accept the propriety of speaking of one intermediate level on the grounds that the assignment of kāraka terms involved both semantic and cooccurrence conditions. The present paper clarifies the issue, argues that the assignment of abstract *l*-affixes to the same level as kāraka classification by Kiparsky is problematic, that most rules considered to be purely phonetic (sandhi rules) in fact include morphological conditions and concludes that although there are intermediate stages in derivation, Pāṇini considers there to be just two levels. The semantic and syntactic levels are properly coalesced in a syntacticosemantic level and the abstract morphological and the morphophonemic level are properly coalesced in a single morphophonemic level.

**Keywords.** levels, generative grammar, Panini, Astadhyayi, phonology, morphology, syntax, semantics, morphophonemic, syntacticosemantic, computational implementation.

## I.   Kiparsky's architecture

One of the most prominent contemporary linguistic models used to interpret Pāṇinian grammar is the idea that grammar consists of modules in a generative hierarchy, or levels. Clearly influenced by Chomskian generative grammar, Kiparsky and Staal (1969) proposed that Pāṇinian grammar contains rules in a hierarchy of four levels of representation: semantics, deep structure, surface structure, and phonology. More recently Kiparsky (2002) restates this scheme referring to the four levels as follows: (1) semantic, (2) morphosyntactic, (3) abstract morphological, and (4) phonological (see Fig. 1). Three classes of rules map prior levels onto subsequent levels: (1) rules that assign kārakas and abstract tense, (2) morphological spellout rules, and (3) rules of allomorphy and phonology. Rules incorporate conditions at both the levels from which and to which they map, as well as at prior levels in a unidirectional derivation beginning with semantics and ending with phonology.

As an example of how derivation is understood to work in the four-level hierarchy, one may take the derivation of the sentence *Devadatta odanaṁ pacati* (Fig. 2). At the semantic level, the speaker intends to express that Devadatta, called here John Doe,

undertakes the action of cooking in present time for the purpose of making boiled rice. Pāṇinian semantics classifies John Doe as the independent agent in the action, and boiled rice as that which is desired to be obtained. Four rules apply to map the semantic level onto the morphosyntactic level. 1.4.49 and 1.4.54 assign kārakas, 3.4.69 lets an *l*-affix occur to denote an agent (*kartṛ*), and 3.2.123 assigns abstract tense by introducing the *l*-affix *laṭ* on the condition that present time is to be denoted.

| | |
|---|---|
| 1. | Semantic information |
| ↓ | Assignment of kārakas (th-roles) and of abstract tense |
| 2. | Morphosyntactic representation |
| ↓ | Morphological spellout rules |
| 3. | Abstract morphological representation |
| ↓ | Allomorphy and phonology |
| 4. | Phonological output form |

**Fig. 1.** Levels according to Kiparsky 2002: 3.

1. John Doe$_{[svatantra]}$ rice$_{[īpsitatama]}$ cooks$_{[vartamāna]}$.
   John Doe$_{[independent]}$ rice$_{[desideratum]}$ cooks$_{[present]}$.

   ↓  1.4.49  *kartur īpsitatamaṁ karma*
   1.4.54  *svatantraḥ kartā*
   3.4.69  *laḥ karmaṇi ca bhāve cākarmakebhyaḥ*
   3.2.123  *vartamāne laṭ*

2. Devadatta$_{[kartṛ]}$ odana$_{[karman]}$ ḍupacaṣ+laṭ.
   Devadatta$_{[agent]}$ odana$_{[direct\ object]}$ pac+laṭ.

   3.4.78  *tiptasjhi...iḍvahimahiṅ*
   1.3.78  *śeṣāt kartari parasmaipadam*
   1.4.108  *śeṣe prathamaḥ*
   1.4.22  *dvyekayor dvivacanaikavacane*
   ↓  3.1.68  *kartari śap*
   4.1.2  *svaujasamauṭ...ṅyossup*
   2.3.2  *karmaṇi dvitīyā*
   2.3.46  *prātipadikārthaliṅgaparimāṇavacanamātre prathamā*

