The Phonology and Syntax of Tone Spreading in Dan[*]

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1 Introduction

Dan (dnj, Mande, Côte d'Ivoire) has a productive rightward one step tone spread process. There are a few important things to note about this spread: any one of the 5 tones can spread (1), and the underlying tone of target syllable does not affect the spread (2).

(1) All tones can spread

    a.   klà è   **já jǎ**   (Carve: /já/)
          kla 3SG yam carve
          kla carves the yam

    b.   klà è   **gbɛ́ ká**   (Cut: /ká/)
          kla 3SG dog cut
          Kla cuts the dog

    c.   klà è   **mɛ̄ jā**
          kla 3SG man carve
          kla carves the man

    d.   klà è   **tɔ̀   jà**
          kla 3SG chicken carve
          kla carves the chicken

    e.   klà è   **ɓɔ̀ɔ̀ jà**
          kla 3SG pig carve
          kla carves the pig

(2) Underlying tone doesn't affect spread

    a.   klà è   **tɔ̀   kà** (cut: /ká/)
          kla 3SG chicken cut
          Kla cuts the chicken

    b.   klà è   **tɔ̀   jà**   (carve: /já/)
          kla 3SG chicken carve
          kla carves the chicken

    c.   klà è   **tɔ̀   mà** (hit: /mā/)
          Kla 3SG chicken hit
          kla hits the chicken

    d.   klà è   **ɓɔ̀ɔ̀ ɓɤ̌** (eat: /ɓɤ̌/)
          kla 3SG pig eat
          Kla eats the pig

    e.   XXX
          XXX
          XXX

Crucially, this tone spread is a one-step process. For example, one of the places where the spread is seen is in compounds, where the tone spreads onto the last syllable of the compound from the preceding syllable (3a); however, as (3b) shows, this spread is not unbounded: tone spreads onto the final syllable from the penultimate syllable only, not from the beginning of the word. Furthermore, when there target morpheme is disyllabic (as is the case of the progressive morpheme *nāgú*), the tone only spreads to the *first* syllable of the target morpheme (3c).

(3) Spread is binary

    a.   **mɛ̄-tɔ̄**   (/mɛ̄ + tɔ̀/)
          Pet chicken   (person + chicken)

    b.   wúú**kámɛ́**   (/wúú + ká + mɛ̄/)
          butcher   (meat + cut + person)

    c.   klà è   gṵ̀   gbɛ́   **ká nᴧ́gúú**
          kla 3SG PST dog cut PROG
          "Kla is cutting the dog."

We show that this tone spread is restricted to specific domains, and that these domains are syntactic in nature, targeting the morphological/syntactic head of the domain. Furthermore, we show that the one-step spread can be multiplied, given the right syntactic context: when one domain is embedded inside of another domain, and the head of the embedded domain immediately precedes the head of the embedding domain, iterative 'one-step spread' from head to head is possible. Because the iteration of this spread is specifically a head-to-head process, we provide a Match theory account of the syntax-phonology interactions in licensing tone spread.

Theoretical interest

- Long distance spreading can be broken down/grouped into smaller 1-step spread within each embedded domain.

- Syntactic labels are accessible to the phonology through the mediation of prosodic domains.

2 Background

Tonal inventory: Dan has been analyzed as a five-level tone system (Flik 1977; Vydrine and Mongnan 2008, Gondo 2014). But Ahoua, Akinlabi and Gondo (2016) re-analyzed the language as a four level tone plus creaky

voice system, arguing that the difference between the Low tone and the Super-Low tone is the addition of creaky voicing. Here we show the five phonetic tones.

(4) a. H': **gbá̋** 'sort of dance'
     b. H: **gbá** 'shed'
     c. M: **gbā** 'make love'
     d. L: **gbà** 'antelope'
     e. L': **gbà̰** Onomatopoeic sound

Syntax: Dan is a pro-drop language, with auxiliaries which distinguish between perfective/non-perfective aspect and subject agreement. Nonperfective aspect is the unmarked aspect. We assume that overt subjects, when present, as left dislocated (*c.f.* Schneider-Zioga (2000); Baker (2003) for left dislocated subjects in Kinande).

   The basic word order is S-aux-O-V-IO, where the indirect object is almost always introduced by a postposition. Given that other phrases in the C-T-V spine (CP, TopP, FocP, TP, and AspP) are all unambiguously head initial, we also assume that VP is head initial, but that the object moves out of the VP to a higher position, which yields the typologically unusual word order: DO V IO. We suggest that this movement is for case-licensing purposes: DPs cannot get case in the VP, unless licensed by a postposition (e.g. Indirect objects/objects of phrasal verbs).[1] Support for this notion comes from the fact that with double object constructions, the direct object can appear post-verbally, but only if it is licensed by a post-position (5b).

(5) a. má   **bàlɔ́ŋ** nṵ̄   Zɔ̀kű ɗɛ̰́
         1.SG.PRF ball   give Zoku to
         'I gave the ball to Zoku'
     b. má   nṵ̄ **bàlɔ́ŋ ká** Zɔ̀kű ɗɛ̰́
         1.SG.PRF give ball   P   Zoku to
         'I gave the ball to Zoku'

Additionally, a couple of verbs exhibit the spray load alternation, in which either object DP can appear preverbally, with the second DP appearing post-verbally, licensed by a postposition (6).

(6) a. má   jǐ   pɛ̰́ŋ kɔ́   ɓá̋
         1SG.PERF water spray house on
         'I sprayed water on to the house'
     b. má   kɔ́   pɛ̰́ŋ jǐ   ká̋
         1SG.PERF house spray water with
         'I sprayed the house with water'

We suggest that in Dan the direct object moves to Spec-AgrO (*cf* Chomsky 1991) for case licensing purposes.[2]

   In contrast to phrases in the V-T-C spine, the PP (7) and the DP (8) are head final. Note that the 'plural marker' (nṵ̀) is a plural determiner in Dan: an adjective/numeral can intervene between it and the noun. The plural marker can also precede the adjective/numeral, but the meaning changes, as (8) shows.

(7) a. blṵ̋   ɗɛ̰́
         forest into
         'into the forest'
     b. nʌ́   tá
         child over
         'over the child'

(8) a. gblòò plɛ̄ɛ̄ nṵ̄
         chair two PL
         'the two chairs'

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[1]Exceptions to this generalization are locative objects introduced by the word *go (ɗó)*, which appear post-verbally without a post-position. We suggest that *ɗó* assigns quirky case.

