

THE INADEQUACY OF THE INERTIAL DEVELOPMENT PRINCIPLE IN ACCOUNTING FOR SOUND CHANGES IN SEVERAL AUSTRONESIAN LANGUAGES

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1.0. James Foley's inertial development principle (henceforth, IDP) in phonology (Foley 1970a,b, 1973, 1977) has been applied to account for sound changes in certain European languages (mostly Germanic) by Foley himself, in Scots by Taylor (1973), and in several Austronesian languages (Malay, Indonesian, Javanese, Toba Batak, Tagalog, and Samoan) by Mashudi Kader (1979). While in certain Germanic languages the IDP seems to be, at first glance, reasonably adequate in explaining some aspects of sound change, in Austronesian languages, however, this principle is totally inadequate. Thus, the universal validity of the IDP that has been claimed by Foley and subscribed, among others, by Mashudi should be seriously questioned, especially with regard to sound changes in the above Austronesian languages.

In this paper we seek to show that the IDP is in many cases not only inadequate but somewhat strange in handling sound changes in the data offered by Foley and Mashudi, and even Taylor (1973). We would also like to argue that sociolinguistic as well as psycholinguistic aspects should not be excluded from any attempt at solving the problems of sound changes in any language (cf. Weinreich, Labov, and Herzog 1968; Slobin 1977; Baron 1977; Andersen 1973; Goyvaerts 1975; Simanjuntak and Ramii Salleh 1980), including the Austronesian languages. Further we will argue that the principles used to account for sound changes in one particular language may not be valid for other languages due to, among other things, different sociolinguistic aspects. However, before we proceed to discuss the application of the IDP to the Austronesian languages to see its adequacy/inadequacy, let us briefly sketch out what the IDP is all about.

2.0. Roughly the IDP (Foley 1977:107) states that:

- (1) strong elements strengthen first and most extensively and preferentially in strong environments, and
- (2) weak elements weaken first and most extensively and preferentially in weak environments.

The α and β scales of relative phonological strength of segments of the IDP

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is as follows (Foley 1977:34):

(1)	4	↑	kk	tt	pp
	3		k	t	p
β	2		g	d	b
	1		ɣ	ð	β
			1	2	3
			α		

The β strength scale arranges consonants according to manner of articulation and voicelessness/voicedness, whereas the α strength scale arranges consonants according to their place of articulation. Thus, following the above matrix of strength values we can immediately tell that p, for example, is stronger than b according to the β scale by one point, but they are of the same strength according to the α scale ($p=\alpha_3\beta_3$; $b=\alpha_3\beta_2$).

The notion of strength in the above IDP has been based on several observations made by Foley which indicate that in North German, Danish, and Spanish g spirantises more readily than d or b, and g and d spirantise more readily than b. Foley therefore establishes the above relation ($\begin{smallmatrix} g & d & b \\ 1 & 2 & 3 \end{smallmatrix}$) "which refers to the propensity to spirantization, with the weakest element being most inclined to spirantization... The relation α is the relative phonological strength of elements appearing phonetically as velars, dentals and labials" (1977:28).

The relation α has been determined by whether or not certain elements weaken. Other observations reveal that g weakens to ɣ but that d does not weaken to ð. This kind of weakening reveals that g is phonologically weaker than d and that ɣ is weaker than g. These relations ($\begin{smallmatrix} 2 & g & d & b \\ 1 & \uparrow & & \\ 1 & \gamma & \partial & \beta \end{smallmatrix}$) are called β phonological strength, "which reflects the fact that the weakened reflexes of voiced stops are voiced continuants" (1977:33).

Based on the same observations on Norwegian, Lithuanian, English and Latin, Foley has also created the relative phonological strength ρ as follows:

(2)	t	s	n	l	w	e
	1	2	3	4	5	6

where t stands for oral stops, s for continuants, n for nasals, l for liquids, w for glides, and e for vowels, and where higher number represents greater relative strength.

3.0. Unfortunately the above inertial development principles do not work the way they are supposed to, even in Germanic languages. According to the IDP, strengthening applies first to the strongest elements. Thus, in the second Germanic consonant shift the voiceless stops (β_3), being the strongest elements, strengthened before the voiced stops (β_2). Now let us consider the following examples that Foley gives (1977:107):

(3)	German	English	
	<i>Tür</i>	'door'	d (α_2)
	<i>Bart</i>	'beard'	b (α_3)
	<i>Grab</i>	'grave'	g (α_1)

Foley states that when the voiced stops do shift to the stronger voiceless stops, only the strongest voiced stop undergoes the shift, while the weaker voiced stops do not undergo the shift. So, in (3) *b* ($\alpha 3$) is the strongest element according to (1) but it does not shift, while the less stronger *d* ($\alpha 2$) does.

Another point which shows the cryptotaxonomic¹ nature of this Foleyan framework is its application to handle acoustically caused changes (Ohala 1974). According to Foley (1973:51), his concept of relative phonological strength (IDP) must be included within a theoretical system of phonology to account for what Foley considers as the phonological type of assimilation, that is, the kind of assimilation which cannot be explained phonetically. To clarify his point, Foley gives the following examples in Norwegian:

- (4) (a) *slem* [šlem] 'bad'
 sɪɪ [šlo] 'beat'
 Oslo [ošlo] 'Oslo'
- (b) *snakke* 'talk'
 snø 'snow'
 snar 'quick'

Foley states that "the conversion of *s* to *š* cannot be attributed to phonetic influences since *l* and *n* are both dentals, and in any case conversion of dental *s* to palatal *š* looks more like dissimilation than assimilation". (1973:51). He argues strongly that "there is no phonetic explanation for the palatalization of *s* before *l* but not before *n*" (p.51). So Foley offers a solution which he calls "a phonological explanation" (p.51) by applying the relative phonological strength ρ ((2) above): "*l* is phonologically stronger than *n*, and *s* is strengthened by proximity to *l* but not by proximity to the relatively weaker *n*; the strengthened *s* then manifests itself as *š*" (1973:51).