3. Devadatta+su odana+am ḍupacaṣ+śap+tip.
   Devadatta+$_{[nom]}$ odana+$_{[acc]}$ pac+$_{[3sa\ pre]}$.

   1.3.9  *tasya lopaḥ*
   6.1.107 *ami pūrvaḥ*
   ↓  8.3.17  *bhobhagoaghoapūrvasya yo 'śi*
   8.3.19  *lopaḥ śākalyasya*
   8.3.23  *mo 'nusvāraḥ*

4. Devadatta odanaṁ pacati.
   Devadatta cooks rice.

**Fig. 2.** Example of Four-level Derivation

Several "spellout" rules then apply to map the morphosyntactic level onto the abstract morphological level. 3.4.78 provides that a basic verbal termination replaces the *l* of the affix *laṭ* that occurs after the verbal root *pac*. Restrictive rules 1.3.78, 1.4.108 and 1.4.22, read in conjunction with 3.4.78, select the third person singular active (3sa) affix *tip* on condition that a single agent that is neither the speaker nor the addressee is to be denoted. Before the affix *tip* (termed *sārvadhātuka* by 3.4.113 *tiṅśit sārvadhātukam*), 3.1.68 provides the default verbal stem-forming affix *śap* to cosignify the agent. Then 4.1.2 provides nominal terminations. Restrictive rules 2.3.2, 2.3.46, and 1.4.22, read in conjunction with 4.1.2 select the appropriate nominal termination. 2.3.2 selects a second triplet nominal termination (*dvitīyā*) after the stem *odana* on condition that the kāraka *karman*, which has not yet been denoted (*anabhihite* 2.3.1), is to be denoted. 2.3.46 selects a first triplet nominal termination (*prathamā*) after the stem *devadatta* on condition that just the stem meaning, gender, and number are to be denoted. (The kāraka *kartṛ* has already been denoted by the verbal termination thus preventing 2.3.18 *kartṛkaraṇayos tṛtīyā* from applying.) 1.4.22 selects the singular terminations *am* (2s) and *su* (1s), respectively in each triplet.[1]

Finally, several rules of allomorphy (of which there are none in the present example) and phonology apply to map the abstract morphological level onto the phonological level.[2]

The example of the derivation of the sentence *Brāhmaṇāya phalāny adāt*, shown in Fig. 3, provides greater detail. At the semantic level, the speaker intends to express that someone, indicated by an X, undertakes the action of giving in past time for the purpose of transferring his ownership of fruit to a Brahmin. Pāṇinian semantics classifies X as the independent one in the action, and the fruit as that which is desired to be obtained. Five rules apply to map the semantic level onto the morphosyntactic level. 1.4.32, 1.4.49 and 1.4.54 assign kārakas, 3.4.69 lets an *l*-affix occur to denote an agent (*kartṛ*), and 3.2.110 assigns abstract tense by introducing the *l*-affix *luṅ* on the condition that past time is to be denoted.

Several "spellout" rules then apply to map the morphosyntactic level onto the abstract morphological level. 3.4.78 provides that a basic verbal termination replaces the *l* of the affix *luṅ* that occurs after the verbal root *dā*. Restrictive rules 1.3.78, 1.4.108 and 1.4.22, read in conjunction with 3.4.78, select the third person singular active (3sa) affix *tip* on condition that a single agent that is neither the speaker nor the addressee is to be denoted. Before the affix *tip* (termed *sārvadhātuka* by 3.4.113 *tiṅśit sārvadhātukam*), 3.1.43 provides the default abstract verbal stem-forming affix *cli* that occurs with verbal terminations that replace *luṅ*. Then 4.1.2 introduces nominal terminations. Restrictive rules 2.3.2, 2.3.13, and 1.4.22, read in conjunction with 4.1.2 select the appropriate nominal terminations. 2.3.2 selects a second triplet nominal termination (*dvitīyā*) after the stem *phala* on condition that the kāraka *karman*, which has not yet been denoted (*anabhihite* 2.3.1), is to be denoted. 2.3.13 selects a fourth triplet nominal termination (*cathurthī*) after the stem *brāhmaṇa* on condition

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[1] Rules 1.4.99-108 that designate verbal and nominal terminations in the lists 3.4.78 and 4.1.2 by terms that allow selection according to person, number, and voice are not shown.