[2]Our analysis does not hang on the label of this projection - it could just as easily be the μP of Johnson (1991), Coon and Preminger (2017), *inter alia*, which is also considered to be the landing site of object DPs in cases of object shift/short object movement. What *is* crucial to the analysis which follows is that this projection is above the verb phrase.

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b. gblòò nū plɛ̄ɛ̄
chair PL two
'two of the chairs'

3 Syntactic Domains of Tone Spread

3.1 The Lexical Domain

If a word is morphologically complex (such as compound words and nominalized verbs and adjectives) the tone spreads from the preceding syllable onto the head morpheme of the word (i.e. the head of the compound or the nominalizer).

For example: the word *wúɪ* ('meat') productively compounds with other nouns to indicate a specific kind of meat; in these cases *wúɪ* is the head of the compound, and it loses its high tone, and the tone of the previous syllable spreads onto it. Similarly, the word *mɛ̄* ('person') productively compounds with nouns and verbs to create nouns denoting "person with property X". In these compounds, 'person' is the head, and so it is the target for the tone spread. Crucially, however, it is a one-step spread. That is, the tone does not spread from the start of the word if the word is more than two syllables (as in (9a) (9d)) - it spreads only from the penultimate syllable.

(9)   a. wúɪ-**kʌ̰́-mɛ̰́**   (/wúɪ + kʌ̰ + mɛ̰̄/)
         meat-cut-person
         'butcher'
      b. ɓlá-**kpɔ́-mɛ̰́**   (/ɓlá + kpɔ́ + mɛ̰̄/)
         field-cultivate-person
         farmer
      c. **dū-wū̄**   (/dū + wúɪ/)
         cow-meat
         beef
      d. gbá**dɛ̀-mɛ̰̀**   (/gbádɛ̀ + mɛ̰̄/)
         beg-person
         beggar
      e. **ɓɔ̂ɔ̂-wɪ̀ɪ̀**   (/ɓɔ̂ɔ̂ + wúɪ/)
         pig-meat
         beef

This also happens in nominalized verbs and adjectives, where the nominalizer (-sɪ and -dɛ̀) is the head of the word, as shown in (10) and (11). Note that the spread is *binary* - the tone does not spread from the beginning of the word when the stem is polysyllabic (such as in the (b) and (e) examples below).

(10)   With the nominalizer **-sɪ**
      a. **zʊ̌-sʊ̌**
         wash-NOM
         'the washing'
      b. jíɪ́**tó-sú**
         laugh-NOM
         'the laugh(ing)'
      c. **zā-sū̄**
         kill-NOM
         'the killing'
      d. **ɓɤ̀-sɪ̀**
         eat-NOM
         'the eating'
      e. kā-**sɛ̀ɛ̀-sɪ̀**
         become-cold-NOM
         'the freezing'

(11)   With the nominalizer **-dɛ̀**
      a. **glʊ̌ː-dɛ̌**
         bitter-NOM
         'bitterness'
      b. tʃà̰à̰**dɤ́-dɛ́**
         right-NOM
         'righteousness'
      c. **sɔ̄ː-dɛ̄**
         beautiful-NOM
         'beauty'
      d. zɤ̃́ɤ̃́**zɔ̂ɔ̂-dɛ̀**
         foolish-NOM
         'foolishness'

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Notably, the tone always spreads onto the morpheme which determines the category of the complex word, as the schematized version of (10e) in (12) shows (where underlining indicates the span of the tone spread).

(12) $[^N [\sigma^V \underline{\sigma^A}] \sigma^N]$ ($[^N$ [kā-s$\underline{\grave{\bar{\varepsilon}}\grave{\varepsilon}}$]-s$\grave{\bar{u}}$ù])

3.2   PP domain

As mentioned in §2, PPs are right-headed in Dan. Tone spreads from the last syllable of the postposition's complement onto the post-position. This is true both of 'pure' postpostions (as in (13)), as well as postpositions which act as a particle in a particle verb construction, such as *dɛ́* in *nū dɛ́* (come+to=give).[3]

(13)   With **ta** (over)

     a.   kwā   wlɤ̌ **blǔ**   **tǎ**
          1PL.PRF fly   forest over
          'we flew over the forest'

     b.   klà è   wlɤ̌ **nɑ́**   **tá**
          Kla 3SG.AUX fly   child over
          'Kla flies over the child'

     c.   klà wlɤ̀ a   **dā**   **tā**
          Kla fly   3SG.PRN father over
          'Kla flies over his father'

     d.   klà wlɤ̀ **tɔ̀**   **tà**
          Kla fly   chicken over
          'Kla flies over the chicken'

     e.   klà wlɤ̀ **ɓɔ̀ɔ̀ tà**
          kla fly   pig over
          'Kla flies over the pig'

(14)   With **dɛ** (to)

     a.   klà è   ɓáá nű   **vǐ**   **dɛ́** (/vǐ + dɛ́/)
          Kla 3SG rice give fish to
          'Kla gives the rice to the fish'

     b.   klà è   ɓáá nű   **nɑ́**   **dɛ́** (nɑ́ + dɛ́/)
          Kla 3SG rice give child to
          'Kla gives the rice to the child.'

     c.   klà è   ɓáá nű   **mɛ̄**   **dɛ̄** (/mɛ̄ + dɛ́/)
          Kla 3SG rice give person to
          'Kla gives the rice to the person.'

     d.   klà è   ɓáá nű   **tɔ̀**   **dɛ̀** (/tɔ̀ + dɛ́/)
          Kla 3SG rice give chicken to
          'Kla gives the rice to the chicken.'

     e.   klà è   ɓáá nű   **ɓɔ̀ɔ̀ dɛ̀** (/ɓɔ̀ɔ̀ + dɛ́/)
          Kla 3SG rice give pig to
          'Kla gives the rice to the pig.'

We suggest that this is because the PP is a domain for tone spread, with the head of that domain being a target for spread (attracting the tone from the preceding syllable), as illustrated in (15).

(15) $[^{PP} [^{DP} \sigma\underline{\sigma}] \sigma^P]$ (e.g: $[^{PP} [^{DP} \underline{ɓɔ̀ɔ̀}] d\underline{ɛ̀}]$)

These examples demonstrate a case where the tone spreads from the complement of the head onto the head. When the NP is extracted from the PP, the post-position is realized with its underlying tone - it does note attract the tone from the preceding word, as that word is not in the domain headed by the postpostion, as evident in the schematization in (16b).