One thing that Foley forgets is that although *l* and *n* are both dentals they are two quite different segments especially acoustically, the *l* being (+lateral) and (-nasal) and the *n* being (-lateral) and (+nasal). Ohala (1974) has noticed the tendency among many phonologists to think of phonetically plausible processes as being primarily those involving articulatory assimilation by neglecting acoustically-caused changes. In the above examples (4), Foley has failed to explain the changes from the acoustic point of view which is phonetic in nature by immediately jumping to the conclusion that there is no phonetic explanation for the changes. Actually, if in (4) *s* palatalises to *š* before *l* but not before *n* we should not be surprised, it is quite common in assimilation, because *s* occurs in two quite different environments, namely (5) (a) and (b) below:

- (5) (a) *s* _____ *š*/ _____ *l*
 (b) *s* _____ idem/ _____ *n*

Hence, the two different environments are responsible for the acoustically, thus phonetically, plausible change. Einar Haugen (1942) has worked on this kind of change in Norwegian (cf. also Ohala 1974). In the cluster *sɪɪ*, the *l* is partially devoiced because of its proximity to *s* thus yielding [sɪɪ]. The partially devoiced [ɪ] is acoustically a fricative, and according to Haugen (1942) it is in fact very much like [š]. This acoustically caused assimilation in the word *slem* in (4) can be shown as follows:

(6)	/slɛm/	Underlying Form
	/sʎlɛm/	Partial Devoicing
	/sslɛm/	Acoustic Assimilation
	/ʃlɛm/	Cluster Simplification
	[ʃlɛm]	Phonetic Form

In the word *snakke* of (4), however, the cluster *sn* does not cause acoustic assimilation because the devoiced [ŋ] does not yield a fricative sounding [ʃ]. We can see clearly that there is no need to create a new theory (the IDP) just to explain a simple acoustic assimilation.

4.0. Let us now turn to the application of the IDP to Malay and Javanese, the first two Austronesian languages chosen by Mashudi (1979) to verify these principles:

(7) *Malay (Bahasa Malaysia)*

	Prefix-stem	Final form	Glosses
1a.	məŋ + kawal	məŋawal	'to guard'
b.	məŋ + gulun	məŋgulun	'to roll something'
2a.	məŋ + tulis	mənules	'to write'
b.	məŋ + dapat	məndapat	'to get, to obtain'
3a.	məŋ + pukul	məmukul	'to hit'
b.	məŋ + basuh	məmbasuh	'to wash'

Javanese

4a.	ŋ + kidol	ŋidol	'to the south'
b.	ŋ + gole?	ŋgole?	'to look for'
5a.	ŋ + tapo?	napo?	'to slap the mouth'
b.	ŋ + delo?	ndelo?	'to see'
6a.	ŋ + paku	maku	'to nail'
b.	ŋ + belah	mbelah	'to split'

In both Malay and Javanese, as in (7) above, Mashudi observes that "t disappears in a strong position (postnasal), while d remains. The disappearance of t in postnasal position is due to postnasal strengthening of t and not to assimilation or elision" (1979:35-36). (The dental t is used by Mashudi as a cover symbol for p and k as well). Thus, applying postnasal strengthening to t first, according to Mashudi, it will yield the correct results for both *mənules* and *məndapat*, as follows:

(8)	məŋ + dapat	məŋ + tules	Underlying Form
	mən + dapat	mən + tules	Ass.I.(ŋ → n/ ____ +d) ____ +t)
	mən + dapat	mən ⁺ tules	Positional Potentiation (t → t ⁺ /N+ ____)
	məndapat	mənules	Modular Depotentiation (t ⁺ → ∅)

In this paper we would like to argue that the disappearance of t in data (7) above is not due to postnasal strengthening, but is simply due to a phonological process called *coalescence of consonants* which is phonetically motivated. Or it can also be solved by the simple assimilation process in the traditional way of Generative Phonology. If it is due to postnasal strengthening t (β3 according to (1)) should not disappear, instead it should be strengthened to tt (β4), and

then we would get the wrong results:

- (9) 1a. məŋ + kawal → məŋ + kkawal → *məkkawal
 2a. məŋ + tulis → məŋ + ttules → *məttules
 3a. məŋ + pukul → məŋ + ppukul → *məppukul

The application of the Foleyian 'gadget' of the so-called 'modular depotentiation' by Mashudi to tackle the effacement of *t* is quite untimely and thus cannot be justified, because after *t* is strengthened to its strongest form *tt* it is not strengthened any more and there is no point in effacing it, but instead it should stay in its strongest form. This is also one of the drawbacks of the Foleyian framework of the IDP. When the IDP faces a problem it cannot handle, such as the supposed strengthening of a strong element which results in its lenition, Foley immediately creates a 'gadget' to tackle the problem, that is the 'modular depotentiation', "the special instance of the strongest element on a parameter when strengthened appearing phonetically as the weakest element" (1977:108). While Foley only says "appearing phonetically as the weakest element", Mashudi seems to feel like going a little bit further by effacing the element. This, we think, is a bit strange, because in the first instance, when an element is strengthened it becomes stronger, not weaker, let alone elided.

As has been mentioned above the disappearance of *t* in (7) can be explained in two ways: (a) by the traditional nasal assimilation process of the Generative Phonology (GP), or (b) by the phonological process of the coalescence of consonants also of the GP. The traditional nasal assimilation (a) is as follows (cf. Farid M. Onn 1976, 1980):

(10)	(a)1	məŋ + dapat	(a)2	məŋ + tulis	Underlying Form
		mən + dapat		mən + tules	Nasal Assimilation
		--		mənules	Cluster Simplification
		məndapat		mənules	Phonetic Form

In (10) (a)1 there is no need to apply the cluster simplification rule, because both *n* and *d* have the feature (+voice) which binds/renderers them as an easy-to-produce cluster (unmarked),² while in (10) (a)2 it has to be applied since *n* and *t* do not usually go together in Malay (the cluster *nt* is marked).