[2] The rule that deletes markers, 1.3.9, is shown here though its application is simultaneous with the introduction of affixes.

that the kāraka *saṁpradāna* is to be denoted. 1.4.21 selects the plural second-triplet termination *śas* (2p) after the stem *phala*, and 1.4.22 selects the singular fourth-triplet termination *ṅe* (4s) after the stem *brāhmaṇa*.

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1. X$_{[svatantra.eka]}$ Brahmin$_{[karmaṇā\ yam\ abhipraiti.eka]}$ fruit$_{[īpsitatama.bahu]}$
   gave$_{[bhūta.śeṣa.eka]}$·
   X$_{[independent.one]}$ Brahmin$_{[whom\ one\ intends\ with\ the\ direct\ object.one]}$
   fruit$_{[desideratum.many]}$ gave$_{[past.3rdperson.one]}$·

   1.4.32   *karmaṇā yam abhipraiti sa saṁpradānam*
   1.4.49   *kartur īpsitatamaṁ karma*
   ↓   1.4.54   *svatantraḥ kartā*
   3.4.69   *laḥ karmaṇi ca bhāve cākarmakebhyaḥ*
   3.2.110   *luṅ* (*bhūte* 84)

2. Brāhmaṇa$_{[saṁpradāna.eka]}$ phala$_{[karman.bahu]}$
   ḍudāñ+luṅ$_{[kartṛ.bhūta.śeṣa.eka]}$·
   Brāhmaṇa$_{[indirect\ object.one]}$ phala$_{[direct\ object.many]}$
   dā+luṅ$_{[3rdperson.one]}$·

   3.4.78   *tiptasjhi...iḍvahimahiṅ*
   1.3.78   *śeṣāt kartari parasmaipadam*
   1.4.108   *śeṣe prathamaḥ*
   1.4.21   *bahuṣu bahuvacanam*
   ↓   1.4.22   *dvyekayor dvivacanaikavacane*
   3.1.43   *cli luṅi*
   4.1.2   *svaujasamauṭ...ṅyossup*
   2.3.2   *karmaṇi dvitīyā*
   2.3.13   *caturthī saṁpradāne*

3. Brāhmaṇa+ṅe$_{[caturthī.ekavacana]}$ phala+śas$_{[dvitīyā.bahuvacana]}$
   ḍudāñ+cli+tip$_{[luṅ.prathama.ekavacana]}$·
   Brāhmaṇa+$_{[dative.sg]}$ phala+$_{[accusative.pl]}$ dā+$_{[3sa\ aor]}$·

   1.3.9   *tasya lopaḥ*
   3.4.100   *itaś ca* (*ṅitaḥ* 99, *lasya* 77, *lopaḥ* 97)
   3.1.44   *cleḥ sic*
   1.4.99   *laḥ parasmaipadam*
   2.4.77   *gātisthāghupābhūbhyaḥ sicaḥ parasmaipedeṣu* (*luk* 58)
   7.1.13   *ṅer yaḥ*
   ↓   7.1.20   *jaśśasoḥ śiḥ* (*napuṁsakāt* 19)
   1.1.42   *śi sarvanāmasthānam*
   7.1.72   *napuṁsakasya jhalacaḥ* (*num* 58)
   7.3.102   *supi ca* (*ato dīrgo yañi* 101)
   6.4.8   *sarvanāmasthāne cāsaṁbuddhau* (*nopadhāyāḥ* 7, *dīrghaḥ* 6.3.111)
   6.4.71   *luṅlaṅlṛṅkṣv aḍ udāttaḥ*
   6.1.77   *iko yaṇ aci*

4. Brāhmaṇāya phalāny adāt.
   He gave fruit to the Brahmin.

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**Fig. 3.** Fuller Example of Four-level Derivation

