Alabama Type I agent morpheme agreement: A Stratal OT account

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Abstract

One of the most difficult to explain processes in the morphology of Alabama (a Muskogean language spoken in East Texas, USA) is how to account for three series of affixes which are capable of prefixation, infixation, and suffixation, depending on the verb they attach to. In this paper, I propose a unified account of this Type I agent agreement, mediopassive infixation, and negative agent agreement using Stratal OT. We furthur propose the underlying agent morphemes to be not {tʃ, l} as proposed by Montler & Hardy (1990) but as underlyingly *-chi*, and *-li* based on evidence from Choctaw and Chickasaw, and deletion rules in Alabama. We finally offer a morphosyntactic account of Alabama verbs which are seemingly exempt from the prosodic constraints of 'simple' verbs and use an auxiliary construction instead.

1 Introduction

Alabama is noted for its complex system of agreement for negatives and positive polarity verbs, particularly in the 2.SG, 2.PL, 1.PL persons for positive polarity agents, and for all persons in the negative. Unlike all other Muskogean languages—with

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the exception of Koasati, Alabama's close relative—type I agreement markers are capable of prefixation, suffixation, or infixation depending on the verb to which they attach.

Until Montler & Hardy (1990), Muskogeanists largely analysed Alabama and Koasati with verb-class based approach as done by Lupardus (1982), Haas (1946), Kimball (1991), and Booker (1980). Previous attempts to describe the system by Lupardus (1982) and Montler & Hardy (1990) have both analyzed type I agreement in Alabama as having *subclasses*: six such subclasses under Montler & Hardy (1990)'s analysis, and five, excluding periphrastic conjugation under Lupardus (1982).

Such analsyses often were predicated on unclear assertions: Lupardus (1982) describes a class of infixed stems as a result of affixation to a root, followed by some other derivational morpheme; yet no clear explanation exists explaining why words like *talwa* 'to sing', *hosso* 'to write', or *onti* 'to come' should be separated into separate roots; indeed such supposed roots (*o*, and *nti* for *onti*, for example) never appear elsewhere in the language. Montler & Hardy (1990)'s account was the first morphophonological analysis of either the Alabama and Koasati languages. Their analysis posited the underlying form of the agent markers not as having two allomorphs (*chi* and *is*; *li* and *il*, etc.), but as being underlyingly monosegmental: {tʃ} and {l}. These morphemes are then placed in the stem according to a rules-based phonology, determined entirely on the syllable structure of the underlying form. The placement of the resultantly inserted vowel is based on a process of epenthesis into a position that breaks up illegal consonant clusters, rather than a result of two separate allomorphs as proposed by Lupardus (1982).

(1) **Placement Rules for -ch-, 2.SG.AGT**

Syll Structure	Example	Expected 2.SG Form
CV	ipa	i-**s**-pa
CVV·CV	choopa	choo-**s**-pa
CVC·CV	hofna	ho-**ch**i-fna
CV·CV	hochifa	hochif-**ch**i
(CVV)	sòo-li	sòo-**ch**i
(CVC)	bit-li	bit-**ch**i

(2) **Placement Rules for /-l-/, 1.PL.AGT**

Syll Structure	Example	Expected 2.PL Form
CV	ipa	i-**l**-pa
CVV·CV	choopa	choo-**l**-pa
CVC·CV	hofna	ho-**l**i-fna
CV·CV	hochifa	hochif-hi**l**i
(CVV)	sòo-li	sòo-hi**l**i
(CVC)	bit-li	bit-hi**l**i

Montler & Hardy ascribe this behavior to two prosodic rules governing Alabama.

(3) **Dfn. ALABAMA VERB FRAME:** (Montler & Hardy 1990)
Derived verbs must end in a two-syllable, three-mora foot.

(4) Dfn. **TYPE I AGREEMENT PLACEMENT:** (Montler & Hardy 1990)
First person plural is /l/; second person is /c/. Affix the agreement marker so that it will add at least one mora to the stem.

While the prosodic structure the Alabama Verb Frame describes is clearly important in the language, their account however raises several questions they are unable to answer. In particular, it does not explain why some positions which would otherwise add a mora to the stem are dispreferred. For example, *choo**li**pa* or *choop**cha*** are dispreferred to *choo**s**pa*, as *hofi**s**na* is to *ho**ch**ifna*. Nor does it explain why deletion of the final vowel *plus epenthesis* occurs in the CVCV stems. If the underlying morphemes are truly monosegmental, and the /-i/ is a result of epenthesis due to a ban on final heavy syllables, Montler & Hardy's rules cannot explain why vowel deletion and epenthesis would be preferred to a form like *hochisfa*, which nearly exactly mirrors the development in CVVCV verbs.

These rules are further unable to explain why derived words behave according to the placement rules for their underlying forms.

(5) *maat-ib-ch-o
DIR-kill-2.SG-IND
Intended: 'You hunt it.'

(6) maat-is-b-o
DIR-2.SG-kill-IND
'You hunt it'

In (5) and (6)[1], Montler & Hardy's rules predict placement based solely on the phonological form of the stem; The surface form instead conjugates as if it were the root in its form before derivation. The same occurs in CVCV which undergo lengthening, where the surface realization conforms to the form predicted not by the lengthened vowel stem, but by the underlying root.

(7) *hopoo-s-ni-ti
cook-2.SG-cook-PST1
Intended: 'You cooked it.'

(8) hopon-chi-ti
cook-2.SG-PST1
'You cooked it.'

(9) hopooni-ti
cook-PST
'(S)he cooked it.'

Montler & Hardy must also limit the rules in (4) to non-derived stems; those ending in *-ka* and *-chi* 'differ from those handled by (4).' (Montler & Hardy 1990). A separate variant of the agreement morphemes—(*h*)*is*, (*h*)*il*, (*h*)*as*—must be 'infixed before -ka'. These forms appear even after vowels.

