

## Towards a prosodic model for Tiberian Hebrew: An intonation-based analysis

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### Abstract

This study advances a preliminary framework for conceptualising the prosodic nature and structure of Tiberian Hebrew (TH) represented by the *ṭa ʾāmê hammiqrā* through an analysis of an extant Ashkenazi cantillation tradition. The *ṭa ʾāmê hammiqrā* (lit. “the senses of the reading [viz. Scripture]”) are notations added by medieval scribes to the written text of the Hebrew Bible to preserve and transmit its oral performance. Modern prosodic theory and the musical concept of conjunct and disjunct melodic motion are used to demonstrate that the *ṭa ʾāmê hammiqrā* have a highly structured iconic and intonational basis that organises the system and conforms substantially to Selkirk’s (2000, 2009) cross-linguistic prosodic hierarchy. The intonation-based prosodic model proposed in this study offers a solution to the limitation Drescher (1994, 2013; see also Drescher and DeCaen 2018; DeCaen and Drescher 2020) encounters with the intonational phrase domain of his prosodic model, permitting an alternative analysis of so-called pausal forms as lengthened forms, which can occur at prosodic phrase boundaries regardless of pause. The intonation-based model is tested by assessing how accurately it reflects the cross-linguistic prosodic features of restrictive and nonrestrictive relative clauses. The results indicate that TH distinguishes three prosodic classes of relatives – prosodically marked restrictives, prosodically marked nonrestrictives, and prosodically undifferentiated relatives – findings that accord with Birkner’s (2012) intonation-based study of the prosodic structure of German relative clauses.

**Keywords:** Masoretic cantillation accents, Tiberian Hebrew, cross-linguistic prosodic hierarchy, prosodic phonology, syntax-phonology interface, relative clauses

### 1. Introduction

In the Middle Ages, scribal scholars known as Masoretes, who were dedicated to the preservation of the received oral and written traditions of the Hebrew Bible, devised a system of notations for preserving and transmitting the precise oral performance of Scripture.<sup>1</sup> This

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<sup>1</sup> The authoritative manuscripts of the twenty-four books of the Hebrew Bible are known as the Masoretic Text. There are two sets of *ṭa ʾāmîm* for the Hebrew Bible – one set for the books of Psalms, Proverbs, and Job (commonly

notational system is known as the *ṭa ʾāmē hammiqrā*. Although melody is the most salient feature of the *ṭa ʾāmē hammiqrā* and has been the focus of its earliest descriptions (Yeivin 1980:161,168; Jacobson 2017:1-10), a pausal notion for this system has been the accepted conceptual framework since Wickes formalised the Law of Continuous Dichotomy (LCD) in 1881/1887 (Breuer 1958; Cohen 1969:37; Dresner 1994; Dresner and DeCaen 2018; DeCaen and Dresner 2020). The LCD is a philological algorithm that stipulates the order in which the “pausal melodies” of the *ṭā ʾāmîm* punctuate the text until no further divisions can be made (Wickes 1887:2, 29). Scholars have attempted to simplify Wickes’ algorithm, but have done so only by positing categories that effectively reduce their number and disregard their melodic variety.<sup>2</sup> Furthermore, as Dresner (1994:12-14; see also Dresner and DeCaen 2018; DeCaen and Dresner 2020) has shown, his LCD-based model cannot account for so-called pausal forms within a fully-functioning intonational phrase domain.<sup>3</sup> This study argues that the prosodic structure of the *ṭa ʾāmē hammiqrā* extrapolated from an intonation-based analysis of an extant cantillation tradition is better suited than the LCD for modelling the prosodic organisation of this system. The intonation-based prosodic model for Tiberian Hebrew (TH) yields 1) a full prosodic model corresponding to Selkirk’s (2009, 2011) cross-linguistic model and 2) attested cross-linguistic prosodic phrase structures for the relative clause domain. The intonation-based prosodic model also offers an alternative explanation for the presence of so-called pausal forms in places that have long puzzled scholars who adhere to a pausal framework for the *ṭa ʾāmē hammiqrā*.