Finally, several rules of allomorphy and phonology apply to map the abstract morphological level onto the phonological level. Three rules modify the basic terminations provided after the verbal and nominal stems: 3.4.100 deletes the *i* in the basic verbal termination *ti* that replaces *luṅ*, 7.1.13 replaces the basic singular fourth triplet nominal termination *ṅe* with *ya*, and 7.1.20 replaces the basic plural second triplet nominal termination *śas* after a neuter stem with *śi*. Two rules modify the verbal stem-forming affix: By 3.1.44 *cli* is replaced by the *s*-aorist stem-forming affix *sic*, and 2.4.77 deletes it after the root *dā* before a verbal termination termed *parasmaipada* by 1.4.99. Four rules modify the nominal and verbal stems: 7.1.72 provides the augment *n* after the final vowel of the vowel-final neuter stem *phala* before the termination *śi* which is termed *sarvanāmasthāna* by 1.1.42; 6.4.8 lengthens the penultimate vowel of an *n*-final stem before such a termination, 7.3.102 lengthens the final vowel of an *a*-final stem before a nominal termination that begins with a semivowel, nasal, *jh*, or *bh* (here the *y* in *ya*), and 6.4.71 adds the augment *a* to the beginning of a stem followed by a termination that replaces *luṅ*, *laṅ*, or *lṛṅ*. Finally, a purely phonetic rule applies: In *phalāni*, 6.1.77 replaces the vowel *i* followed by a vowel with *y*.[3]

## II.  Kārakas

As early as 1964, R. Rocher (1964: 51) criticized the characterization of kārakas as syntactic categories, instead arguing that they are semantic. Calling them syntactico-semantic, Cardona (1976: 215-224) countered that it is suitable to consider kārakas as a level between the purely semantic level and the level at which nominal terminations are introduced (the abstract morphological level in Kiparsky 2002) because the rules that introduce kāraka terms include both semantic and co-occurrence conditions.

It is certainly the case that co-occurrence conditions enter into kāraka classification rules, and therefore that the kāraka classification is an intermediate stage of derivation between that of semantic conditions and that of the introduction of nominal terminations. The intermediate stage is a way of achieving a complex mapping between meaning and speech. It is possible that such an intermediate stage serves merely the purpose of procedural economy and does not imply that kāraka classification constitutes a level in any psychological or structural sense. Pāṇini may conceive of just two levels: semantic (*artha*) and phonetic (*śabda*).

## III.  *L*-affixes

In their description of levels, Kiparsky and Staal place *l*-affixes at the same level as kārakas. Kiparsky (2002: 3) describes "Assignment of kārakas (th-roles) and of abstract tense" as the function of the first set of rules mapping the semantic level to the morphosyntactic level. The treatment of *l*-affixes by Pāṇini, however, differs markedly from the treatment of kārakas. Kārakas are semantic objects classified by being designated by terms (*sañjñā*). Section 1.4 classifies semantic objects intended to be expressed by a speaker in relational categories by calling them by a kāraka term.

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[3] Notes 1-2 apply to Figure 3 as well.

Speech forms are subsequently introduced under the condition that an item designated by a kāraka term is to be denoted. *L*-affixes, in contrast, are introduced under semantic and syntactic conditions, just as other affixes are, and then are replaced by morphological elements; they serve therefore as abstract morphological elements themselves (level 3) rather than as morphosyntactic representations (level 2).[4] Kiparsky's placement of *l*-affixes in level 2 rather than level 3 therefore sharply contrasts with Pāṇini's treatment.

Part of the motivation for assigning *l*-affixes to the level of morphosyntactic representation and their replacements *tip*, *tas*, *jhi*, etc. to the level of abstract morphological representation is to place the basic set of verbal terminations and the basic set of nominal terminations at the same level in the hierarchy and thereby to achieve parallelism between them. 1.4.14 *suptiṅantaṁ padam* refers to basic verbal (*tiṅ*) and nominal (*sup*) terminations alike as the items ending in which a phonetic string is termed a word (*pada*). Just as the basic nominal terminations *su*, *au*, *jas*, etc. are distributed over semantic and syntactic conditions including kāraka and number, the basic verbal terminations *tip*, *tas*, *jhi*, etc. are distributed over the same conditions kāraka and number, and similar conditions such as person (*puruṣa*). Kiparsky (2002: 3) calls the rules that achieve this distribution 'morphological spellout rules'. 3.4.78 *tiptasjhi...* introduces the basic set of verbal terminations just as 4.1.2 *svaujas...* introduces the basic set of nominal terminations. These sutras are read in conjunction with restrictive rules (*niyama*) that achieve the proper distribution over the conditions of number (1.4.21-22),[5] person (1.4.105-108),[6] and kāraka (pāda 2.3 for nominal terminations, and 1.3.13-93 for verbal terminations).