The phonological process of the coalescence of consonants (b) is only applied to problem (a)2 of (10) above as in (11) (a)2 below (cf. Simanjuntak 1979):

(11)	(a)1	məŋ + dapat	Underlying Form
		mən + dapat	Nasal Assimilation
		məndapat	Phonetic Form
	(a)2	məŋ + tulis	Underlying Form
		mə-n-ules	Coalescence
		mənules	Phonetic Form

In (11) (a)2 the marked cluster *ŋt* undergoes the coalescence process while in (11) (a)1 the unmarked cluster *nd* does not.

Schane (1973:56) explains the coalescence process as involving "both assimilation and reduction, [it] could be described as the joint action of these two processes". In the above coalescence process both elements *ŋ* and *t* must undergo assimilation and reduction in that order: first *ŋ* must assimilate to *t* and *t* to *ŋ* simultaneously, and then both must be reduced to *Ø*, or one of them

which contains the major features is modified and the other is deleted, to give place to the resultant assimilated form, the intermediary element, that is an element which in between η and t , the choice of which depends on which of the two has the major (stronger) features. In the above case the choice is n .³

In order to decide the intermediary element let us first list the features of both elements, thus:

(12)	Members of the coalescence process		Intermediary element
	η	t	n
voc	-	-	-
ant	-	+	+
cons	+	+	+
cor	-	+	+
hi	+	-	-
vc	+	-	+
bk	+	-	-
cont	-	-	-
lw	-	-	-
nas	+	-	+
str	-	-	-

(Based on Chomsky and Halle 1968)

From (12) above we can immediately see that η has two major features which t lacks, they are [+voice] and [+nasal]. On the other hand t has (hierarchically) high features which η lacks, they are [+anterior] and [+coronal]. In other words η is stronger than t in its voiceness and nasality, but t is stronger than η in its anteriority and coronality. Thus, the intermediary element must be one in between η and t that contains the four types of strength, namely voiceness, nasality, anteriority, and coronality and it must also be [+consonantal], because this feature is contained by both members of the coalescence process. The only element that meets these conditions is n (see (12) above). The above coalescence process which involves assimilation and reduction can be stated by the following rules:

- (13) (a) $\begin{matrix} <v\eta & \xrightarrow{\quad} & n/ & v & \xrightarrow{\quad} & t > \\ & t\eta & \xrightarrow{\quad} & n/ & \eta & \xrightarrow{\quad} & v > \end{matrix}$ or
- (b) $\begin{matrix} <v\eta & \xrightarrow{\quad} & n/ & v & \xrightarrow{\quad} & t > \\ & t\eta & \xrightarrow{\quad} & \phi/ & \eta & \xrightarrow{\quad} & v > \end{matrix}$

Either rule (13) (a) or rule (13) (b) can be chosen according to one's preference: in rule (13) (a) both members of the coalescence process (η and t) are changed (reduced) to n , while in rule (13) (b) one member (η) is modified to n and the other (t) is deleted (cf. Schane 1973:68).

In the data from Javanese above (7), two processes are responsible for the sound changes: total assimilation and coalescence.

- (14) (a) 1 $\eta + kidol$ $\eta idol$ '*to the south*'
 (a) 2 $\eta + tapo?$ $napo?$ '*to slap the mouth*'

In (14) (a)1 total assimilation process takes place, that is k is totally assimilated to ŋ, while in (14) (a)2 coalescence process yields the phonetic form [napo?]:



5.0. Let us now turn to Indonesian data. The same processes above can be applied to explain sound changes in the data from Indonesian taken by Mashudi (1979:38) below:

(15) *Indonesian*

	Prefix-stem	Final form	Glosses
(a)1	məŋ + kawal	məŋawal	'to guard'
(a)2	məŋ + pukul	məmukul	'to hit'

In (15) (a)1 total assimilation process is responsible for the elision of k in [məŋawal], while in (15) (a)2 coalescence process may be used to yield the phonetic form [məmukul]:



In this case the strength of the element p lies in its anteriority only, so the intermediary element should contain the feature [+anterior] in addition to the other two major features belonging to ŋ, which are [+voice] and [+nasal] and the shared feature [+consonantal], so the intermediary element is m (see (16) below):

(16) Members of the coalescence process Intermediary element

	ŋ	p	m
voc	-	-	-
ant	-	+	+
cons	+	+	+
cor	-	-	-
hi	+	-	-
vc	+	-	+
bk	+	-	-
cont	-	-	-
lw	-	-	-
nas	+	-	+
str	-	-	-

(Based on Chomsky and Halle 1968)

6.0. Let us now observe the following data from Toba Batak⁴ taken by Mashudi (1979:39) and compare them to the Proto-Austronesian (PAN) forms:

(17)	PAN	Toba Batak	Glosses
(a)	*tunked	tukkot	'a walking stick'
(b)	*zempu	ʝopput	'to pick up with the hand'
(c)	*dembar	hombar	'twin'
(d)	*sumpel	suppol	'a cork'
(e)	*pentas	pottas	'a platform'

In the above data (17) Mashudi refers to the development of *ŋk > kk in (17) (a), *mp > pp in (17) (b) and *nt > tt in (17) (e), but *mb > idem in (17) (c). Mashudi admits that he does not have examples for *nd > idem and *ng > idem. However, he takes these forms (in orthography): manggolom, mandege, and mambuwat, as additional data to support his argument, that in postnasal position in Toba Batak g, d, b, do not undergo strengthening and this in turn lends support to his claim that the IDP is universally valid. Unfortunately, in actual pronunciation, (17) (c) and the additional data are not as truthful as they look orthographically, because they are actually represented phonetically as follows (thus, g, d, b also undergo strengthening if the so-called strengthening really takes place):