## 2. Background

The *ṭa ʾāmē hammiqrā* represent a prosodic orthography for liturgical TH (Pitcher 2020) consisting of eighteen disjunctive and eight conjunctive accent marks called *ṭā ʾāmîm*. The graphemes of these twenty-six *ṭā ʾāmîm* are positioned over or below each prosodic word in the Hebrew Bible.<sup>4</sup> Together with the Masoretic vowel markings, the *ṭa ʾāmē hammiqrā* represent the full vocalisation of the orally performed biblical text (Pitcher 2020; see also 2017). *Ṭa ʾam*, the singular form of *ṭā ʾāmîm*, means “taste” or “reason”, alluding to its primary function of clarifying the meaning of the text (Jacobson 2017:2; see also Portnoy and Wolff 2000:6). The graphemes of the *ṭā ʾāmîm* represent pitch accents, and together they form the intonational contours of the verse,<sup>5</sup> indicating the proper prosodic vocalisation of the biblical text (Pitcher 2020:130-145). Generally speaking, conjunctive *ṭā ʾāmîm* conjoin words to form a cohesive unit, while disjunctive *ṭā ʾāmîm* delimit a cohesive unit.

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called the Poetic Books), and another set for the remaining twenty-one books (commonly called the Prose Books). This study focuses on the set of *ṭā ʾāmîm* for the Prose Books.

<sup>2</sup> Scholars have classified the *ṭā ʾāmîm* into different groupings (Breuer 1958; Cohen 1969; Dresner 1994 (see also DeCaen and Dresner 2020); Portnoy and Wolff 2000:72; Scott 2007:27-31; Price 2010:24) in order to explain the application of the LCD.

<sup>3</sup> The term “pausal form” in traditional Hebrew scholarship refers to an alternate form of a word that exhibits vowel lengthening and/or a shift in lexical stress. Pausal forms are most often marked by *ʾetnaḥtā* and *sillūq*, the two disjunctive *ṭā ʾāmîm* that are understood to signal the greatest pausal value in a verse (Dresner 1994:9, 11-12; Price 2006:1-2, 5; Revell 2015, 2016).

<sup>4</sup> See Yeivin (1980:167) and also Pitcher (2020:viii-ix) for a complete listing of the individual *ṭā ʾāmîm* that comprise the *ṭa ʾāmē hammiqrā* for the Prose Books in the Hebrew Bible. Note that Pitcher (2020:viii-ix) does not list *mā ʾayyālā* as an independent conjunctive because it represents secondary stress, much like *ga ʾyā* (also known as *meteg*). Regarding *mā ʾayyālā*, Yeivin (1980:179-180) states: “In ten or eleven cases in the Bible, a sign of the same form as *ṭippāḥā* appears as a secondary accent on the same word as [*ʾetnaḥtā* or *sillūq*]. This sign, which is also generally marked on an open syllable suitable for *ga ʾyā*, is called *mā ʾayyālā*.”

<sup>5</sup> Pitch accents are post-lexical movements of pitch associated with the locus of lexical stress.

According to Yeivin (1980), the traditional understanding of the *ṭa ʿāmē hammiqrā* is that they have three functions: 1) to represent the melodic motifs “to which the biblical text was chanted in the public reading,” with the purpose of “emphasizing the logical relationships of the words” (Yeivin 1980:158); 2) to guide the semantic structure of the text, as the *ṭa ʿāmîm* are grouped into “semantic units, which are not always identical with syntactic units” (Yeivin 1980:158); and 3) to indicate the locus of lexical stress, as most *ṭa ʿāmîm* are placed above or below the first consonant of the stressed syllable (Yeivin 1980:158). These three functions of the *ṭa ʿāmē hammiqrā* align with the main components of a modern prosodic system, namely: 1) intonation, 2) post-lexical meaning (viz. intonational meaning above the domain of the lexeme), and 3) autosegmental metricality.