(16)   a.   blǔ   mɛ̀ɛ̀   kwá   wlɤ̀ __ tà
          forest which 1PL.PRF fly   *t*   over
          'which forest did we fly over?'

     b. $[^{VP} \sigma^V [^{PP} [^{DP} —] \sigma^P]]$

3.3   DP domain

The 'plural marker' (nṵ̋) is a plural determiner in Dan: an adjective/numeral can intervene between it and the noun. This determiner is a target for tone spread (17), regardless of the category of the preceding lexical item. Tone spread is also found in possessive DPs, where the tone spreads from the last syllable of possessor phrase onto the possessive marker (18). Note that the tone spread is once again binary: in (18b), the tone does not spread from the beginning of the DP, it only spreads from the syllable immediately before the head of the phrase (the determiner).

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[3]There are, however, some prepositions which do not appear to attract tone, such as *ká* and *gúr*; at this point we cannot offer an explanation for these exceptions.

(17) The Plural Determiner DP

 a. **jǎ nǚ**
  yam PL
  'the yams'

 b. **nʌ́ nú**
  child PL
  'the children'

 c. gblòò **plɛ̄ɛ̄ nṵ̄** wò t̋t̋
  chair two PL 3PL small
  'the two chairs are small'

 d. **gblòò nṳ̀**
  chair PL
  'the chairs'

 e. **ɓɔ̀ɔ̀ nṳ̀**
  pig PL
  'the pigs'

(18) The Possessive DP

 a. nʌ́ **kpɛ̋ɛ̋ ɓǎ** tɔ̀
  child skinny POSS chicken
  'the skinny child's chicken.'

 b. **nʌ́ ɓá tɔ̀**
  child POSS chicken
  'the child's chicken.'

 c. **mɛ̄ ɓā** jı̋
  person POSS water
  'the person's water'

 d. **tɔ̀ ɓà** wɛ̀ɛ̀
  chicken POSS flea
  'the chicken's flea'

 e. **zɔ̀ɔ̀ ɓà** nʌ́
  sparrowhawk POSS child
  'The Sparrowhawk's child'

(19) a. The structure of DP$_{PL}$:
  [^{DP} [^{NP} $\sigma\underline{\sigma}$] σ^{D}] e.g.: [^{DP} [^{NP} gblòò $\underline{plɛ̄ɛ̄}$] nṵ̄]

 b. The structure of DP$_{POSS}$:
  [^{DP} [^{DP} $\sigma\underline{\sigma}$] [$^{D'}$ σ^{D} [^{NP} $\sigma\sigma$]]] e.g.: [^{DP} [^{DP} nʌ́ $\underline{kpɛ̋ɛ̋}$] [$^{D'}$ ɓǎ [^{NP} tɔ̀]]]

The fact that the plural determiner DP and possessive DPs have different structures (schematized in (19))[4] gives some important insight for understanding this tone spread. Firstly, it shows us that the spread is specifically targeting the *head* of the domain, not simply the final syllable of the domain (see (19b)). Furthermore, we can also tell that the Head attracts tone from whatever precedes it in its domain - regardless of whether or not the preceding word is part of the head's complement (19a) or its specifier (19b).

3.4 TopP Domain

TopP is left-headed in Dan. Tone spreads from the last word in the topicalized DP onto the topic marker – (regardless of the category of the preceding word). Again, this illustrates a case of tone spread from the specifier onto the head, as illustrated in (21).[5]

(20) a. tɔ̀ **kpɛ̋ɛ̋ zʌ̋** è ɓáá ɓɤ̌
   chicken thin TOP 3SG rice eat
   'As for the skinny chicken, it eats rice'

 b. **gbɛ̰́ zʌ́** ā mā
   dog TOP 1SG hit
   'As for the dog, I hit it'

 c. **ɓī zʌ̄** ī ɓáá ɓɤ̌
   you TOP 2SG rice eat
   'As for you, you eat rice'

 d. **tɔ̀ zʌ̀** è ɓáá ɓɤ̌
   chicken TOP 3SG rice eat
   'As for the chicken, it eats rice'

 e. **Mǔsò zʌ̀**, Klà è sàɓá nǘ à ɗɛ̀
   Muso TOP Kla 3SG shoe give him to
   As for Muso, Kla gives him the shoe'   (Gondo 2016:192)

(21) [^{ToP} [^{DP} $\sigma\underline{\sigma}$] [$^{Top'}$ σ^{Top} [^{XP} $\sigma\sigma$]]] e.g.: [^{ToP} [^{DP} tɔ̀ $\underline{kpɛ̋ɛ̋}$] [$^{Top'}$ zʌ̋^{Top} [^{TP} è ɓáá ɓɤ̌]]]

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[4]Note that the idea of different types of determiners having different DP structures is not unusual. The Fanti dialect of Akan, for example, shows this same asymmetry between definite DPs (head final) and possessive DPs (head initial) (Owusu, pc). Furthermore, Swahili appears to have post-nominal demonstrative determiners, where as its definite (anaphoric) determiners are prenominal (Van de Velde 2005).

[5]We follow Rizzi's (1997) analysis of topicalization, in which the topicalized DP occupies the specifer of the TopP, and the remainder of the clause ('the comment') is the complement to Top.

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3.5 The AgrO Domain

In the nonperfective, the verb attracts tone from the direct object, as demonstrated in (22), where the underlying form of the verb is /já/'. In the prefective, however, tone *does not* spread from the direct object onto the verb (23).

(22) Nonperfective: tone spreads to V

    a. klà ě **jǎ jä̰**
        kla 3sG yam carve
        'Kla carves the yam.'

    b. klà ě **gbɛ́ já̰**
        kla 3sG dog carve
        'Kla carves the dog.'

    c. klà ě **mlɔ̰̄ɔ̰̄ jā̰**
        kla 3sG civet carve
        'Kla carves the civet.'

    d. klà ě **tɔ̀ jà̰**
        kla 3sG chicken carve
        'Kla carves the chicken.'

    e. klà ě **ɓɔ̰̀ɔ̰̀ jà̰**
        kla 3sG pig carve
   'Kla carves the pig.'