(10) amaa-yl-ka-ti
meet-1.PL-KA-PST1
'We met.'

This fact indicates that the /i/ of the agent markers might be underlyingly a part of the morpheme itself, rather than epenthetic. Evidence from Choctaw and Chicasaw support this, where the prothetic vowel for CV words is /a/ (as in *apa* cognate with Alabama *ipa*, and *abi* cognate with Alabama *ibi*)(Lupardus 1982). Despite this, the Choctaw Type I agent agreement markers have all kept the vowel Montler & Hardy claim to be 'epenthetic', shifting the agreement morphemes to become exclusively prefixes. The Choctaw example in (11) shows this.

[1]Unless otherwise indicated, all examples come from personal fieldwork with native speakers of Alabama

(11) apa=li-tok
eat=1.SG-PTT
'I ate' (Broadwell 2006)

(12) ish-pa-tok
2.SG-eat-PT
'You ate' (Broadwell 2006)

If this analysis is right, it indicates that the /i/ in the agent morphemes in Alabama and Choctaw must be of the same origin; it cannot be analysed as underlyingly epenthetic, or else the expected forms in Choctaw would be *ashpa*, *aapa/alpa*, etc. This exactly mirrors the data for CV verbs in Alabama.

(13) ipa=li-ti
eat=1.SG-PST1
'I ate it.'

(14) is-pa-ti
2.SG-eat-PST1
'You ate it.'

Beyond issues with the morpheme placement rules, an issue exists with Montler & Hardy (1990)'s definition of the Alabama Verb Frame: (HL) metrical trochaic foot structure as the primary foot structure—as Montler & Hardy suggest in the Alabama Verb Frame—is marked typologically (Mellander 2003, Prince & Smolensky 2004). As such, we follow the likes of Takano (1995) in shifting to a new model of footing for Alabama.

With these facts in mind, we propose the underlying forms of the agent markers to instead be *-chi* and *-li* for the 2.SG and 1.PL markers respectively, as posited by Lupardus (1982)—We reject the existence of a separate set of morphemes *is-* and *il-*, claiming their existence can be predicted reliably based on prosodic rules and metathesis of underlying *-chi* and *-li*. Their distribution must therefore be based on rules, or constraints, which explain the distribution in (1) and (2). In Section 3 we turn to Optimality theory (Prince & Smolensky 2004, 1993) to provide an account of leftwards morpheme placement, explaining the ability of thse suffixes to become prefixes or infixes through an entirely phonological account. We argue that the morpheme placement can be accounted for through Stratal OT (**Citation**, Kiparsky 2015). We propose some earlier, root-level stratum whereby secondary stress is assigned, and a later stem-level stratum in which the agent morphemes attach, moving leftward while not deleting any vowels parsed with stress in the previous stratum. The OT hierarchy we propose governing the first stratum is in (15).

(15) **Alabama Root-Level OT Hierarchy**
WeightToStress, FtForm-Trochee » Align-R » Parse » Align-L » FtBin

We propose the following hierarchy for a subsequent stratum.

(16) **Alabama Stem-level OT Hierarchy**
Max-V$^{\text{STRONG}}$, FtBin, FtForm-Iambic, NoHiatus » Nonfinality » Dep$_{\mu}$ » Stress-to-Weight, Parse » Max-V, CV-Contiguity » Dep, Edgemost

Finally, we adopt some constraints at the word-level to account for other morphemes which do not obey the constraints which the agent morphemes are subject to. We adopt the following hierarchy, although leave space for some set of constraint accounting for vowel hiatus methods.

(17) **Alabama Word-level OT Hierarchy**
Precede(*ha*-, -*chi*), RealizeMorph(1.pl) » NoHiatus » Id(Stem)

2 Stratal OT and Opacity

The opacity exhibited by Alabama agent morphology appears to be selective. That is, some affixes are placed according to different phonological rules than other. This can in part be explained by Stratal OT. Stratal OT (Kiparsky 2015) offers a version of OT where hierarchies of constraints are different for different 'strata' in the process of development—different morphemes then attach at different levels and are subject to different hierarchies of constraints. Stratal OT in this way accounts for the opacity exhibited in certain languages, and *cyclicity*, whereby phonological properties may be inherited from bases to derivatives (Kiparsky 2015). More importantly for the Alabama case, however, is the restriction of overgenerated forms, such that phonological processes may be restricted and better explain morphological interactions with the phonology of the language (Kiparsky 2015). In particular, this helps distinguish the morpheme placement of the -CV structured agent agreement suffixes from other -CV suffixes.

(18) choo-l-pa < choopa-li
buy-1.PL-buy < buy-1.PL
'We buy.'

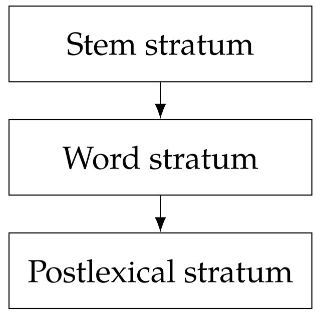
(19) choopa-li < choopa-li
buy-1.SG < buy-1.SG
'I buy.'

Using a stratal analysis further allows us to consider the foot as a constituent itself, which seems pertinent for the Alabama example (We define foot here as some constituent of the phonological word, 'organizing the syllables of words into higher-order units built around stressed syllables.' (Hammond 2011)). Evidence from Aluutiq (Leer 1985 as cited in Gordon 2016), Dutch (Kager 1989; Booij 1995; van Oostendorp 1995 as cited in Gordon 2016), and as we argue, Alabama, suggest that constraints referring to feet, and constraints referring to stress assignment grid marks are needed in any conception of OT. The assignment of feet however, is not one that can be made without first considering some stratum before foot-related constraints may appear. Stratal OT solves this issue by breaking the phonological derivation into parallel grammars, interacting via input and output representations (Kiparsky 2015). There are three main features of Stratal OT Kiparsky describes:

(20) a. *Stratification*: phonology and morphology are organized into STRATA (also known as LEVELS), each constituting a parallel constraint system.
b. *Level-ordering*: each of the cross-categorial domains *stem, word, phrase* corresponds to a morphosyntactic and phonological stratum.
c. *Cyclicity*: Stems and words must satisfy the applicable stem and word constraints at every stage.
(Kiparsky 2015).