The underlying framework for the intonation-based prosodic model for TH proposed in this study is Selkirk’s (2009, 2011) cross-linguistic prosodic hierarchy. According to Selkirk (2011:437), the prosodic hierarchy is “the name for an ordered set of prosodic category types”. This study employs Selkirk’s hierarchy because it exhibits phrase structure domains for the phonological phrase and the intonational phrase that align with the prosodic phrase structure identified by an intonation-based analysis of the *ṭa ʿāmē hammiqrā*. Selkirk’s model for the cross-linguistic prosodic hierarchy, like many others (Wang and Hirschberg 1991; Beckman and Pierrehumbert 1986; Pierrehumbert and Beckman 1988; Jun and Fougeron 1995, 2000, 2002; Tabain 2003; Arvaniti and Baltazani 2005; Beckman et al. 2005; Büring 2016; Gordon 2005; Grice et al. 2005; Gussenhoven 2005; Ladd 2008; Michelas and D’Imperio 2012; Féry 2017), identify a prosodic word domain, a phonological phrase domain, and an intonational phrase domain, all within the domain of the utterance. However, the distinction in Selkirk’s model in (1) is that its phonological phrase domain comprises a minor phrase (MiP) and a major phrase (MaP). The MiP is a phonological phrase that includes “at least one pitch accent” (Selkirk 2000:252), and the MaP is a phonological phrase that “consists of at least one minor phrase” (Selkirk 2000:252).

(1) Cross-linguistic Prosodic Hierarchy

Utterance (U)

Intonational phrase (ι)

Major phonological phrase ( $\varphi_a$ )

Minor phonological phrase ( $\varphi_i$ )

Prosodic word ( $\omega$ )

Characteristic features for each prosodic domain of the cross-linguistic hierarchy include the following: 1) the prosodic word is the domain of metrical stress (Beckman 1996:19, 31; Arvaniti 2016:38; see also Pierrehumbert 1980:10-11; Ladd 2008:13; Féry 2017:60-61); 2) the phonological phrase is the primary domain of phonological rules and the syntax-phonology interface (Selkirk 2011; see also Dresher 1994);<sup>6</sup> 3) the intonational phrase is primarily associated with post-lexical meaning (von Heusinger 2007), distinct boundary tones (Jun 2005), and easily perceived pauses (Jun 2005, Rao 2010); and 4) the utterance is the most structurally variable unit of speech, as its constitution is semantically and pragmatically determined.

One of the primary motivations for proposing the cross-linguistic prosodic hierarchy is the observation that the phonology and syntax of an utterance are often incongruent (Selkirk 2000,

<sup>6</sup> Note that the domain of the phonological phrase is also called the intermediate phrase (see Beckman et al. 2005; Arvaniti and Baltazani 2005; Büring 2016; Pitcher 2020).

2009, 2011). Chomsky and Halle (1968:372) demonstrate this nonisomorphism in their example reprinted in (2), where the prosodic phrasings in (2b) cut across major syntactic divisions in (2a).

- (2) a. This is [the cat that caught [the rat that stole [the cheese]]]  
 b. (This is the cat) (that caught the rat) (that stole the cheese)

The nonisomorphism of the syntactic phrasing of the Masoretic Text with its phrasing delineated by the *ta'āmê hammiqrā'* has long been observed (Wickes 1887:44-60, Aronoff 1985:66; Janis 1987:48) and is one of the primary indicators of the system's prosodic nature (Dresher 1994:7-8; Pitcher 2020:1-3). Example (3) demonstrates this phenomenon, where (3a) exhibits the TH syntactic phrasing and (3b) exhibits the TH prosodic phrasing as delineated by the *ṭə'āmîm*. In this example, the verb *וַיִּזְלַד* forms a prosodic phrase with only one of its adverbial constituents (*בְּדַמּוּתוֹ*); the second one (*כְּצַלְמוֹ*) is excluded from the prosodic unit.