(23) Perfective, tone does not spread to V

    a. klà jà **jǎ já̰**
        kla 3sG.PRF yam carve
        'Kla carved the yam.'

    b. klà jà **gbɛ́ já̰**
        kla 3sG.PRF dog carve
        'Kla carved the dog.'

    c. klà jà **mɛ̄ já̰**
        kla 3sG.PRF man carve
        'Kla carved the man.'

    d. klà jà **tɔ̀ já̰**
        kla 3sG.PRF chicken carve
        'Kla carved the chicken.'

    e. klà jà **ɓɔ̰̀ɔ̰̀ já̰**
        kla 3sG.PRF pig carve
        'Kla carved the pig.'

We suggest that the issue at the heart of this asymmetry is this: In the nonperfective, the verb and the object are in the same domain (AgrO),[6] whereas in the perfective they are not. Specifically, we suggest that the perfective introduces a new syntactic domain which prevents the verb from moving to AgrO, whereas the direct object still moves to AgrO for case-licensing purposes. Thus the verb and the direct object are in different domains.

(24) Non-perfective: One domain
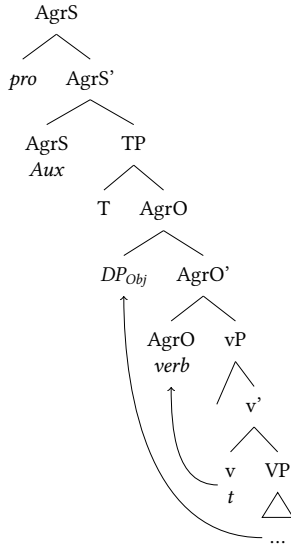
(25) Perfective: Two different domains
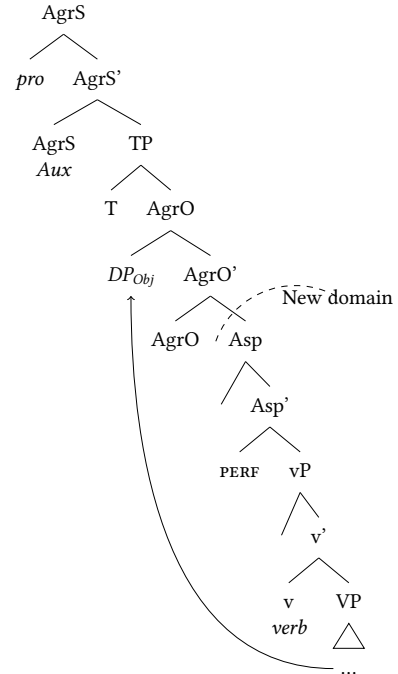
Interesting, this mirrors a proposal put forward by Coon and Preminger (2017), in which they argue that perfective aspect splits a clause into two distinct domains. This, they argue, is why split ergative languages mark

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[6]See discussion in §2.

subjects of transitive verbs with ergative case in perfective clauses. However, they argue that split ergativity is epiphenomenal, and that this bifurcation of the clause into two distinct domains exists in all languages, but that it is obscured in languages that do not mark ergativity.

Crucially here, the introduction of the perfective phrase into the clausal spine results in the verb *not* moving to AgrO, and thus tone cannot spread from the object onto the verb, as the two are not in the same domain in the perfective (26b). This is in contrast to the nonperfective, where they are both in AgrO, and the verb heads AgrO.

(26) a. $[^{\text{AgrO}} [^{\text{DP}} \sigma\underline{\sigma}] [^{\text{AgrO'}} \underline{\sigma}^{\text{AgrO}} [^{\text{vP}} ...]]]$ e.g.: $[^{\text{AgrO}} [^{\text{DP}} \underline{\text{tɔ̀}}] [^{\text{AgrO'}} \text{jà}^{\text{AgrO}} [^{\text{vP}} ...]]]$
      b. $[^{\text{AgrO}} [^{\text{DP}} \sigma\sigma] [^{\text{AgrO'}} [^{\text{AspP}} ...\sigma^{\text{V}}]]]$ e.g.: $[^{\text{AgrO}} [^{\text{DP}} \text{tɔ̀}] [^{\text{AgrO'}} {}^{\text{AgrO}} [^{\text{AspP}} ...\text{já̰}]]]$

3.6 The ProgP Domain

Progressive aspect also seems to result in the verb not moving to AgrO, as tone does not spread from the object to the verb in the progressive. However, tone *does* spread from the verb onto the first syllable of the progressive morpheme (27).

(27) a. klà è ɓɔ̀ɔ̀ **kǎ̰ nˊᴧgúɪ̀**   c. klà è ɓɔ̀ɔ̀ **mā̰ nᴧgúɪ̀**
          kla 3sg pig cut prog   kla 3sg pig hit prog
          'Kla is cutting the pig'   'Kla is hitting the pig'
      b. klà è ɓɔ̀ɔ̀ **já̰ nˊᴧgúɪ̀**   d. klà è ɓɔ̀ɔ̀ **ɓɤ̀ nˋgúɪ̀**
          kla 3sg pig cut prog   kla 3sg pig hit prog
          'Kla is carving the pig'   'Kla is hitting the pig'

We suggest that in the progressive the verb head adjoins to the the progressive head, and does not move up into AgrO (28). This results in the verb being in the same domain as the progressive, but not in the same domain as the object, thus accounting for the patterns in tone spread that we see.

(28) Progressive: Two different domains
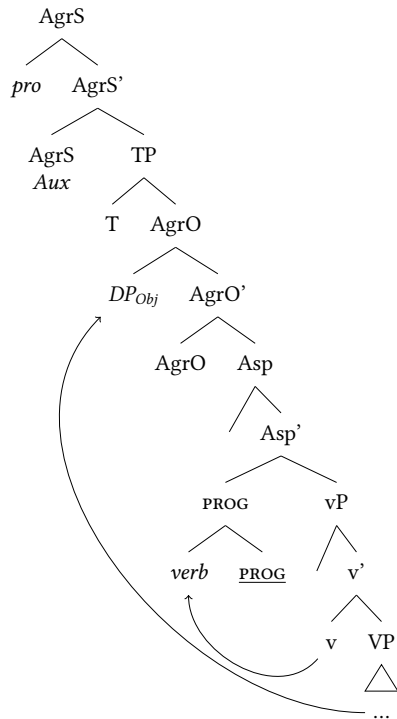
(29) $[^{\text{AgrO}} [^{\text{DP}} \sigma\sigma] [^{\text{AgrO'}} [^{\text{AspP}} \underline{\sigma}^{\text{V}} \sigma\sigma^{\text{Prog}}]]]$ e.g.: $[^{\text{AgrO}} [^{\text{DP}} \text{ɓɔ̀ɔ̀}] [^{\text{AgrO'}} [^{\text{AspP}} \underline{\text{ɓɤ̀ nˋgúɪ̀}}]]]$

It is worth noting here that although the head of the domain is disyllabic here, the one-step nature of the tone spread means that the tone only spreads onto the first syllable.