(18)	hombar	[hobbar]	'twin' or 'next to'
	manggolom	[maggolom] ⁵	'to hold in the hand'
	mandege	[maddege]	'to set foot on'
	mambuwat	[mabbuwat]	'to take'

Of course Mashudi must not be blamed for this since Toba Batak data are usually taken from Van der Tuuk's books especially since one of them has been translated into English. Dempwolff (1934-38) and Dyen (1968) and others also take Toba Batak data from Van der Tuuk's books. Toba Batak is a notoriously difficult language to transliterate, and all the materials, especially the Batak 'pustaha' (manuscripts) studied and consulted by Van der Tuuk were written in Toba Batak script. In Toba Batak script the data in (18) are represented as follows (cf. Van der Tuuk 1862, 1971; Sibarani 1970):

(19)	Original form	Transliterated form
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ḥ ḥ x ʔ ʔ ḥ	hombar
ḥ ḥ ʔ x ḥ ḥ x	manggolom
ḥ ʔ ḥ ḥ	mandege
ḥ ḥ ʔ ḥ ḥ	mambuwat

The transliterated form is not the actual phonetic form of a word but it is the underlying form. So the actual phonetic representations of (19) are as in (18).

The translator of Van der Tuuk's *Tobasche spraak(k)unst* (A grammar of Toba Batak 1971) has also erred linguistically (or rather phonetically) speaking for putting all the Toba Batak transliterated forms in square brackets as if they were the actual forms in pronunciation.

From the contradictory data in (18) and (19) an immediate conclusion can be drawn that the IDP is inadequate as has been implicitly mentioned by Mashudi when he says: "I do not have examples for *nd > idem and *ng > idem" (1979:39).

The examples do not exist, however see note 4 in the case of *ŋg > idem, when the word is pronounced very slowly.

To clarify our point let us consider the following data from Toba Batak (Van der Tuuk 1971):

(20)	Transliterated form (Underlying form)	Phonetic form	Glosses
(a)	/tintinhu/	[tittittu] or [tittikku]	'my ring'
(b)	/napuranhu/	[napurattu] or [napurakku]	'my betel'
(c)	/onomhalak/	[onoppalak] or [onokkalak]	'six people'
(d)	/onomhorbo/	[onopporbo] or [onokkorbo]	'six buffaloes'

We think that the IDP is quite inadequate to explain the sound changes in data (20) above. However, let us try to apply the IDP to account for the development of nt > tt and nh > tt or kk in (20) (a) following exactly the steps Mashudi takes to explain the sound changes in data (17):

(21)	tintinhu	Underlying Form
	tint ⁺ inh ⁺ u	Positional Potentiation
	tinttinhhu	Depotentiation (t ⁺ → tt) (h ⁺ → hh)
	*tittihhu	Nasal Effacement (N → ∅ / ____ CC)

Here we get the final form *tittihhu which is not the correct form. If h (ρ₂ according to scale (2)) is strengthened because of its proximity to the stronger n (ρ₃ according to scale (2)), does it become h⁺ or k or what? Suppose it becomes k and not h⁺ like in (21), then the process will proceed like (22) below:

(22)	tintinhu	Underlying Form
	tint ⁺ inku	Positional Potentiation
	tinttin?u	Depotentiation (t ⁺ → tt) (k → ? according to the αβ scale)
	*titti?u	Nasal Effacement (N → ∅ / ____ CC) (N → ∅ / ____ C)

Actually when we come to the third step we get stuck because we do not have any cogent reason to depotentiate t⁺ in the cluster nt⁺ and k in the cluster nk. If, however, k should be depotentiated for no reason at all then we would get ? according to the combination of the α and the β scales. Then after the nasal effacement we get the wrong form: *[titti?u].

Another thing which is quite puzzling is the use of t⁺ and tt in the IDP. First Foley (1970) uses t⁺ (β₄) to indicate the strengthened t (β₃) and this 1970 version is used by Mashudi (1979). But then later Foley (1977) uses tt (also β₄) to indicate the strengthened t (β₃). From the use of the two versions we may conclude that t⁺ is the same as tt. But then Mashudi uses tt to indicate that

t^+ has been depotentiated, although the reason for this depotentiation is unclear. Foley uses or creates the so-called 'modular depotentiation' rule only when "the element is already the strongest element and cannot appear phonetically as a stronger element. In this case,... the strengthened strongest element undergoes modular depotentiation, appearing phonetically as the weakest element" (1977:123). In the above example (22) there is no reason to strengthen t twice. The first strengthening is reasonable because of its proximity to the stronger element n , but the second strengthening is baseless. If for no reason whatsoever the element t^+ must be strengthened then it should undergo the modular depotentiation rule because t^+ is already in its strongest form (β_4). If t^+ undergoes modular depotentiation then it will become the weakest element δ according to the β scale or k according to the α scale. In Toba Batak the element δ does not occur, so t^+ must undergo total weakening, that is, it must be effaced according to Foley (1977:123). So t^+ after strengthening should become either $\emptyset$ or k : whichever it is the final form is wrong. We can see how inadequate the IDP is in handling complicated sound changes of this nature.