- (3) a.  $VP[כְּצַלְמוֹ \quad בְּדַמּוּתוֹ \quad וַיִּזְלַד]$  (Pitcher 2017:62)  
 [wayyôled bidmûtô kəšalmô]<sub>VP</sub>  
 [and.he.begat in.his.likeness according.to.his.image]<sub>VP</sub>  
 Genesis 5:3
- b. (*כְּצַלְמוֹ*) (*בְּדַמּוּתוֹ* *וַיִּזְלַד*) (Pitcher 2017:62)  
 (wayyôled bidmûtô) (kəšalmô)  
 (and.he.begat in.his.likeness) (according.to.his.image)  
 Genesis 5:3

The *ta'āmê hammiqrā'* reflect the prosodic phrase structure of the orally performed text (see Janis 1987; Dresher 1994, 2013; DeCaen and Dresher 2020). This can be discerned in part by the repeated intonational sequences of the *ṭə'āmîm* and the iconicity of their graphemes (Pitcher 2020). The repeated sequences of the *ṭə'āmîm* form small prosodic phrases (viz. MiPs) within larger prosodic phrases (viz. MaPs). The MiP ( $\varphi_i$ ) domain for TH consists of a single disjunctive pitch accent and the conjunctive pitch accents that precede it, while the MaP ( $\varphi_a$ ) domain consists of a group of related disjunctive pitch accents belonging to the same intonational family.<sup>7</sup> For example, the pitch accents *dargā'*, *təbir* and *ṭippəḥā'* are all members of the same intonational family. Within this intonational sequence, the disjunctive pitch accents *təbir* (including its conjunctive *dargā'*) and *ṭippəḥā'* each form MiPs, while *ṭippəḥā'*, the head of the larger prosodic unit, delimits the MaP, as in (4).

- (4) The phrase structure of a sequence of prosodic constituents marked by *dargā'*, *təbir*, and *ṭippəḥā'*:  
 ((*dargā'* *təbir*) $\varphi_i$  (*ṭippəḥā'*) $\varphi_i$ ) $\varphi_a$

<sup>7</sup> See Pitcher (2017:322-329) for the classification of disjunctive *ṭə'āmîm* according to their respective intonational families.



- b. The conjunctive (-C-) *dargā*’ (ךָ) is oriented to the left, in the direction the text is read, indicating a continuation of the MiP( $\varphi_i$ ):

$a\varphi(i\varphi(\text{אַרָב} \quad \text{לְגִשֶׁת})) \quad i\varphi(\text{אֶת־לְבוֹן} \quad \text{עָרַב})$   
 ((‘*ārab*-C- ‘*et*-*libbô*) $\varphi_i$  (lāgešet ‘*elay*) $\varphi_i$ ) $\varphi_a$   
 ((he.pledge ACC-his.heart) $\varphi_i$  (to.me to.approach) $\varphi_i$ ) $\varphi_a$   
 Jeremiah 30:21b

- c. The conjunctive (-C-) *mērkā*’ (ךָ) is oriented to the left, in the direction the text is read, indicating a continuation of the second MiP( $\varphi_i$ ):

$a\varphi(i\varphi(\text{אַרָב} \quad \text{לְגִשֶׁת})) \quad i\varphi(\text{אֶת־לְבוֹן} \quad \text{עָרַב})$   
 ((‘*ārab* ‘*et*-*libbô*) $\varphi_i$  (lāgešet-C- ‘*elay*) $\varphi_i$ ) $\varphi_a$   
 ((he.pledge ACC-his.heart) $\varphi_i$  (to.approach to.me) $\varphi_i$ ) $\varphi_a$   
 Jeremiah 30:21b