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3.7 Not all syntactic XPs are domains for tone spread

As shown in the examples above, tone spread is licensed in syntactic domains. However, not every syntactic domain is a tone spreading domain: syntactic domains which are not tone spread domains include FocP (30a), CP (30b) and NumP (30c).

(30)   a.   **klà nā̰** jà ví nū ná̰   nṵ́ ɗɛ́
            kla FOC AUX fish give child PL to
            'It's Kla that gave fish to children.'

       b.   **dē** ɤ́   ḭ̄   kpà̰ ɓà
            who COMP 2SG look on
            'Who do you see?'

       c.   **gblòò dō**
            chair one
            'One chair.'

Interim Summary

There is a productive tone spread process, but it is limited to certain syntactic domains. It is always the head of the domain which attracts tone. Further more, the spread is binary: the domain may contain multiple syllables, but the tone only ever spreads from the syllable which immediately precedes the head of the domain on to the head.

4   Syntactic override of the 1-step restriction

The restriction that the spread be binary can be over-ridden, given the right syntactic configuration. Crucially, if one domain is embedded in another domain, AND the heads of the two domains are adjacent, with the embedded head preceding the embedding head, then tone can undergo subsequent spread from head-to-head.

For example, in (31a) a compound noun is embedded by the plural determiner *nṳ̀*, with the result that the tone spreads from the syllable preceding the head of the compound, onto the head of the compound, and then onto the head of the DP. If the phrase occupies the specifier position of a possessive DP, as in (31b), the tone can then spread an additional step onto the head of the possessive DP. Similarly, a pluralized compound in object position (in the nonperfective) will also show this quaternary spread (31c). Finally, (31d) shows that even if the preceding head is *deeply* embedded inside the domain of the embedding head - such as in a relative clause in the object DP - the spread can still iterate from head to head.

(31)   a.   wṹ-**ká̰-mɛ̰́**   **nṹ**
            [[[meat-cut-person] PL]
            'butchers'

       b.   wṹ-**ká̰-mɛ̰́**   **nṹ ɓá̰**   tɔ̀
            [[[[meat-cut-person] PL] POSS chicken]
            'butchers' chicken'

       c.   klà ȅ   ɓlṹ-**kā̰-mɛ̰̄**   **nṵ̄ mā̰**
            kla 3SG. [[forest-do-person PL] hit]
            'Kla hits hunters.'

       d.   zòtá̰ ȅ   mɛ̰̄   ɤ́ mṹ**sò mà̰ dɔ̰̋**
            Zota 3SG [[person REL [Muso hits]] know]
            'Zota knows the person who hits Muso.'

Crucially, the head of a domain can only attract tone spread from a preceding word if that word is in its domain. For example, if two heads are adjacent, but in two different domains, tone can not spread from the first head onto the second. This is shown in (32), where the head of TopP (which is a domain for spread is adjacent to the nonperfective verb, which can attract spread within it domain; [7] however, because TopP is not embedded inside the domain headed by the verb, the spread cannot iterate from head to head.

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[7] Is is made possible by the fact that the 3rd person singular aux may occasionally be omitted, as is the case in (32).

(32) **nᾰ̰**   **zᾰ́** kpᾰ̰ klà ɓà
Grandma TOP look kla on
'Grandma, she sees Kla.'

(33) ɓlṹ mὲ̰ὲ̰ kwá **wlɨ̀ __ tὰ**
Forest which 1PL.PRF [fly [over]]
'which forest did we fly over?'

This point is made again in (33), where the verb and the postposition are adjacent (as a result of extraction of the DP from the PP), but where tone cannot spread onto the postposition from the verb, because the verb is not embedded in the PP. Furthermore, even though the PP is embedded in the VP, tone cannot spread from the P to the V, because there is a left-to-right restriction on the spread.

5 Prosodic Domains of Tone Spread

Generalizations in syntax-phonology interface hold that certain phonological phenomena are diagnostic of syntactic structure/constituency because these phenomena are present in some and systematically absent in others (Chomsky and Halle 1968; McCawley 1968, a.o.). In Dan, the domain of the binary tone spread is *almost* isomorphic with syntactic constituency[8]. We present, in the sections below, an analysis of the syntax-phonology mapping that is mediated by prosodic domains. In other words, phonological domains are presented in terms of domains of the prosodic hierarchy and then matched with syntactic domains.

    Selkirk's (2006) Match Theory is adopted because it '*predicts a strong tendency for phonological domains to mirror syntactic constituents*' (Selkirk 2011:5) on one hand and provides on the other hand, a natural way to derive a nested recursion of phonological domains to mirror the syntactic nesting. We depart from Selkirk's (2011) analysis in that we introduce constraints that enforce the preservation of syntactic head labels by matching them to prosodic labels in the prosodic domain. In §5.1 we present an analysis of the Dan tone spread and the syntax-phonology mappings, and in §5.2 we show the shortcomings of alternative syntax-phonology mapping accounts, namely that of ALIGN and WRAP-XP constraints.

5.1 Syntax-Prosody Mapping in Dan

We take the p(honological)-phrase (φ) to be the domain of the binary tone spread because the spread is licensed within words or group of words that are most of the time syntactic phrases. To derive these tone spreads, we first establish a set of constraints that ensure that we get the right outputs for tone spread given the right domains, i.e φ. We employ the Match Theoretic constraints of *Match(φ, XP)*, *Match(XP, φ)* and *BinMin(φ, ω)* (Selkirk 2006, 2011). See the Appendix for their respective definitions. Intuitively, the Match constraints map the syntactic and phonological domains to each other through prosodic domains as shown in (34) and (35), where ι stands for the I(ntonational)-phrase.