These strata interact in a linear way, with no direct input/output from the stem-level to post-lexical (phrase) level.

(21) **Strata relationships** (Kiparsky 2015)



These three strata are likely universal, however evidence exists to suggest that in some languages, there are richer subdivisions of the postlexical stratum (Kaisse 1985, 1990, Kiparsky 1985, Clark 1990, McHugh 1990, Mutaka 1994, Koontz-Garboden 2001, Pak 2005, Pak & Friesner 2006 as cited in Kiparsky 2015).

3 An OT Account of Alabama Type I Agreement

In this section, I propose a Stratal OT-based account of the placement of Alabama agent agreement morphemes, with at least two strata subdivisions of the stem stratum: a first pass at the root level which assigns trochaic stress from right to left, and a second pass which forms iambs through deletion and metathesis. The assignment of stress in Alabama is not yet fully understood, but data from other Muskogean languages like Chicasaw and preliminary data from a recent fieldwork expedition to the Alabama-Coushatta tribe suggests that iambic stress is indeed present in the language. We have made our analysis, following Takano (1995), and based on the overwhelming presence of (LH) feet that the surface foot type in Alabama is iambic.

(22) Ft-Form = I. The foot type is Iambic; permitted feet are (LL), (H), (LH)

We further adopt some constraint Nonfinality, noting that at the stem-level, no word ends in either a heavy vowel, or a coda consonant. Nonfinality is unranked in our hierarchy.

(23) Nonfinality. No foot may be on the right edge of a word (stem).

This is despite the fact that some evidence exists to suggest stress is placed word-finally, and the presence of three switch-reference markers which may appear word finally as a single consonant. To account for this, we may suggest a deranking of Nonfinality in the post-lexical stratum, along with the ranking of a constraint ALIGN-R(STRESS) to assign violations where primary stress is assigned anywhere other than the final syllable. Such considerations are discussed in Section 6.

In adopting Nonfinality, we also adopt a constraint PARSE, which we rank lower than Nonfinality to account for extrametralic final syllables. This also ensures that words may not simply leave all syllables unparsed for any other feet-based rules.

(24) Parse: Syllables must be parsed into feet. Violations are incurred for each 'extrametralic' syllable not included in a foot.

(25)

tʃoːpatʃi	Nonfinality	Parse
a. (tʃoː)(patʃi)	∗!	
b. (tʃoː)patʃi		∗∗!
c. ☞ (tʃoːs)pa		∗

Alabama seems to have a ban on monomoraic words: only the demonstratives *ma* 'that' and *ya* 'this' are monomoraic in certain compounds, and no verbs surface as such ever. Instead, CV stems are subject to prothesis of /i/, as evidenced by the similar phenomena across other Muskogean languages, and in particular Choctaw[2]. Thus, we must introduce some constraint DEP_{μ}: No lengthening. We then rank FtForm and Dep_{μ} over some rule DEP (no insertion) to allow this prothesis.

(26)

(ˌpa)	FtForm	Dep_{μ}	Dep
a. (ˈpa)	∗!		
b. ☞ (iˈpa)			∗
c. (ˈpaː)		∗!	

One final general phenomenon present in the language is the ban on hiatus between vowels.[3] To account for this, we adopt an undominated constraint NOHIATUS, as done by Takano (1995).

[2]See (11)

[3]In post-lexical levels, some hiatus is permitted following deletion of /h/. However, for our purposes we note that hiatus is never permitted at a lexical level.

(27) NoHiatus: No sequence of V.V is permitted; Onsetless vowels are only permitted word initially.

3.1 Alabama Agent Morpheme Placement

We posit the primary explanation for the movement of the morpheme as the formation of iambic feet, with a light extrametralic final syllable due to the ban on word-final feet. This can be clearly seen in CVVCV, CVCCV, CV, CVC, and CVV type stems.

(28)
a. $\text{tʃoːpa-tʃi} \longrightarrow \text{(tʃoːs)pa}, *\text{(tʃoː)(tʃipa)}, *\text{(tʃoː)(patʃi)}$
b. $\text{hofna-tʃi} \longrightarrow \text{(hotʃif)na}, *\ \text{(hof)(natʃi)}$
c. $\text{pa-tʃi} \longrightarrow \text{(is)pa}, *\ \text{(patʃi)}$
d. $\text{bit-tʃi} \longrightarrow \text{(bit)tʃi}$
e. $\text{soː-tʃi} \longrightarrow \text{(soː)tʃi}$

However, CVCV[4] stems do not move the agent morphemes inward to create such a foot as with CVVCV or CVCCV stems. Nor do they attach the suffix with no further modifications as with CVV and CVC stems. Instead, they opt for the deletion of the root-final vowel.

(29) $\text{hotʃifa-tʃi} \longrightarrow \text{(hotsif)-tʃi}$, *(hotʃi-s)-fa, *ho(tʃifa)tʃi

We must explain the seeming contradiction behind CVVCV stems conjugating with infixation, while deleting the vowel within the agent morpheme (ex. CVV**s**CV), while CVCV stems conjugate with final vowel deletion of the stem and suffixaiton of the agent morpheme(ex. CVC**chi**). We suggest this is due to the placement of opaque stress in some pre-initial stratum. Regardless of the surface structure, we suggest that an initial parsing of feet in an initial stratum is necessary: in such cases the foot type is trochaic, though we still disallow (HL) trochees. This necessitates a redefinition of Ft-Form in (22).