- d. The disjunctive (-D-) *tippāhā*’ (ס) is oriented to the right, indicating the end of a MiP ( $\varphi_i$ ) and MaP ( $\varphi_a$ ):

$a\varphi(i\varphi(\text{פְּרִי וְרִבֵּי} \quad \text{אֶת־הָאָרֶץ} \quad \text{וּמְלֵאןָ})) \quad i\varphi(\text{פְּרִי וְרִבֵּי} \quad \text{אֶת־הָאָרֶץ} \quad \text{וּמְלֵאןָ})$   
 ((*pārû* ‘*urabû*) $\varphi_i$  (‘*mil’û* ‘*et*-*hā-’ā*-D-*reš*) $\varphi_i$ ) $\varphi_a$   
 ((be.fruitful and.multiply) $\varphi_i$  (and.fill ACC-the.earth) $\varphi_i$ ) $\varphi_a$   
 Genesis 1:28

Dresher (1994:8) identifies two domains above the prosodic word within his prosodic model for the *ta’āmē hammiqrā*: the conjunctive phrase and the disjunctive phrase. Dresher (1994:8) states that the conjunctive phrase corresponds to the phonological phrase, and that three rules of external sandhi – spirantisation, external gemination, and stress shift – can be applied to this domain (1994:10-11). Spirantisation is realised in certain consonants (viz. כ [b], ג [g], ק [k], פ [p], ת [t]) that are preceded by vowels within the same phonological phrase. For example, in (7a) the word בְּרִגָת, with an initial כ [b], is preceded by a word that ends in a vowel and that occupies the same phonological phrase. The initial consonant in this word is accordingly spirantised. However, when a phonological phrase boundary precedes this word, as in (7b), the initial consonant is not spirantised (בְּרִגָת).<sup>9</sup>

(7) a.  $\varphi(\text{הֵימָן} \quad \text{בְּרִגָת}) \quad \varphi(\text{וַיִּרְדּוּ})$   
 (*ūrādû* *bidgat* *hayyām*) $\varphi$   
 (and.let.them.have.dominion over.fish.of the.sea) $\varphi$   
 Genesis 1:26

b.  $\varphi(\text{הֵימָן} \quad \text{בְּרִגָת}) \quad \varphi(\text{וַיִּרְדּוּ})$   
 (*ūrādû*) $\varphi$  (*bidgat* *hayyām*) $\varphi$   
 (and.let.them.have.dominion) $\varphi$  (over.fish.of the.sea) $\varphi$   
 Genesis 1:28

<sup>9</sup> Spirantisation in the consonant כ is indicated by the absence of a *dāgēsh* (viz. the dot) in this letter.

External gemination in TH is realised when a word with a final vowel exerts phonological pressure on an adjacent word within the same phonological phrase, transforming its initial consonant into a geminate (viz. doubling the consonant). For example, in (8) the a-class vowel at the end of the word בַּטַּחְתָּ (bāṭaḥtā) motivates the doubling of the ל in the word לְךָ (lakā), as represented by the *dāgēsh* in this consonant.

- (8) φ(לְךָ בַּטַּחְתָּ) (Dresher 1994:10)  
 (bāṭaḥtā llakā)φ  
 (you.trust yourself)φ  
 2 Kings 18:21

Stress shift often occurs in order to alleviate phrase-internal stress clash. For example, the stress on the word תֵּלֶךְ (tēlek) shifts from the ultimate syllable in (9a) to the penultimate syllable in (9b), depending on the proximity of the stressed syllable in the following word.