(34) $[[\text{Klà}]^{NP}_{\varphi}$ è $[[[\text{wúú kᾰ̰ mᾰ̰}]^{NP}_{\varphi}$ nṹ$]^{DP}_{\varphi}$ mᾰ̰$]^{VP}_{\varphi}$ $]^{Clause}_{\iota}$ 'Kla hits the butchers'

(35) $[[\text{Klà}]^{NP}_{\varphi}$ jà $[[[\text{wúú kᾰ̰ mᾰ̰}]^{NP}_{\varphi}$ nṹ$]^{DP}_{\varphi}$ mᾱ̰$]^{VP}_{\varphi}$ $]^{Clause}_{\iota}$ 'Kla hit the butchers'

Consistent with Match Theory (MT), we assume that the output of the syntactic representation is what constitutes the input to the phonology. We further assume that syntactic labels are present in this input representation and can be referred to by the constraints. The square brackets indicate the syntactic domains and the parentheses mark the prosodic domain. Finally, we omitted labels on the left edges of the prosodic domains for clarity of exposition, but these boundaries should be considered present at all times.

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[8]We saw in the preceding sections that not only does tone spread fail to occur within some constituents (e.g: FocP, NumP, CP), it also occurs within syntactic environments that are not traditionally analyzed as forming a constituent (e.g: between **á** '1SG.AUX' and **ɗó** 'FUT' in (44)). For this reason, though the correlation is very high between the presence of tone spread and syntactic constituency, the syntactic vs. phonological domains are not perfectly isomorphic.

5.1.1 Spreading in Isomorphic Syntax-Phonology Domains

By isomorphic syntax-phonology domains, we mean cases where tone spreads, either once or iteratively, within a prosodic domain that corresponds exactly to a syntactic XP. These XPs are NP, DP, VP[9], PP and TopP in Dan.

Let's start with the basic one-step tone spread in these isomorphic domains. Consider Tableaux 1 below, where the input is a possessive DP meaning 'Zota's chicken'. The markedness constraint **Share[Tone](Hd$_{\sigma 1}$)** is crucially ranked higher than the faithfullness constraint **Iden(Tone)** because spreading is favored over faithfulness to the input tone, which is why the winning candidate violates **Iden(Tone)** but not the higher ranked **Share[Tone](Hd$_{\sigma 1}$)**.

Match(H, h) and the domain matching constraint **Match(φ, XP)** interact in an interesting way with **Share[Tone](Hd$_{\sigma 1}$)**: without the first two, the latter is unenforceable. The reason for this is that **Share[Tone](Hd$_{\sigma 1}$)** makes explicit reference both to the phonological domain and its head, which are enforced by these two constraints. In other words, a candidate can only violate **Share[Tone](Hd$_{\sigma 1}$)** if it satisfies both **Match(H, h)** and **Match(φ, XP)** simultaneously. As a result, the optimal candidate is one where all labeling and domain information are available and where spreading targets an element of the phonological phrase (φ) that corresponds to the syntactic head[10]. The corresponding element can be at the right-edge of the prosodic domain as in (37) as well as in the middle of that domain as in (36). This is precisely why the **Share[Tone](Hd$_{\sigma 1}$)** constraint needs to be defined without reference to some edge of the domain.

(36)   Tableau 1: One-step spread

[[zòtǎ]$_{NP}$ ɓà$_H$ tɔ̀]$_{DP}$	Share[Tone](Hd$_{\sigma 1}$)	Match(φ, XP)	Match(H, h)	Ident(Tone)
a. ☞ (zòtǎ ɓǎ$_h$ tɔ̀) $_\varphi$				*
b. (zòtǎ ɓà$_h$ tɔ̀)$_\varphi$	*!			
c. zòtǎ ɓǎ$_h$ tɔ̀		*!		*
d. zòtǎ ɓà tɔ̀			*!	

In Tableau 2, the candidates have similar violation profiles to the candidates in Tableau 1 , although [wúꞋ-kǎ̰-mɛ̰̄$_H$]$_{NP}$ is an NP. Every 1-step spread within a syntactic XP will have candidates with similar violation profiles to the ones in Tableaux 1 and 2, and for this reason we'll not show tableaux for them. We now turn to iterative spread in Tableau 3 below.

(37)   Tableau 2: One-step spread

[wúꞋ-kǎ̰-mɛ̰̄$_H$]$_{NP}$	Share[Tone](Hd$_{\sigma}$1)	Match(φ, XP)	Match(H, h)	Ident(Tone)
a. ☞ (wúꞋ-kǎ̰-mɛ̰́$_h$)$_\varphi$				*
b. (wúꞋ-kǎ̰-mɛ̰̄$_h$)$_\varphi$	*!			
c. (wúꞋ-kǎ̰-mɛ̰̄)$_\varphi$			*!	
d. (wúꞋ-kǎ̰-mɛ̰́)$_\varphi$			*!	*

To mirror the syntactic embedding/nesting requirement for iterative spread, we introduce the constraint **BinMin(φ, ω)**. This constraint enforces the iterative domain building. Interestingly, domain embedding is an epiphenomenon of the iterativity. The intuition behind how **BinMin(φ, ω)** enforces iterativity and embedding is that the requirement for every p-phrase to have at least two p-words is satisfied either when the p-phrase directly has the two p-words or when the p-phrase it embeds helps meet the requirement.

In Tableau 3, the winning candidate (38)a only differs from candidate (38)e on the fact that the latter has its verb in its own p-phrase and because the verb is the only element in that p-phrase, candidate (38)-e fatally violates

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[9]In the perfective, we don't get spreading from the DO to the verb and the present constraints cannot capture that. We return to this below.

[10]Note that we did not include candidates that add new headedness labels to elements of the prosodic domain. This is because we assume that there is a high ranked constraint, **Match(h, H)** that bans headedness labels in the prosodic domain that have no correspondance in the input syntactic domain.

BinMin(φ, ω). This supports at least the ranking of BinMin(φ, ω) over Iden(Tone). In fact, BinMin(φ, ω) has to also rank higher than Match(φ, XP) and the key data (shown in Tableau 4) is one where there is tone spread in a prosodic domain without a syntactic XP correspondent. And because Match(H, h) outranks Ident(Tone), we make sure any candidate that fails to have a correspondence with the syntactic head will alway lose to the winning candidate (compare (38)d to (38)a).