(30) a. Ft-Form = T. The foot type is Trochaic; permitted feet are (LL), (H) (Stratum I)

[4]This only applies to CVCV roots longer than two syllables, and CVVCV surface stems that are CVCV underlyingly in the authors' data. CVCV disyllables conjugating this way are unattested, though predicted by Montler & Hardy. All CVCV disyllables collected use periphrastic conjugation instead.

b. Ft-Form = I. The foot type is Iambic; permitted feet are (LL), (H), (LH)
(Stratum II)

This is supported by some preliminary data which suggests a trochaic secondary stress placement.

(31) /hotʃifati/ ⟶ /(ˌho.tʃi).(fa.ˈti)/ 'He/She named it.'

In the latter stratum, we adopt a ban on deleting vowels assigned stress from the first stratum (Max-V$^{\text{strong}}$).

(32) Max-V$^{\text{strong}}$: Don't delete vowels that are strong/stressed in the input, in the candidate.

We suggest Max-V$^{\text{strong}}$ is an undominated constraint and never violated in surface forms. In other words, CVCCV and CVVCV stems are incapable of forming Iambs by deleting the final root vowel—either because of the illegal cluster it would form in CVCCV roots, or because the final vowel in the input is parsed as stressed. To enforce this, we posit non-monomoraic feet in the initial stratum, so long as they are word final. That is, FtBin is dominated by Parse in Stratum I. This ensures that the final vowel in CVVCV and CVCCV stems is still parsed stressed.

(33) *choopa*, Stratum I

tʃoːpa	Parse	FtBin
a. (ˌtʃoː)pa	∗!	
b. ☞ (ˌtʃoː)(ˌpa)		∗

We adopt two constraints accounting for the allophonic spirantization of /tʃ/ to /s/ before consonants, as described by Montler & Hardy (1990). We posit these as undominated, and will henceforth not include any candidates which violate these rules with an affricate-consonant tʃC cluster.

(34) a. *Affricate-C: No affricates immediately before consonants.
b. Id(Strid): segments must keep their strident feature. Non silibants cannot become silibants and silibants may not lose their feature.

These insure that the only phoneme /tʃ/ may become to avoid forming an affricate-C cluster is /s/.

(35)

itʃ.pa	*Affricate-C	Id(Strid)
a. itʃ.pa	*!	
b. ☞ is.pa		
c. ip.pa		*!

We further adopt the constraint WeightToStress to disallow any parsings that avoid assigning heavy syllables to feet (to satisfy further feet-restricted constraints).

(36) WeightToStress: if a syllable is heavy, it is stressed. (Stratum I)

Because of WeightToStress, the edge of the prosodic word that feet are bound to will not matter for CVVCV, CVCCV, CVC, CVV, CV, or CVCV even-numbered syllable stems. However, CVCV odd stems necessitate a footing such that the final syllable is unstressed. That is:

(37) hotʃifa $\longrightarrow$ ho(ˌtʃifa), *(ˌhotʃi)(ˌfa)

Adopting a constraint Align-R applied to each foot ensures that distance from the right edge of the word is preferred.

(38) Align-R(Ft, PrWd): Minimize distance of each foot from the right edge of the prosodic word. VIolation is incurred for each syllable distance between the right edge of a foot and the right edge of the prosodic word. (Stratum I)

Any trochee which minimizes the right-edge distance in CVCV stems will result in a final unstressed syllable. We adopt a ranking Align-R » Parse to prevent forming an extra foot in such cases, leading to an undesireable word-final strong vowel.

(39)

hotʃifa		WeightToStress	FtForm-T	Align-R	Parse
a.	(ˌho)(ˌtʃifa)			∗!∗	
b. ☞	ho(ˌtʃifa)				∗
c.	(ˌhotʃi)(ˌfa)			∗!	
d.	(ˌhotʃi)fa			∗!	∗
e.	ho(tʃiˌfa)		∗!		∗

In Stratum II, this results in inputs of (ˌCVV)(ˌCV) and (ˌCVCV), rather than CVVCV and CVCV at the time agent morphemes are suffixed. For (CVV)(CV) stems, the stem-final vowel cannot be deleted due to Max-V^{strong}, but other vowels may be; we therefore rank some constraint Max-V below Nonfinality, such that weak-position vowels may be deleted to avoid having final feet.

(40)

(tʃoː)(pa)tʃi		Max-V^{strong}	Nonfinality	Max-V
a.	(tʃoːp)tʃi	∗!		
b.	(tʃoː)(patʃ)		∗!	∗
c. ☞	(tʃoːs)pa			∗
d.	(tʃoː)(patʃi)		∗!	

For CVCV, both the stem-final vowel and agent morpheme vowel are unstressed, so both are equal candidates for deletion.

(41)

ho(ˈtʃifa)tʃi		Max-V^{strong}	Nonfinality	Parse	Max-V
a.	ho(tʃiˈfa)tʃi			∗∗!	
b.	(ˈhos)(faˌtʃi)	∗!	∗		∗
c. ☞	(hoˈtʃif)tʃi			∗	∗
d. ☞	(hoˈtʃis)fa			∗	∗

To explain this, we adopt Edgemost(μ; E; D), a constraint which assigns a violation for every segment distance morpheme μ is from edge E of Domain D; morpheme μ stays as close to edge E as possible. In our case, we use the definition of a suffix from Prince & Smolensky (2004).

(42) Dfn. **Suffix**

A *suffix* is a morpheme μ subject to the constraint Edgemost(μ;R;PrWd) (Prince & Smolensky 2004)

Finally, we adopt a constraint CV-Contiguity to explain the movement of agent morphemes in CVVCV and CVCCV syllable structure leftward, preserving the final CV syllable from the underlying form. That is, *choo**s**pa* and *ho**chif**na* are preferred over *choop**cha*** and *hof**intSa*** or *hof**is**na*. This rule is defined:

(43) **Dfn.** CV-Contiguity. [5] if $c\mathscr{R}c\prime$ and $v\mathscr{R}v\prime$ and c immediately precedes v in S, then $c\prime$ immediately precedes $v\prime$ in S$\prime$.