However, the parallelism is incomplete. The verbal terminations introduced by 3.4.78 are not distributed over the conditions of time and mood as the nominal terminations introduced by 4.1.2 are distributed over kārakas. On the contrary, it is rather the *l*-affixes introduced by 3.2.110 *luṅ*, 3.2.111 *anadyatane laṅ*, etc. that are distributed over time and mood. Moreover, the conditions under which *l*-affixes are introduced include kārakas. 3.4.69 *laḥ karmaṇi ca bhāve cākarmakebhyaḥ* provides that *l*-affixes occur under the condition that a *kartṛ* is to be denoted or either a karman or bhāva. The later alternative depends upon whether the root after which the *l*-affix occurs is transitive or intransitive, i.e. occurs with (*sakarmaka*) or without (*akarmaka*) a direct object (*karman*); after intransitive verbal roots the *l*-affix is introduced under the condition that the action itself (*bhāva*) is to be denoted, while after transitive verbal roots the *l*-affix is introduced under the condition that the direct object is to be denoted. 3.4.69 thus accounts for the distribution of *l*-affixes over certain kāraka conditions. In the derivations in Figure 2 and Figure 3, 3.4.69 is clearly out of place; as a rule that maps an abstract morphological element onto a kāraka, it is alone in the section of rules that map from level 1 to level 2. The other rules that map onto kārakas (1.3.78, 3.1.68, and 2.3.2 in Fig. 2; 1.3.78, 2.3.2, and 2.3.13 in Fig. 3) all occur between levels 2 and 3. Verbal terminations, including the so-called basic verbal termi-

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[4] Cardona (1997: 496) calls them "abstract affixes".

[5] 1.4.21 *bahuṣu bahuvacanam.* 1.4.22 *dvyekayor dvivacanaikavacane.*

[6] 1.4.105 *yuṣmady upapade samānādhikaraṇe sthāniny api madhyamaḥ.* 1.4.106 *prahāse ca manyopapade manyater uttama ekavac ca.* 1.4.107 *asmady uttamaḥ.* 1.4.108 *śeṣe prathamaḥ.*

nations, are morphophonemic replacements of the *l*-affixes. On the grounds of the parallelism between *l*-affixes and basic nominal terminations, in addition to the fact that they, like the basic nominal terminations *su*, *au*, *jas*, etc. are initially introduced items rather than replacements, *l*-affixes, rather than the basic verbal terminations *tip*, *tas*, *jhi*, etc., would properly be placed at the same level as basic nominal terminations in a fourfold hierarchy of levels.

Moving *l*-affixation to the level of abstract morphological representation would require that basic verbal terminations appear subsequently in the transformation of abstract morphology to phonological output. Such a move is entirely unproblematic. There are no objective criteria to distinguish the level of the basic verbal terminations that replace *l*'s from the level of the nominal terminations that replace the basic nominal terminations *su*, *au*, *jas*, etc. Just as *l*'s are the primary elements introduced after verbal stems, basic nominal terminations *su*, *au*, *jas*, ..., *ṅi*, *os*, *sup* are the primary elements introduced after nominal stems and feminine affixes. Basic verbal terminations replace *l*'s by 3.4.78, and other verbal terminations replace basic verbal terminations by 3.4.79-112, 7.1.3-5, 7.1.35, 7.1.40-46, etc.[7] Replacements include partial as well as total replacements. For example, by 3.4.79 *ṭita ātmanepadānāṁ ṭer e*, under the condition that the basic verbal terminations are marked with *ṭ*, the segment of the basic ātmanepada terminations *ta*, *ātām*, *jha*, etc. that consists of the last vowel and any following consonants is replaced by *e;* while by 3.4.79 the entire basic verbal termination *thās* is replaced by *se*. The basic verbal terminations inherit markers and other properties from the *l* they replace in accordance with the principle, stated in 1.1.56 *sthānivad ādeśo 'nalvidhau*, that replacements have the status of their substituends. Having the status of their substituends likewise extends to the replacements of basic verbal terminations so that verbal forms qualify to be termed *pada* by 1.4.14.