(38)   Tableau 3: Iterative Spread

[[[wúɛ-kǎ-mɛ̰̄H]NP nṵ̀H]DP mā̰H]VP	Share[Tone](Hd$_\sigma$,1)	BinMin(φ, ω)	Match(φ, XP)	Match(H, h)	Ident(Tone)
a. ☞ ((((wúɛ)$_\omega$ (kǎ)$_\omega$ (mɛ̰́$_h$)$_\omega$)$_\varphi$ (nṵ́$_h$)$_\omega$)$_\varphi$ (mā̰́$_h$)$_\omega$)$_\varphi$					***
b. ((((wúɛ)$_\omega$ (kǎ)$_\omega$ (mɛ̰̄$_h$)$_\omega$)$_\varphi$ (nṵ̀$_h$)$_\omega$)$_\varphi$ (mā̰$_h$)$_\omega$)$_\varphi$	*!**				
c. ((((wúɛ)$_\omega$ (kǎ)$_\omega$ (mɛ̰́$_h$)$_\omega$)$_\varphi$ (nṵ̄$_h$)$_\omega$)$_\varphi$ (mā̰$_h$)$_\omega$)$_\varphi$	*!				**
d. ((((wúɛ)$_\omega$ (kǎ)$_\omega$ (mɛ̰̄)$_\omega$)$_\varphi$ (nṵ̄$_h$)$_\omega$)$_\varphi$ (mā̰$_h$)$_\omega$)$_\varphi$				*!	
e. ((((wúɛ)$_\omega$ (kǎ)$_\omega$ (mɛ̰́$_h$)$_\omega$)$_\varphi$ (nṵ́$_h$)$_\omega$)$_\varphi$ ((mā̰́$_h$)$_\omega$)$_\varphi$)$_\varphi$		*!			***

Here's the place to discussion the obvious violation of the Strict Layer (SL) hypothesis (Selkirk 1995; Nespor and Vogel 2007; Pierrehumbert and Beckman 1988) in the recursion tableau above. This hypothesis captures the idea that a constituent on some level of the prosodic hierarchy can only dominate constituents of the level immediately below it. However, many languages show a level of domain recursion previously unknown to phonology, mainly from syntactic influences on the phonology. In fact, Selkirk (2006, 2011)'s Match Theory and argument in favor of the violable character of the Strict Layer hypothesis follows a new tradition of work that started with Ito and Mester (2007) and their earlier works. The idea is that a constituent on some level of the hierarchy can directly dominate other constituents on the same or lower levels. The current data lends additional support for this revision of the hypothesis because domain recursion and ability to *level-skip* is necessary to account for the generalizations in Dan. We adopt the prosodic recursion representation in (39) below, adapted from Itô and Mester (2003); Itô and Mester (2010).

(39)   Recursive Prosodic Domains in Dan[11]

$$\varphi$$

ω   ω   ω   ω   ω
(((wúɛ   kǎ   mɛ̰́)   nṵ́)   mā̰)
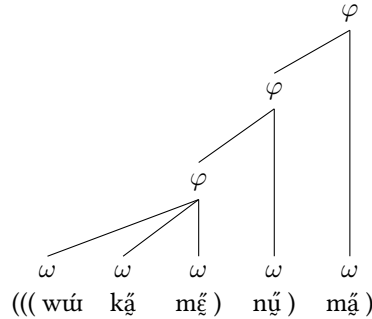
As shown in the diagram in (39), Match Theory maximizes a one-to-one mapping between syntactic and prosodic domains through a recursive embedding. However, things become much more complicated when domains do not match. This can happen in two scenarios: when there's spread in a domain that is not a syntactic phrase or when a syntactic phrase is not a domain of tone spread. We turn to the latter in the next section while the former is saved for unsolved issues.

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[11]We only showed the recursion within the VP here. It is trivial to add the subject's φ, and have ι dominate all of the φs. Also, not that this structure is flat within the p-phrase.

5.1.2 An Account of the Domains without Spread

As discussed above, there are some syntactic phrases where tone spread does not occur. Other than the problematic case of no spread within VPs in perfective aspect, tone does not spread in NumP, FocP and CP. We first take up the NumP issue.

Due to the striking structural similarity between NumP in (40) and an NP with an adjectival modifier in (41), and more importantly because there is no spreading within the two structures, we suggest that neither the numeral nor the adjective are heads of these domains. This will explain why tone does not spread onto them. As such, NumP is derivable without further stipulations by the constraint set and rankings in Tableau 2, where Ident(Tone) will favor NumP candidates without spread over candidates with spread.

(40) gblòò dō chair one
'One chair.'

(41) tɔ̀ kpɛ́ɛ̌ chicken thin
'skinny chicken'

As far as FocP is concerned, the non-spreading can be accounted for in two ways. The first one is to assume that left-dislocated focus is at the intonational phrase level (like in Italian, see Bianchi and Bocci 2012, a.o.) and because ι is not a domain of spread in Dan, $n\grave{\Delta}$, the head of FocP does not get spreaded over. However, a more attractive account, the one adopted here, is one that draws from the cross linguistic tendency for Focus to interact in interesting ways with syntactic constituents (see Zimmermann 2006 for a survey along these lines in Chadic languages). More importantly, due to the fact that focus is usually marked, we argue that focused phrases in Dan are no exception and because they bear this focus feature, there is an undominated constraint that prohibit the parsing of a focused phrase within a p-phrase. In Match theoretic terms, we introduce a markedness constraint, *Match(φ, XP_F), that blocks a focused phrase from being matched to a p-phrase. As shown in (42), the optimal candidate (a) does better than the candidate with spread with respect to Ident(Tone), though they both equally violate the binarity constraint. Candidate (c) fatally violates the undominated *Match(φ, XP_F) constraint and is systematically out. Any other candidate is guaranteed to do worse than the optimal candidate on the current ranking.

(42)   Tableau 4: No spread in FocP

[zɔ̀tɑ́ nλ_H]_{FocP}	*Match(φ, XP_F)	Share[Tone](Hd$_\sigma$,1)	BinMin(φ, ω)	Match(φ, XP)	Match(H, h)	Ident(Tone)
a. ☞ zɔ̀tɑ́ nΔ̀$_h$				*		
b. zɔ̀tɑ́ nΔ́$_h$				*		*!
c. (zɔ̀tɑ́ nΔ́$_h$)$_\varphi$	*!					*

Finally, the non spread within CP. Although we don't have a final and complete analysis for why we don't get tone spread within it, one promising line of thought will be to say that it is directly parsed into an ι phrase and because ι is not a domain of spread, we don't get spreading. This is particularly compelling given the fact that the strict layer hypothesis is violable and domain elements can directly link to the ι phrase without first liking to a φ phrase. Note that this another way of saying it CPs don't get matched to p-phrases either, but for some other reasons.