That is, if some consonant immediately precedes a vowel in the input, then the corresponding segment in the candidate must also be immediately preceding the corresponding segment to the vowel. This must crucially be placed as dominated by Nonfinality such that CV verbs will prefer metathesis of the agent morpheme over forming a (LL) final foot[6]. To prevent epenthesis from being a valid mechanism for solving this, a number of possible constraints and orderings exist, however we adopt a constraint StressToWeight, which prevents (LL) feet from forming. We rank this above CV-Contiguity, and necessarily below Dep$_\mu$, to prevent lengthening of vowels in such cases.

(pa)tʃi	Ft-Form	Nonfinality	StressToWeight	CV-Contiguity	Dep
a. (patʃi)		∗!	∗		
b. (patʃ)		∗!			
c. (pa)tʃi	∗!				
d. (tʃipa)		∗!	∗		
e. ☞ (is)pa				∗	
f. (itʃi)pa			∗!		∗

[5] We define CV-Contiguity in part as a subrule of Max-Contiguity, as defined by Heinz (2004).

[6] This rule is perhaps at risk of overgenerating metathesis in root CVCV bisyllabic stems like *taɬa* > **atɬa*. A few mechanisms may be implemented to account for this: one could further refine CV-Contiguity to only apply to unfooted segments in the input, or could adopt some constraint to avoid altering a verb root when no suffix is attached to it.

For CVVCV, and CVCCV, this is enough to fully explain the morpheme placement rules.

(44) **First Pass, CVCCV**

	hofna	WeightToStress	Trochee	FootForm	Align-R	Parse	Align-L	FtBin
a.	(ˈhof)na				∗	∗!		
b. ☞	(ˈhof)(ˈna)				∗		∗	∗
c.	(ˈhof)na			∗!	∗	∗		
d.	hofna	∗!				∗∗		
e.	hof(ˈna)	∗!				∗	∗	∗

(45) **2.SG Agent Agreement CVCCV**

	(hof)(na)tʃi	Max-V^{strong}	Nonfinality	Parse	CV-Contiguity	Edgemost
a.	(hof)(natʃi)		∗!			
b.	(hofis)na			∗	∗!	∗∗
c.	(hof)(tʃina)		∗!	∗		∗∗
d.	(hofin)tʃa			∗	∗∗!	∗
e. ☞	(hotʃif)na			∗		∗∗

(46) **First Pass, CVVCV**

	tʃoːpa	WeightToStress	FootForm	Parse	FtBin
a.	(ˈtʃoː)pa			∗!	
b. ☞	(ˈtʃoː)(ˈpa)				∗
c.	(ˈtʃoː.pa)		∗!		
d.	tʃoːpa	∗!		∗∗	
e.	tʃoː(ˈpa)	∗!		∗	

(47) **2.SG Agent Agreement CVVCV**

(ˈtʃoː)(ˈpa)tʃi		Max-V^{strong}	Nonfinality	Parse	CV-Contiguity
a.	(ˈtʃoː)(ˈpatʃi)		∗!		
b. ☞	(ˈtʃoːs)pa			∗	
c.	(ˈtʃoːp)tʃi	∗!		∗	
d.	(ˈtʃoːp)tʃa			∗	∗!

For odd-number syllable CVCV stems, these rules are also sufficient. Note that no even-number syllable CVCV root more than two syllables exists in the corpus.

(48) **First Pass, CVCV+**

hotʃifa		WeightToStress	Trochee	FootForm	Align-R	Parse	Align-L	FtBin
a.	(ˈhotʃi)fa				∗!	∗		
b.	(hoˈtʃi)fa		∗!		∗	∗		
c. ☞	ho(ˈtʃifa)					∗	∗	
d.	ho(tʃiˈfa)		∗!			∗	∗	
e.	ho(tʃi)fa				∗!	∗∗	∗	
f.	(ˈhotʃi)(fa)				∗!			∗
g.	(ho)(ˈtʃifa)				∗!			∗

(49) **2.SG Agent Agreement CVCV+**

ho(ˈtʃifa)tʃi		Max-V^{strong}	Nonfinality	Parse	CV-Contiguity	Edgemost
a. ☞	(hotʃif)tʃi			∗		
b.	(hotʃis)fa			∗		∗!∗
c.	(hotʃis)fi			∗	∗!	

For verbs of heavy-final syllable structures, especially monosyllables, no change is needed to the stem upon the addition of agent morphemes. Any ordering of the Root-Level OT hierarchy is possible, so long as the final heavy is stressed, which WeightToStress ensures. In subsequent strata, no change to the stem is needed, as the stem is already an iamb followed by a light, extrametralic syllable.

(50) **CVC, CVV Stratum I**

(bit)tʃi			WeightToStress	FootForm-T	Parse
a.	☞	(ˈbit)tʃi			
b.		(ˈbittʃi)		∗!	
c.		bit(ˈtʃi)	∗!	∗	
d.		bittʃi	∗!		∗∗

(51) **CVC, CVV Stratum II**

(ˈbit)tʃi			Max-V$^{\text{strong}}$	Nonfinality	Edgemost
a.	☞	(bit)tʃi			
c.		(bittʃ)		∗!	
d.		(bist)		∗!	
e.		(bis)ti			∗!∗

3.2 -hili, -hachi, and other agreement

Most morphemes which attach to verbs are opaque to the processes described above, including TAM suffixes like *-ti* ('past tense'), despite forming a final foot in every single word they attach to. Likewise the 'clitic' *-li* '1.SG' (Montler & Hardy 1990) does not behave like its exact homophone *-li* '1.PL'.