According to our observations two phonological processes, assimilation (total or partial) and coalescence, are quite predominant in Austronesian languages. From our point of view (20) and (21) can be solved as follows:

(23)	tintinhu	Underlying Form
	nt $\rightarrow$ tt	Total Regressive Assimilation (n is totally assimilated to t and itself becomes t)
	nh $\rightarrow$ tt or $\rightarrow$ kk	Coalescence ($\langle \begin{smallmatrix} n \rightarrow t \\ h \rightarrow t \end{smallmatrix} \rangle$ or 6) $\langle \begin{smallmatrix} n \rightarrow k \\ n \rightarrow k \end{smallmatrix} \rangle$)
	tittittu or tittikku	Final Form

The coalescence process in (23) deserves further explanation. Both members of the process change to the same intermediary element: to either t or k depending on which member is preferred. If member n is preferred then the intermediary element must be a consonant which is homorganic with n , that is t ; however if the preferred member is h , then the intermediary element must be a consonant which is homorganic with h , that is k .

Problem (20) (b) can be solved in the same way as problem (20) (a), that is by solution (23). Problems (20) (c), (d), (e) can be solved as follows:

(24)	mh $\rightarrow$ pp or $\rightarrow$ kk	Coalescence ($\langle \begin{smallmatrix} m \rightarrow p \\ h \rightarrow p \end{smallmatrix} \rangle$ or $\langle \begin{smallmatrix} m \rightarrow k \\ h \rightarrow k \end{smallmatrix} \rangle$)
		The above can be stated as below:

$$\left\{ \begin{smallmatrix} m \\ h \end{smallmatrix} \right\} \rightarrow \left\{ \begin{smallmatrix} p \\ k \end{smallmatrix} \right\} / v \text{ — } v$$

We can see that in (24) the intermediary element is either p or k ; the first preference is p which is homorganic with m and the second preference is k which is homorganic with h .

7.0. Let us now turn to Samoan data below given by Mashudi to support the universality of the IDP:

(25)	PAN	Samoan	Glosses
(a)	*pulog	fulu	'ten'
(b)	*panaq	fana	'shoot'
(c)	*xepat	fa	'four'
(d)	*apuy	afi	'fire'
(e)	*taqun	tau	'year'
(f)	*tanis (*caŋ is according to Dyen 1971)	tani (tani, Dyen 1971)	'cry'
(g)	*mata	mata	'eye'
(h)	*kaw	ʔau	'you'
(i)	*kutuh	ʔutu	'louse'
(j)	*ikan	iʔa	'fish'
(k)	*aku	aʔu	'I'

In data (25) above Mashudi is concerned with the shift from *p > f, while *t > idem and *k > ʔ. To these problems he combines the $\alpha\beta$ parameters at $\beta:3$, and he comes up with the following scale:

$$(26) \quad \begin{array}{ccccccc} \text{?} & k & t & p & f & & \\ \hline & 4 & 5 & 6 & 7 & 8 & \end{array}$$

According to scale (26), p with a strength value of 7 is stronger than either t or k. He concludes that in Samoan PAN *p undergoes strengthening to f to yield (25) (a) ____ (d) in initial and syllable onset positions. However, in (e) ____ (g) t being weaker than p, although stronger than k, does not strengthen, while k with $\alpha\beta:5$ weakens to ʔ as in (25) (h) ____ (k).

We are not quite sure how Mashudi figures out the scale above, that is (26), because according to the $\alpha\beta$ scale (1), if we combine the $\alpha\beta$ parameters at $\beta:3$ we will have scale (27) below:

$$(27) \quad \begin{array}{ccccccc} \text{?} & k & t & p & f & & \\ \hline & 3 & 4 & 5 & 6 & 7 & \end{array}$$

Thus p is $\alpha_3 \beta_3:6$ and not $\alpha_4 \beta_3:7$, t is $\alpha_2 \beta_3:5$ not $\alpha_3 \beta_3$, and k is $\alpha_1 \beta_3:4$ not $\alpha_2 \beta_3:5$, and if we include g and b we will have scale (28) below:

$$(28) \quad \begin{array}{ccccccc} g & & b & & & & \\ \text{?} & k & t & p & f & & \\ \hline & 3 & 4 & 5 & 6 & 7 & \end{array}$$

where g ($\alpha_1 \beta_2:3$) and ʔ have the lowest strength value, while b ($\alpha_3 \beta_2:5$) and t ($\alpha_2 \beta_3:5$) have the same strength value. Bearing in mind scale (28), let us consider the following data:

(29)	PAN	Samoan	Glosses
(a)	*gilan	ki-kila	'glitter, sparkle'
(b)	*belaj	fola	'spread out'
(c)	*ubi	ufi	'yam'

In data (29) (a) *g which is the lowest in terms of strength value according to scale (28) is strengthened to k which is against the IDP which says that weak elements weaken first and most extensively and preferentially and strong elements strengthen first and most extensively and preferentially in strong environments. As we have seen in data (25) above, k (strength value 4) and t (strength value 5) do not undergo strengthening, but in data (29) g (strength value 3) as the weakest of them all does. Even though k is stronger than g, it nevertheless undergoes weakening to ?. Another case is b (strength value 5) in (29) (b) and (c) which undergoes double strengthening to f (strength value 7) while the strongest element p (strength value 6) undergoes single strengthening only, and t which has the same strength as b does not undergo strengthening at all.

Considering the contradictory data above we strongly feel that the IDP is quite inadequate to account for sound changes in Samoan and in other Austronesian languages.

8.0. Let us now turn to Tagalog data in which, according to Mashudi, b strengthens while d and g do not:

- (30) (a) man + guló > manguló 'to make trouble'
 (b) ipan + damó > ipandamó 'to weed'
 (c) man + bilí > mamilí 'to buy'

In data (30) Mashudi argues that "while b strengthens in a strong position and then returns to the lowest scale, g and d remain neutral in that position" (1979:41). Then Mashudi provides more data to support his argument. He says: "Since b strengthens in postnasal position, according to the IDP, k, t, p, should also strengthen. That they behave as expected may be illustrated by the following examples" (1979:4):

- (31) (a) man + tahí > manahí 'to sew'
 (b) man + kúha > manúha 'to get'
 (c) man + píli? > mamíli? 'to choose'

Based on data (30) and (31) Mashudi draws the following conclusion: "Therefore, in agreement with the IDP, the Tagalog data have illustrated that strengthening applies to strong elements, namely k, t, p, b in a postnasal position; but d and g do not strengthen in that position" (1979:42).