5.2 Limits of ALIGN Constrains in Domains Mapping

The earlier Selkirkian restriction principle that the syntax-phonology mapping constraint ALIGN-XP,R/L applies exclusively to XPs that are headed by lexical categories and not to those headed by functional categories (Selkirk 1995; Selkirk and Shen 1990) is challenged in Dan. Truckenbrodt (1999, 2007) analyzes this restriction principle as the effect of the Lexical Category Condition (LCC), whereby alignment constraints such as the ALIGN-XP,R/L don't make reference to functional projections (e.g: DPs) (Selkirk 1995; Truckenbrodt 2007). With the Dan data, the ALIGN constraints face two major challenges.

The first challenge comes from the fact that binary tone spread occurs in syntactic phrases headed not only by lexical categories but also by functional ones. As shown in the DP examples in (17) and (18), on one hand and in the PP domains in (13) and (14) on the other, domains headed by these functional categories (Abney 1987) also license tone spread in Dan. Even in the aspectual domain, tone spread targets the progressive aspect marker *nāgúa*, another functional head. Given this 'unexpected' reference to functional domains, any ALIGN-XP,L/R constraint with the LCC will only partially succeed in mapping phonological/prosodic domains with syntactic ones in Dan.

The second challenge is about the alignment of the edges. A key restriction imposed over the ALIGN constraints is that either the ALIGN-XP,L or ALIGN-XP,R can be active in a given language but not both. In Dan, for cases with perfect isomorphism between a syntactic phrase and a prosodic domain, both the left- and the right-edges of the two domains align. It falls out that Dan requires both ALIGN-XP,L and ALIGN-XP,R to be active. So, unless the restriction about using one or the other align constraint is removed, these constraints can not derive all the Dan data.

Truckenbrodt's (1999) WRAP-XP constraint solves precisely the 'one edge alignment' problem. The constraint requires that every XP be contained in a Phonological Phrase. While this constraint can handle simultaneous left- and right-edge alignments of the syntactic and prosodic domains, it does not by itself guarantee domain *recursion*. For instance, under the WRAP-XP constraint, a VPs such as $[_\varphi^{VP}$tɔ̀-nù bɤ̀] is indistinguishable from $[_\varphi^{VP}[^{DP}$tɔ̀-nù] bɤ̀] 'eat chickens', because both equally satisfy WRAP-XP. In order to enforce recursion, Truckenbrodt proposed an interaction between WRAP-XP and the ALIGN-XP,L/R constraints. However, as argued by Selkirk (2011), the WRAP-XP-plus-ALIGN-XP constraints make typological predictions that are not borne out in current known typological work (We refer the reader to Selkirk (2011) for details of this argument). For these reasons, we conjecture that a Match theory analysis is superior in the present instance.

6   Unresolved Issues

There is an important issue, not yet discussed, which remains unresolved, and that is although the domains of spread often align with specific XPs (such as DP, PP, TopP, AgrO and ProgP), there is a domain which appear to be *bigger* than a single XP, and (prosodically?) headed by the more deeply embedded syntactic head. Specifically, verbs in the nonperfective do not only attract tone from the direct object: if there is no direct object, the tone of the auxiliary (which we assume to occupy AgrS, for reasons discussed below) can spread on to the verb as in (43).

I don't know if we wanna call it a prosodic head, it is the prosodic correspondant of a syntactic head.

think we should be able to get LL and M. tone on aux always seems to lower by one lever when aux not sentence initial. so try with 'kla touches the civet cat' (LL on e) and 'as for me, I touch the civet cat' (M on 'a')

(43) a. **á jɛ́**   mlɔ̄ɔ̄ ɓā
          1SG touch civet on
          'I touch the civet.'
      b. **è jɛ̀**   mlɔ̄ɔ̄ ɓā
          3SG touch civet on
          'She touches the civet.'

In these cases, it would not seem that the verb heads an XP which embeds the auxiliary - but it nonetheless seems that there is a non-XP domain which can contain the auxiliary, the moved object DP and the verb, and which is headed by the verb, as the verb can attract tone from whichever of the other two items immediately precedes it.

At first glance, this domain looks a lot like the extended T spine (AgrS-T-AgrO), but this is complicated by the fact that if an overt element, occupies T (such as the future morpheme /ɗó/), the word in T position attracts tone from the nonperfective Aux, *and* the verb no longer attracts tone - neither from the direct object, nor from the item heading TP.

(44) a. Klà **è ɗò** ɓáá ɓɤ̀
          kla 3SG FUT rice eat
          Kla will eat rice.
      b. XXX need example of "I will touch the civet"

Due to these complications, we reserve the phonological analysis of this tone spread to future work.

7 Conclusion

- Tone spreading in Dan is a 1-step process, triggered in some syntactic domains.

- Spreading becomes iterative when (1) a spreading domain is embedded in another domain AND (2) the head of the embedded domain is adjacent to the head of the embedding domain.

- Tone spreading is crucially a binary phonological process in Dan. The multi-step spreading can be seen as a recursive application of the binary spread.

APPENDIX

The constraints used in the main text are defined below:

- **Share[Tone](Hd$_{\sigma 1}$)**: Incur a violation when the first syllable of an h-labelled element does not share the tone of the immediately preceding syllable within the same domain[12].

- **Match(X, h)**: Incur a violation when a head in the input syntactic representation does not have a correspondent in the phonological representation.

- **Ident(Tone)**: Incur a violation for each input-output syllable pairs differing in their tone specification.

- **$^*\varphi$**: Incur a violation for every inserted φ domain[13].

- **Match(φ, XP)**: Incur a violation when the left and right edges of a φ in the output phonological representation do not correspond to the left and right edges of a phrase (XP) in the input syntactic representation.

- **Match(XP, φ)**: Incur a violation when the left and right edges of a phrase (XP) in the input syntactic representation do not correspond to the left and right edges of a φ in the output phonological representation.

- ***Match(φ, XP$_\text{F}$)**: Incur a violation when the left and right edges of a φ in the output phonological representation correspond to the left and right edges of a focused phrase (XP$_\text{F}$) in the input syntactic representation.

- **BinMin(φ, ω)**: Incur a violation for a φ that does not contain at least two ω.

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[12]This constraint is derived from McCarthy's (2011) family of Share[F] constraints.
[13]This is a low ranked constraint but its effect is visible on candidates with too many φ.

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