(52) a. (hotʃif)na-ti ⟶ (hotʃif)(nati), ∗(hotʃi)(tif)na, ∗ ho(tʃitif)na
b. (tʃoː)pa-li ('I buy') ⟶ (tʃoː)(pali), ∗ (tʃoːl)pa

We claim that non-agent-agreement morphemes (and 1.SG, and 3.PL clitics) attach at a *word*-level stratum. At this level, we rank the constraint ID(STEM), such that the stem is unaltered. This rule is dominated by two constraints: NOHIATUS, which bans vowel hiatus, and some constraint to resolve hiatus. Though vowel hiatus is completely banned in Alabama, precisely how vowel hiatus is resolved is yet unclear. For example, while most vowel initial morphemes delete short vowels immediately before them, patient prefixes will delete the vowel that follows them. Long vowels instead insert *-y-* in between them and the other vowel in hiatus, regardless of the other vowel's length.

(53) *choo-s-p-o*
buy-2.SG-buy-AUX
'you bought it.'

(54) *cha-lbi*
1.SG.PAT-arm
'my arm.'

(55) *aay-oo-li-mpa*
dir-consume-MED.PASS-consume
'table; (Lit.) place of consuming'

Left unanswered however is the infixation of *-hi-* in the 1.PL after CVV, CVC, and CVCV verbs, and of *-ha-* in all 2.PL forms. Since *-hachi* follows the *exact* distribution as *-chi*, despite forming a final foot in some words it attaches to and an extrametralic final syllables in others, it is unclear that syllable structure rules along can explain its placement.

(56) Underlying forms of a theoretical ***-hachi** morpheme

Syll Structure	Example	Expected 2.PL Form
CV	ipa	(pa**ha**)**chi**
CVV·CV	choopa	(choo)(pa**ha**)**chi**
CVC·CV	hofna	(hof)(na**ha**)**chi**
CV·CV+	hochifa	(hochi)(fa-**ha**)**chi**
CV·CV	tała	(tała)(**hachi**)
(CVV)	sòo-li	(sòo)-(**hachi**)
(CVC)	bit-li	(bit)-(**hachi**)

Of the predicted underlying forms, only CVCV, CVC, and CVV would motivate any alteration to the stem because of nonfinality. In fact, the existing hierarchy would suggest metathesis as the only solution in CVC verbs, to something like *bitahchi*. Instead, we suggest that *-ha-* is a separate morpheme, which attaches in the word level stratum. It is subject to a constraint PRECEDE(*HA*, *CHI*) which outranks Id(Stem).

(57) Precede(μ_1, μ_2). μ_1 must immediately precede μ_2.

(58) a.

	(tʃoːs)paha	Precede	Id	Nonfinality
a.	(tʃoːs)(paha)	∗!		∗
b.	(tʃoːs)(hapa)	∗!		∗
c. ☞	(tʃoː)(has)pa		∗	

b.

	(hotʃif)tʃiha	Precede	Id	Nonfinality
a.	(hotʃif)(tʃiha)	∗!		∗
b. ☞	(hotʃif)(hatʃi)		∗	∗

In this sense, *-ha-* is a morpheme which will attach itself wherever *chi* is, leading to the appropriate distribution. Because it never surfaces overtly as a suffix, We posit it instead as a prefix, reflecting its supposed related prefixal clitic *ho-* '3.PL'; however our analysis is not reliant on this fact.

(59) **Placement Rules for /*-chi-ha*/, 2.PL.AGT**

Syll Structure	Example	Expected 2.PL Form
CV	ipa	**ha-s**-pa
CVV·CV	choopa	choo-**ha-s**-pa
CVC·CV	hofna	ho-**ha-chi**-fna
CV·CV	hochifa	hochif-**ha-chi**
(CVV)	sòo-li	sòo-**ha-chi**
(CVC)	bit-li	bit-**ha-chi**

In this sense, we instead posit *-chi* as a general 2 person marker, with *ha-* as a morpheme specific to 2.PL.

We agree with Montler & Hardy (1990) that the *-hi-* in *-hili* is probably the result of disambiguation with the 1.SG and the result of plural infixation, a process present elsewhere in the langauge. For most syllable structures, it is not needed due to sufficient differentiation between the singular and plural number forms. However in CVV, CVC, and CVCV stems, the clitic and plural agent marker would produce unsatisfactorily similar forms to the 3.SG and 1.SG

(60) a. bit.li 'he dances'

b. **CVC, CVV Stratum II**

(ˈbit)-li 'we dance'		Max-V^{strong}	Nonfinality	Edgemost
a.	☞ (bit)li			
b.	(bitli)		∗!	
c.	(bilt)		∗!	
d.	(bil)ti			∗!∗

Assuming that the plural is more marked than the singular, it follows that the plural number needs to realized somehow. As such, some constraint REALIZEMORPH(1.PL) to assign a violation at Word-Level processes for non-distinct 1.PL forms is needed. That is, the selection of some plural h-infix *-hi-* with disregard to the syllable structure prosodic constraints of the stem-level process is motivated by a ban on homophony in marked forms. Supposing that this process occurs in the word-level stratum, so as to not have to explain the modification to the verb stem, we adopt this constraint at least dominating Id(Stem).