If we study data (30) and (31) closely and nothing else we will be tempted immediately to believe that the IDP is indeed quite adequate to account for the above sound changes. But if we look at some other data from Tagalog we will be persuaded to question the adequacy of the IDP. Let us look at the following data (cf. Panganiban 1972; Aspillera 1974) and compare them with data (30) and (31):

(32) cf. data (30) (a):

- | | | |
|-----|-------------------------------------|---|
| (a) | maṇ + guló → manguló
→ maguló | 'to cause trouble'
'troublesome' |
| (b) | maṇ + gulay → magulay
→ maggulay | 'having plenty of vegetables'
'to cook and eat vegetables' |
| (c) | maṇ + gusót → magusót | 'to become crumpled' |
| (d) | maṇ + gutom → magutom | 'to be hungry' |
| (e) | maṇ + galit → maḡalit | 'to be angry' |

(33) cf. data (30) (b):

- | | | |
|-----|---------------------------|------------------------------|
| (a) | maṇ + dalanin → manalanin | 'to pray' |
| (b) | maṇ + dalasa → manalasa | 'to assault' |
| (c) | maṇ + dalapán → manalapán | 'to ride in a large rowboat' |
| (d) | maṇ + dikít → manikít | 'to adhere' |

(34) cf. data (30) (c):

- | | | |
|-----|--|---|
| (a) | maṇ + bilí → manilí
→ mabilí
→ magbilí
(bumilí : 'to buy')
(infix: -um-) | 'to make purchases'
'to be able to buy'
'to sell' |
| (b) | maṇ + bihasa → manihasa
→ mabihasa | 'to get used to a certain practice'
'to get used to' |

(35) cf. (31) (a):

- | | | |
|-----|--|--|
| (a) | maṇ + tahan → magtahan | 'to stop' |
| (b) | maṇ + tahip → magtahip | 'to winnow grains' |
| (c) | maṇ + talo → matalo
→ manalo
→ magtalo | 'to lose'
'to win'
'to argue with each other' |
| (d) | maṇ + tanán → magtanán | 'to escape' |
| (e) | maṇ + tanón → magtanón
→ matanón | 'to ask about something'
'to happen to be asked a question' |

(36) cf. (31) (b):

- | | | |
|-----|---|--|
| (a) | maṇ + kuha → maṇuha
→ makuha
→ mákuha | 'to gather, to collect'
'to be able to get'
'to happen to get' |
| (b) | maṇ + kulam → makulam
→ mákulam | 'to be able to bewitch something'
'to become bewitched' |
| (c) | maṇ + kulan → magkulan | 'to fail to please due to shortcomings' |
| (d) | maṇ + kulambô → magkulambô | 'to use a mosquito net' |
| (e) | maṇ + kurtina → magkurtina | 'to use curtains' |
| (f) | maṇ + kusa → magkusa | 'to do a thing voluntarily' |
| (g) | maṇ + kuskós → magkuskós | 'to scrub' |

(37) cf. (31) (c):

- | | | |
|-----|--|--|
| (a) | maŋ + píli → mamíli
→ mapíli | 'to choose'
'choosy' |
| (b) | maŋ + pilay → mapilay | 'to become tame' |
| (c) | maŋ + piliŋ → magpiliŋ | 'to be close together' |
| (d) | maŋ + pilipit → mamilipit
→ mapilipit | 'to become twisted'
'to be able to twist something' |
| (e) | maŋ + pilit → mamilit
→ magpilit | 'to force'
'to try hard' |
| (f) | maŋ + pinsala → maminsala
→ mapinsala | 'to injure'
'to be injured' |
| (g) | maŋ + piraso → mapiraso | 'to be broken into pieces' |
| (h) | maŋ + piriŋ → magpiriŋ | 'to cover one's eyes with a blind-fold' |

Data (32)-(37) above are enough to tempt us to hypothesise that in Tagalog the underlying form /maŋ/ is phonetically realised in different forms ([maŋ], [man], [ma], [mag]) depending on the meaning of the word in which it is used. In other words the phonetic representations of the underlying form /maŋ/ seem to be mostly semantically motivated although in some cases phonological motivations also try to manifest themselves. However, we can also hypothesise that in Tagalog there are four underlying forms (/maŋ/, /man/, /ma/, /mag/) which manifest themselves in the same forms phonetically to form different types of verbs, thus as [maŋ], [man], [ma], [mag]. In data (32)-(37) above the first hypothesis has been applied.

By applying the first hypothesis, we think that the IDP is inadequate to explain the sound changes that Tagalog manipulates to convey different meanings. In data (32), for example, ŋ (p3) should not disappear from the cluster ŋg according to the IDP because it is stronger than g (p1) according to the p scale (2). In data (33), d should not disappear according to the IDP (cf. data (30) (b)), because it must not strengthen in postnasal position due to its weaker strength value (α2 β2). In data (34) [mamiŋ] and [mamihasa] are the correct forms according to the IDP, but we also have [mabiŋ], [magbiŋ], and [mabihasa]. And so on and so forth.