There is no segregation of the type of conditions under which replacements of basic verbal terminations and their subsequent replacements occur, nor any segregation of such conditions according to the location of the sūtras that provide such replacements in the *Aṣṭādhyāyī*. Replacements of the basic terminations in the third adhyāya include phonological conditions, and subsequent replacements in the seventh adhyāya include semantic conditions. For example, 3.4.109-111 include morphological and phonological conditions in the provision that *jus* replaces the *jhi* that replaces *l* marked with *ṅ*. Thus 3.4.109 *sijabhyastavidibhyaś ca* includes the condition that the *jhi* follows the vikaraṇa *sic*, a reduplicated root (*abhyasta*), or the class 2 root *vid*; 3.4.110 *ātaḥ* includes the phonological condition that the *jhi* follows an *ā*-final root after the deletion (*luk*) of *sic;*[8] and 3.4.111 *laṅaḥ śākaṭāyanasyaiva* allows the replacement, in the opinion of Śākaṭāyana, also if the *jhi* that replaces *laṅ* follows an *ā*-final root. On the other hand, 7.1.35 *tuhyos tātaṅ āśiṣy anyatarasyām* provides that *tātaṅ* optionally replaces *tu* or *hi*, which are themselves derived from the basic verbal terminations *tip* and *sip* respectively by 3.4.86-87, under the semantic condition that a wish is to be expressed (*āśiṣi*).

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[7] Cardona (1997: 487-496) analyses the abstraction of a set of basic verbal terminations first introduced as replacements of *l* by 3.4.78 from verbal terminations that occur in various tenses, aspects, and moods and (1997: 273-279) discusses rules that derive the occuring verbal terminations from the basic verbal terminations.

[8] Cardona (1997: 278) provides details of the derivation of examples.

Likewise, basic nominal terminations are replaced under phonological conditions as well as semantic conditions. For example of the former, after *a*-final stems 7.1.9 *ato bhisa ais* replaces the basic nominal termination *bhis* by *ais*, 7.1.12 *ṭāṅasiṅasām ināṭsyāḥ* replaces the basic nominal terminations *ṭā*, *ṅasi*, and *ṅas* by *ina*, *at*, and *sya*, and 7.1.13 replaces the basic nominal termination *ṅe* by *ya*. For example of the latter, 7.1.19 *napuṁsakāc ca* and 7.1.20 *jaśśasoḥ śiḥ* replace the basic dual and plural first-triplet nominal terminations by *śī* and *śi* respectively after neuter stems.

The fact that there are no objective criteria to distinguish the character of replacements of *l*-affixes from replacements of nominal terminations makes the relocation of basic verbal terminations to the chain of morphophonemic changes that occur in the transformation of abstract morphology to phonological output entirely suitable.


## IV. Abstract morphology versus phonology

The claim that the phonological output form resides on a different level from the abstract morphological representation is problematic. The abstract morphological representation often appears unchanged as the final phonological output, without having been subject to any additional rule. In the example *devadatta odanaṁ pacati* discussed in section I above (Fig. 2), the affix *-ti* in *pacati*, remains unchanged except for the dropping of the marker *p*.

Conversely, the abstract morphological representation often undergoes more than one permutation before arriving at its final phonological output form. The number of permutations is not correlated with the number of levels. In the same example, the final *s* in *devadattas* (*devadatta+su*) is placed at the level of abstract morphological representation (level 3). The *s* is first changed to *y* by 8.3.17 and then to zero (*lopa*) by 8.3.19 undergoing replacement twice in stepping one level. Figure 3 shows several instances in which there are multiple stages of derivation that take place in transforming abstract morphology to phonological output. Most notably 3.1.44 replaces *cli* (introduced at the level of abstract morphology by 3.1.43) with *sic* which 2.4.77 subsequently deletes.