(61) **CVC, CVV Stratum III**

(ˈbit)li		RealizeMorph	Id(Stem)
a.	(bit)li	∗!	
b.	☞ (bit)(hili)		∗

4 Conclusion

In this paper we have argued that surface agent agreement in Alabama can be attributed to the movement of suffixed morphemes *-chi* and *-li*, so as to form an iambic, non-word-final foot. We further adopted a constraint CV-Contiguity based on Heinz (2004) to explain restrictions on metathesis. We suggest a constraint banning the deletion of strong-position vowels, assigned secondary stress from some earlier stratum. Finally, we adopt a word-level stratum where the plural morpheme *ha-* attached immediately preceding the second person singular morpheme *-chi-*. The result is that we may posit the underlying forms of type I agreement markers to form a single set of morphemes, displayed neatly in table (62). Their placement is then accounted for by the OT hierarchies described in (64) and (65)

(62)

	SG	PL
1	*-li*	*-li*
2	*-chi*	*-chi-ha*
3	Ø	(*ho-*)

Notably we find that not all of the morphemes attach in the same stratum. The reason for this is unclear and merits investigation. In particular, only the 2.SG, 2.PL, and 1.PL markers attach in the stem-level stratum, while the 1.SG and 3.PL 'clitics' attach in the word-level hierarchy. *-li* and its cognates in other muskogean languages do interact with the inflectional stem differently than all other person markers: for example, in Choctaw and Chicasaw, it is the only morpheme to attach itself after the verb root, and all other agent markers are prefixes (Broadwell 2006). This evidence has led others to claim that this markers is an enclitic, outside the scope of word-level phonology (Montler & Hardy 1990). It is important to note however that this marker *does* precede all TAM markers.

(63) bit.li-li-ti
dance.LI-1.SG.AGT-PST1
'I danced.'

The analysis presented in the preceding sections relies on a Stratal OT framework to account for the phonological opacity present. The data from Alabama however provides evidence for a richer subdivision of lexical strata, whether of the stem or word levels. For our purposes, we consider the subdivision to be of the stem-level stratum. We arrive with the constraints for some pre-stem stratum:

(64) **Alabama Root-Level OT Hierarchy**
WEIGHTTOSTRESS, FTFORM-TROCHEE » ALIGN-R » PARSE » ALIGN-L » FTBIN

As well as the following order for the stem-level process.

(65) **Alabama Stem-level OT Hierarchy**

Max-V$^{\text{strong}}$, FtBin, FtForm-Iambic, NoHiatus » Nonfinality » Dep$_{\mu}$ » Stress-to-Weight, Parse » Max-V, CV-Contiguity » Dep, Edgemost

We further adopt some later stratum with a process:

(66) **Alabama Word-level OT Hierarchy**

Precede(*ha-*, *-chi*), RealizeMorph(1.pl) » NoHiatus » Id(Stem)

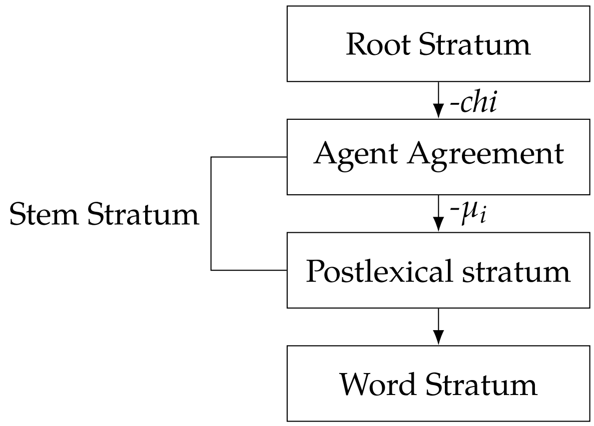
Our analysis of Alabama thus provides evidence for an account which makes use of constraints reliant on the *foot* itself as a constituent, rather than merely the output of OT processes. This affirms the accounts described in Gordon (2016). That is, the motivation for the movement of agent morphemes is predicated on the formation of iambic feet, while permitting the deletion of vowels parsed unstressed in prior strata in trochee constituents.

The data finally raises questions of the nature of verbal agreement in Koasati and Proto Muskogean which both display systems markedly similar to Alabama. Both may also be subject to a similar system of affixal movement, rather than the abstract verb classes described by previous authors. Likewise, there may in fact not be separate sets of agreement markers as proposed by Haas (1946), Kimball (1991), and Lupardus (1982), but a single one whose allomorphs can be accounted for through a complex series of constraints, whether the same as in Alabama, or slightly different.

5 Addendum: Imperfective Vowel Gemination and CVCV Stems

The hierarchies described before also explain the patterns seen in CVCV bisyllabic roots subject to Imperfect Vowel Gemination, supposing the morpheme causing the vowel lengthening is attached later than agent agreement. Upon attachment, the vowel lengthening process will target the now heavy penultimate syllable so as to not create a final heavy foot.

(67) **Lexical stratal processes**



That is, first a CVCV root will take agreement markers regularly. For 1.PL, 2.SG, 2.PL, this results in the stem-final vowel deletion as expected. Otherwise, the stem stays unmodified. Then, the imperfective vowel lengthening morpheme is attached. Because the stem-final vowel cannot be lengthened in the stem-level stratum for risk of creating a final foot, only the interior vowel may the lengthened, resulting in the exact forms predicted. We must only adopt some constraint REALIZEMORPH(μ_i) above Dep$_\mu$ to ensure that vowels may be lengthened if need be.

(68) **2.SG Agent Agreement *hoponi***

ho(ˈponi)tʃi	Max-V^{strong}	Nonfinality	Parse	CV-Contiguity	Edgemost
a. ☞ (hopon)tʃi			∗		
b. (hopos)ni			∗		∗!∗
c. (hotʃip)ni			∗	∗!	

(69) **Imperfective stem formation, *hoponchi***

(hopon)tʃi-μ_i	Nonfinality	*C^{unsyll}	RealizeMorph(μ_i)	Dep$_\mu$
a. (hopon)(tʃiː)	∗!			
b. (hopon)tʃːi		∗!		
c. (hoponː)tʃi		∗!		
d. ☞ (hopoːn)tʃi				∗
e. (hopon)tʃi			∗!	

What's difficult to explain is why the stem-level processes may affect CVCV bisyllables which are subject to imperfective vowel gemination, but no longer those which do not attach the vowel-lengthening morpheme. In fact, all CVCV bisyllable roots require periphrastic conjugation, in a shift from the data presented by Montler & Hardy (1990). It is possible that one such word may be capable of conjugating as predicted by Montler & Hardy, but all verbs tested but one by the authors were probably incapable of such in either agent agreement, or negative stem formation.