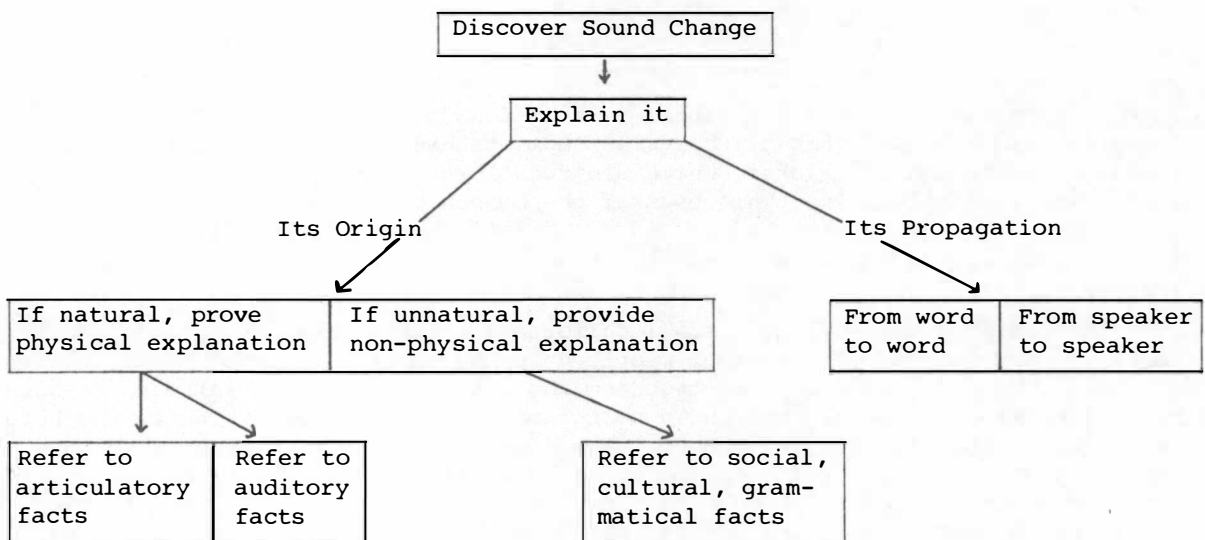
From the above data we can conclude that Tagalog is a language that manipulates assimilation and coalescence processes not only for the sake of ease of production but most importantly for distinguishing different meanings. These kinds of phonological processes are said to be semantically motivated in the sense that phonological processes are used or are made good use of for semantic purposes. As an illustration let us take just one example: data (34) (a):

- | | | | | |
|------|-----|-------------|-----------------|-------------------------------|
| (38) | (a) | biŋ | Root | 'the amount paid for a thing' |
| | | /maŋ + biŋ/ | Underlying Form | |
| | | ↙ ↘ | | |
| | | m | | |
| | | mamiŋ | Coalescence | < ŋ → m
b → m > |
| | | [mamiŋ] | Phonetic Form | 'to make purchases' |

- (b) /maŋ + bili/ Underlying Form
 mabbili Total Assimilation n → b/ — b
 mabili Cluster Simplification
 [mabilí] Phonetic Form 'to be able to buy'
- (c) /maŋ + bili/ Underlying Form
 magbili Partial Assimilation N → Stop/ — Stop
 [magbilí] Phonetic Form 'to sell'

(Note: In order to have a word with the meaning 'to buy', the language uses the infix um (-um-), thus we have the word bumilí with that meaning.)

9.0. So far, Samoan is the only language for which we have not given alternative solutions to its problems of sound changes. This is because of the fact that we consider sound changes in Samoan to be unnatural to the extent that we cannot find articulatory or auditory (acoustic) facts or even semantic motivations to account for these sound changes. To show the unnaturalness of the Samoan sound changes, let us consider the consonant segments of this language. Samoan has the following consonant segments: p t ʔ m n ŋ f s v l (Biggs 1971: cf. Churchward 1951). Two segments h and r are only used in words of foreign origin, and k is used only in foreign words (e.g. saka 'to boil' and puka 'an interjection' are words from some neighbouring islands). Another unusual thing about the phonology of this language is that in colloquial Samoan the segment n has changed to ŋ, a fact which contradicts the statement made by Ferguson in Greenberg (1966:57) that if there are only two nasals they will be m and n. The segment p also is very rare and it usually occurs in loanwords. Because of the unusualness of the Samoan segments, we do not think that the IDP is adequate to explain this fact. So we have to refer to other facts, non-physical facts (cf. J. Ohala 1974b: the diagram below), and here we would suggest that we refer to (consider) sociolinguistic as well as psycholinguistic aspects.



We would like to argue here that these non-physical facts are just as important and relevant as the physical (neurolinguistic) facts in accounting for sound changes in natural languages (cf. J. Ohala 1974b; Slobin 1977; Baron 1977; Goyvaerts 1975; Andersen 1973; Simanjuntak and Ramli Salleh 1980). These non-physical factors are unique to a particular language, so they must be language-specific and culture-specific (J. Ohala 1974b). Some of the non-physical factors that Malkiel mentions (1973: see also J. Ohala 1974b) are: hypercorrection, fashionable pronunciations (cf. Postal 1968 who suggests that sounds change due to the same whims of fashion that cause clothing and car styling to change), spelling pronunciation, analogical extension of grammatical paradigm. Here we would like to report a unique observation made by Simanjuntak (1971) which illustrates how a sociolinguistic as well as psycholinguistic incident causes sound changes in the language of children under seven years of age.