In contrast to *pacati* in Figure 1, an extra stage of replacement occurs in the derivation of the form *pacanti* (3pa pre: *pac-a-anti < pac-a-jhi < pac-jhi < pac-laṭ*). The *l* of *laṭ* is replaced by *jhi* in accordance with 3.4.78 *tiptasjhi...* and then the cover symbol *jh* is replaced by *ant* after *a*-final stems in accordance with 7.1.3 *jho 'ntaḥ*. The symbol *jh* is replaced by *at* instead after reduplicated stems in accordance with 7.1.4 *ad abhyastāt* and after stems that do not end in *a* before ātmanepada terminations in accordance with 7.1.5 *ātmanepadeṣv anataḥ*. Thus are accounted for forms such as *dadati* (3pa pre *dā* 'give') and *cinvate* (3pm pre *ci* 'collect') respectively. The use of the cover symbol *jh* achieves a valuable generalization in unifying the verbal terminations of the third person plural that do and do not contain *n*. Without privileging either *ant* or *at* as the more basic termination, the former of which is more common in parasmaipada terminations and the latter of which is more common in ātmanepada terminations, positing *jh* as basic nevertheless achieves the same economy of rules as would be achieved by positing *ant* as the basic termination.

# Levels in Pāṇini's *Aṣṭhādhyāyī*

It is certainly arguable that in some instances the choice of abstract morphological representation, whether it ever appears in phonological output or not, is motivated by procedural economy and proportional representation of forms that actually occur. Cardona (1997: 330-332) discusses cover symbols and (490-492) demonstrates the economy and elegance of the inclusion of the cover symbol *jh* in the basic verbal terminations. The reasons for the use of the abstract symbol *cli* as the basic aorist stem-forming-affix are less apparent. To what extent procedural economy and proportional representation in phonological output serve as the criteria to determine the choice of abstract morphological representation requires further investigation. It is nevertheless certainly clear that the choice of the particular abstract morphological representation in some cases is identical to a final phonological output; in other cases it requires several stages of transformation to reach phonological output; and in still others it never appears as phonological output. The last is precisely what the previous section argued is the situation with *l*-affixes. Just as *jh* and *cli* are abstract morphological representations at level 3, *l*, with various markers, is the abstract morphological representation of all verbal terminations. Since the number of permutations is not correlated with the number of levels, the fact that *l*'s undergo more than one permutation before reaching final phonological output form in most verb forms is not grounds for segregating these permutations into separate levels, just as it is not grounds for positing a separate level for the *y* posited as a replacement for the nominal termination *su* in accordance with 8.3.17 (Fig. 2), or for *sic* which replaces *cli* by 2.4.77 (Fig. 3), both of which undergo an additional permutation before appearing in final phonological output.

Once *l*-affixes are postponed one level to the level of abstract morphology, basic verbal terminations *tip*, *tas*, *jhi*, etc. are seen to be simply one additional morphophonemic modification of *l*-affixes, just like, for example, the imperative terminations *tu*, *tām*, *antu*, etc. which are further morphophonemic modifications of the basic verbal terminations *tip*, *tas*, *jhi*, etc., and just like *ais* (introduced after *a*-final stems by 7.1.9 *ato bhisa ais*) which is a morphophonemic modification of the basic nominal termination *bhis*.

The only justification for considering that *l*-affixes belong to the level of morpho-syntactic representation rather than to the level of abstract morphological representation like other abstract affixes such as *cli* and *jh* is that the conditions for the replacement of *l*-affixes include semantics and syntax while the conditions for the replacement of *cli* (by 3.1.44) and *jh* (by 7.1.3-5) are only morphological and phonological. However, this criterion is invalid. As Scharf (2008: sections IVB and IVD2) pointed out, Houben (1999) demonstrated that semantic factors directly serve as conditions even in phonological rules, and Cardona (personal communication) pointed out that most phonological rules include syntactic conditions. Houben (1999: 46) illustrated the direct use of semantic and pragmatic factors as conditions for phonetic modifications to strings in the section of rules 8.2.82-108. Factors such as giving a responding greeting to someone belonging to a higher caste than a śūdra (8.2.83 *pratyabhivāde 'śūdre*) and calling from a distance (8.2.84 *dūrād dhute*) conjoin with the syntactic condition, specified in the heading to the section (8.2.82 *vākyasya ṭeḥ pluta udātta*), that the string be a sentence to condition vowel prolongation and high tone. Since semantic and syntactic conditions can serve as conditions in rules that map from abstract morphological representation (level 3) to phonological output form (level 4) it is not the case that conditions are restricted to the levels from which and to

which they map. Kiparsky (2002) conceded that rules incorporate conditions at prior levels as well. Therefore the fact that rules that replace *l*-affixes include semantic and syntactic conditions is not sufficient grounds for preponing *l*-affixes to the level of morphosyntactic representation. The real motivation for doing so must be recognized as a twentieth century conception of a fourfold distinction between semantics, syntax, morphology, and phonetics.