(70) taɬa-t-is-ka-ti
weave-CONV1-2.SG.AGT-KA-PST1
'You wove it.'

(71) ?taɬ-chi-ti
weave-2.SG.AGT-PST1
Intended: 'You wove it.'

(72) aɬ-chi-lo
put.in-2.SG-FUT

Overall, bisyllabic CVCV words are marked: only eleven examples exist in the corpus, three of which are totally 'irregular' (Montler & Hardy 1990) and instead take prefixes as though they were of a CV syllable structure. A further two have shifted class to patient agreement. Of the remaining vocabulary items, most are unfamiliar to current speakers. It is unclear if this is a shift in progress to periphrastic conjugation as the sole method of conjugation for CVCV verbs, or the unfamiliarity of the remaining CVCV bisyllable words that motivates the switch to periphrastic conjugation.

6 Addendum: Primary Stress and Phrasal Considerations

A further phenomenon which must be explained through a subsequent stratum is word-final stress. Spectrogram data suggests that stress is assigned finally, regardless of underlying syllable structure or vowel length. This contrasts directly with the type of Nonfinality exhibited in stem-level phonology.

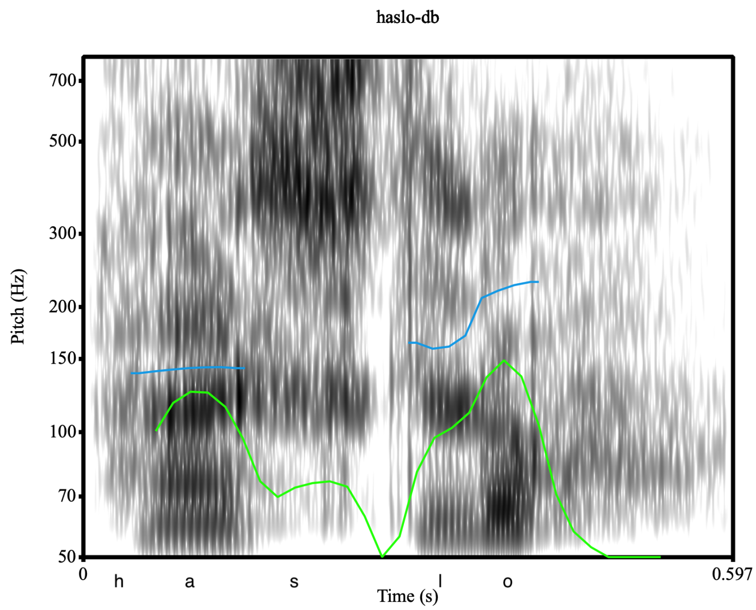


Figure 1: Spectrogram of *haslo*, 'you all came'. Volume indicated in Green in decibal units, Pitch indicated in cyan in Hz.

For some speakers, this results in lengthening underlying short vowels, resulting in lengthened versions of allophones otherwise restricted to lax, short environments. Consider below, [bɪ.la.ˈtɪː]

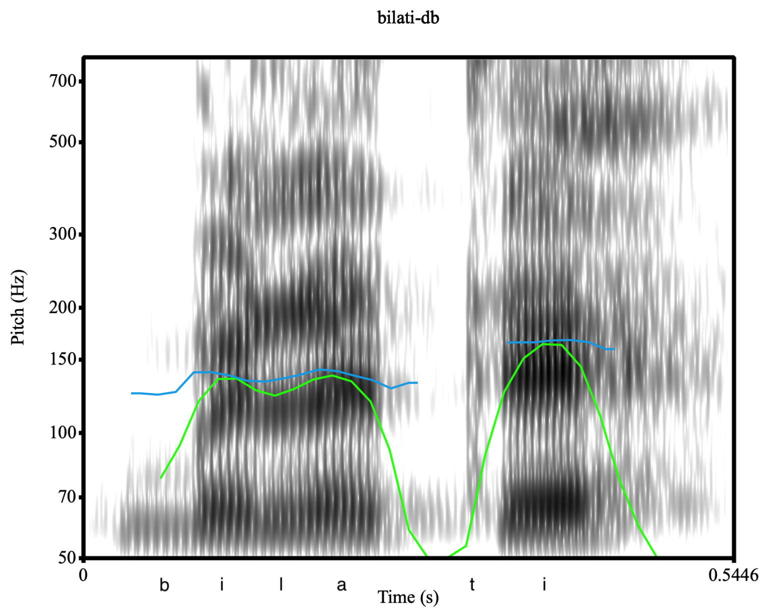


Figure 2: Spectrogram of *bilati* ([bɪ.la.ˈtɪː]), 'melted'. Volume indicated in Green in decibal units, Pitch indicated in cyan in Hz.

Final word-stress is then explained by the constraint Align(Stress, R). This is undominated such that the final syllable will always recieve stress, even if it is a light syllable. This must outrank Nonfinality. While unclear, final stressed light syllables may be subject to lengthening (with some speakers) or final *-h* epenthesis (in others). If this is true, this can be accounted for with the domination of the constraint StressToWeight over Dep$_\mu$ and Id(Stem) in the Post-Lexical Stratum. Thus, even words unaltered from stem-level OT processes with a (H)L syllable structure are subject to this lengthening and stress assigment.

(73)

$(\sigma\sigma).\sigma$	Align-R(Stress)	StressToWeight	Dep$_\mu$	Id(Stem)
a. $(\text{ˈ}\sigma\sigma).\sigma$	*!			
b. $(\sigma\sigma).(\text{ˈ}\sigma)$		*!		*
c. ☞ $(\sigma\sigma).(\text{ˈ}\sigma\sigma)$			*	**

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