One day, in a remote village in Tapanuli (North Sumatra), Simanjuntak overheard small children (under seven years of age) being taught by older children how to pronounce correctly the numbers from one to ten in Toba Batak, the mother tongue of the children. The small children's pronunciation was strange which made the older children laugh and so they tried to teach them the correct pronunciation. This is how the small children counted from one to ten:

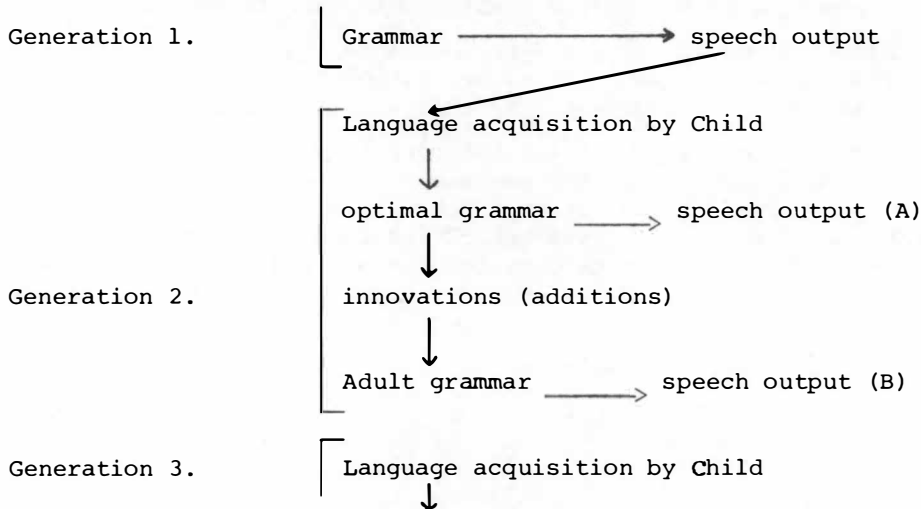
Children's Pronunciation	(Correct) Adult's Pronunciation	
[sada]	[sada]	'one'
[dua]	[dua]	'two'
[tolu]	[tolu]	'three'
[okat]	[opat]	'four'
[liŋa]	[lima]	'five'
[onoŋ]	[onom]	'six'
[kitu]	[pitu]	'seven'
[ualu]	[ualu]	'eight'
[sia]	[sia]	'nine'
[sakkulu]	[sappulu]	'ten'

What is apparent is that all bilabial segments changed to velars. Further investigation revealed that all bilabial segments had indeed disappeared from the language of the small children, while older children seemed to have managed to regain the lost bilabials. This unusual phenomenon had urged the investigator to do further study as to what had caused the disappearance of the bilabials from the language of the small children: the observed situation appears to be as follows.

In that particular village small children are taken care of by older people, usually grandmothers. These older people have the habit of chewing betel leaves and tobacco and at the same time teaching their grandchildren to talk and to count by telling stories and all the while doing small household tasks. While the betel leaves are being chewed, the tobacco 'clump' or 'ball' is inserted between the upper lip and the upper teeth or gum creating a situation in which the upper lip can never meet the lower lip when talking. The situation is aggravated by the betel leaves which are placed between the upper and lower molars preventing the upper teeth from reaching the lower lip. We can imagine how impossible it is for these eager grandmothers to produce bilabial sounds when teaching their grandchildren, thus the easiest way for them, which is quite natural, is to replace

all bilabials with velars. To make the situation worse, the younger adults have the habit of imitating the nonbilabial-sound language of the grandmothers to create humorous situations in the presence of the small children. Thus, practically speaking, the small children are acquiring this nonbilabial-sound language from the start. However, when the children start schooling their defective language is corrected by the teachers because Toba Batak is the medium of instruction in the elementary school up to standard three (beginning standard four, Bahasa Indonesia, the national language, takes over as the medium).

The above incident is a good example of the many possible similar incidents that might (or must) have taken place during the many thousands of years which separate Samoan from its Proto-Austronesian ancestor and which have resulted in the present disappearance of *b*, *h*, *r*, *k* from its phonemic inventory. These incidents must have caused the language to restructure its phonological grammar many times which must have resulted in the repeated additions, losses, and reorderings of its phonological rules (cf. King 1969; Kiparsky 1965, 1968; Farid Onn 1980) or probably inversions of these rules (cf. Vennemann 1972). Non-physical causes of sound changes are indeed very difficult to describe precisely as to how they have caused a particular language to change its sounds. We can only guess. But roughly the sociolinguistic and psycholinguistic processes of sound changes can be illustrated by the following diagram (Goyvaerts 1975:128):



(Linguistic change is change in competence not in performance.)

NOTES

1. It appears that the IDP is also inadequate in handling the European languages, hence J. Ohala (1974) may be justified in saying that Foley has cryptotaxonomic goals with this theory of phonology, which Foley claims to be "perhaps the only genuine theory of phonology in existence" (1971:1).
2. In Ulu Muar and Kedah (Langkawi) dialects (both are Malay dialects), however, this cluster simplification rule takes place, so that the cluster *nd* is simplified to *n*, although both elements have the feature [+voice], thus /*men + daki*/ → [mə*n*aki], /*men + dapat*/ → [mə*n*apat] (see Hendon 1966 for Ulu Muar and Collins 1976 for Kedah; cf. Farid M. Onn 1976, 1980a).
3. In traditional descriptive linguistics this coalescence process is known as internal sandhi, a term borrowed from Sanskrit meaning a 'putting together' (in this case) of two consonants. However, how this 'putting together' is actually motivated to produce a third consonant is not explained.
4. Toba Batak is one of the six Batak dialects (the others are Mandailing, Karo, Angkola, Simalungun, Dairi or Pak-Pak) spoken in North Sumatra, Indonesia. The Batak language belongs to the Austronesian family (Simanjuntak 1976).
5. But according to Siahaan (1975) the consonant *n* does not change if the following consonant is *g*, for example in the word *tanggurung* [tanggu*ŋ*]. This may be true in slow speech especially when the word is pronounced in isolation. However, in rapid speech and when the word is used in a sentence, such as *Tingki manggarut tanggurunghu*, the *ŋ* changes to *g* : [tikki maggarut tagguru*kk*u]. This has been tested by Simanjuntak with four native speakers of Toba Batak.
6. These can be stated as follows:

$$\left\{ \begin{smallmatrix} n \\ h \end{smallmatrix} \right\} \rightarrow \left\{ \begin{smallmatrix} t \\ k \end{smallmatrix} \right\} /v \text{ ______ } v$$

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