## V.   Conclusions

Stages of replacement vary greatly in the production of speech forms; there is no clear association between those stages and any psychological or conceptual level. In distinction to potentially multiple stages of affixes and their replacements, it seems to me that just one level is involved once an affix has been introduced. The fact that Pāṇini uses the technique of replacement for the derivation of the final output form from an abstract morphological representation indicates that the replacement is considered to belong to the same level rather than to a different one; it belongs to the morphophonemic level as opposed to the syntacticosemantic level.

The semantic and syntactic levels are properly coalesced in a syntacticosemantic level and the abstract morphological and the morphophonemic levels are properly coalesced in a single morphophonemic level. While Pāṇini derives forms through numerous un-correlated stages of derivation, he makes a clear distinction between the level of meaning and the level of speech.

The concept of levels in Pāṇinian grammar, and the hierarchy of four levels proposed by Kiparsky and Staal, was inspired by divisions that evolved in modern linguistics. It is anachronistic to read them into the *Aṣṭādhyāyī*. Kiparsky himself (2002: 2) hedges his attribution of levels to Pāṇini calling them, "what we (from a somewhat anachronistic modern perspective) could see as different levels of representation." Pāṇini's grammar certainly worked with two levels: meaning and speech. Its derivational procedure certainly included more than two stages. However, it appears forced to press the derivational stages into a conceptual hierarchy of levels between the purely semantic and the purely phonetic, particularly into a four-level hierarchy corresponding to modern linguistic divisions.[9] Consequently, it would be inappropriate to call a computational implementation of such a four-level hierarchy a close model of Pāṇinian methodology.

In working within the two levels meaning and speech, Pāṇini does stratify these levels so that it is possible to consider that there are four levels, though these do not align neatly with the modern conceptions of semantics, syntax, morphology, and phonology. The level of meaning can be stratified into an initial stage of naive worldly semantics as opposed to a subsequent stage of syntacticosemantic organization ready to serve as conditions for morphophonemic rules. The level of sound can be stratified into an initial stage in which basic morphophonemic elements, including abstract

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[9] Hyman (2003: 188-89) argues that Herodian's recognition of three types of linguistic errors--namely, barbarism, solecism, and acyrologia--corresponds to the threefold distinction of phonology, morphosyntax, and semantics.

morphological elements, are introduced and a final stage of the finished phonological form. In this way one does arrive at a four-fold hierarchy with three types of rules: rules that organize the syntacticosemantic level, rules that introduce basic elements, and rules that modify introduced elements. Rules that organize the syntacticosemantic field include kāraka classification. Rules that introduce basic elements include the rules that introduce affixes after roots and stems in chapters 3-5 of the *Aṣṭādhyāyī*. Rules that modify introduced elements include rules of augmentation, substitution, and deletion. The criteria for the segregation of such rules are obvious in the syntax and purport of the rules themselves.

## VI. Implications for computational modeling

Because it is incorrect to assert that *l*-affixes, which would be more appropriately placed in the level of abstract morphological representation, and kārakas, which belong to the level of morphosyntactic representation, occupy the same level in a four-level hierarchy, therefore a four-module implementation based on such a hierarchy would not produce a close computational model of Pāṇinian procedure if it implemented rules that provide *l*-affixes in the same module as rules that classify kārakas. Likewise, because it is incorrect to assert that verbal terminations, which are morphophonemic modifications of *l*'s brought about by 3.4.78, etc., and the nominal terminations *su*, *au*, *jas*, etc., which are affixes that serve as abstract morphological representation initially introduced by 4.1.2, occupy the same level, it would not produce a close computational model of Pāṇinian procedure to implement these rules in the same module. In a computational model based upon a hierarchy of levels that modeled Pāṇinian procedure, *l*-affixes would have to be introduced in the same module that introduced other affixes, in a module prior to a module that provided morphophonemic replacements of them, and in a module subsequent to one that classified kārakas. Verbal terminations would have to replace *l*-affixes in the same module that provided other morphophonemic replacements of abstract morphological representations, and in a module subsequent to one that initially introduced affixes.

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