- (9) a. : אֲחַרַיִךְ (לֹא-תֵלֶךְ הָאִשָּׁה) אֲחַרַיִךְ  
 'ulay (lō'-tēlek hā'isšā)φ 'ahārāy  
 perhaps (not-she.will.go the.woman)φ after.me  
 Genesis 24:39
- b. φ(: אֲחַרַיִךְ (תֵּלֶךְ הָאִשָּׁה) אֲחַרַיִךְ  
 'ahārāyik (tēlek hā'reb)φ  
 after you (it.will.go sword)φ  
 Jeremiah 48:2

While Dresher's conjunctive phrase is operative, he concludes that the disjunctive phrase is poorly conceived and does not correlate with a fully-functioning intonational phrase domain (Dresher 1994:12-14; see also DeCaen and Dresher 2020:337, 352). In fact, according to DeCaen and Dresher (2020:352), the intonational phrase domain is not represented by the *ta'āmē hammiqrā'* as evidenced by the distribution of so-called pausal forms within the text.

Contrary to Dresher's prosodic model, this study finds that an intonation-based analysis, unconstrained by the LCD, can yield a functioning intonational phrase domain for the *ta'āmē hammiqrā'*. This study explores additional evidence for the prosodic nature of the *ta'āmē hammiqrā'* and the prosodic structure of TH through an analysis of the melodic structure of an extant cantillation tradition (Section 3). The intonation-based prosodic model for TH (Section 4) is assessed by its ability to accurately distinguish the cross-linguistic prosodic features of relative clauses (Section 5). Finally, the prosodic framework conceptualised in this study presents a solution to Dresher's conundrum regarding the distribution of so-called pausal forms, arguing that these forms do not all coincide with pause, but rather all exhibit phonological lengthening, a ubiquitous feature of prosodic phrase structure (Section 6).

### 3. Preliminary theory of intonation for the *ta'āmē*

The intonation-based prosodic model for TH is based on a systematic analysis of the melodic patterns of the Masoretic accents in the twenty-one Prose Books (Pitcher 2017). The instantiation of the accents employed is an Eastern European Ashkenazi cantillation tradition

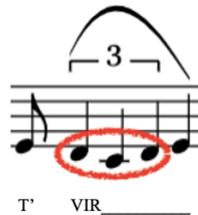
transmitted through A.W. Binder (1959); the individual melodies (viz. pitch patterns) for each of the *ṭə'āmîm* in this section were taken from Portnoy and Wolff (2000:92-93). The analysis reveals that the *ṭə'āmê hammiqrā'* encode internally coherent and cohesive intonational features and structures that organise syntactic constituents in a manner analogous to the cross-linguistic prosodic hierarchy.

The prosodic components of an intonational contour of a *ṭə'am* include the following: a) the onset, b) the nucleus, and c) the coda (see Pitcher 2017:83-84, 2020:84-85). In example (10), the pitch pattern for the disjunctive *ṭəbīr* illustrates these components.

- (10) a. The onset – consists of the leading tone or prefix of the *ṭə'am*:<sup>10</sup>



- b. The nucleus – consists of the main intonational contour of the *ṭə'am* called the melisma, which is a group of notes chanted on a single syllable, corresponding to the locus of lexical stress:



- c. The coda – consists of the suffix of the *ṭə'am*, either a continuing tone (if the suffix conjoins with the prefix of an adjacent *ṭə'am* to extend the prosodic unit) or a final tone (as with the suffix of *sillūq*):



The intonational framework for this prosodic model is rooted in the types of melodic intervals that conjunctive *ṭə'āmîm* do and do not form. These intervals can be described according to the musical concept of conjunct and disjunct melodic motion. Conjunct melodic motion is the movement of pitch by intervals of a unison or a second (Schmidt-Jones 2013:2). Example (11a) exhibits an interval of a unison because both pitches occupy the same line on the musical staff.

<sup>10</sup> Rubin and Baron (2006:72) use the terms prefix, nucleus, and suffix to refer to the leading, core, and final pitches of a *ṭə'am*. In this study, the phonological terminology of the syllable (onset, nucleus, coda) is used to describe the structural components of a *ṭə'am*.

Example (11b) exhibits an interval of a second because the second pitch is one pitch removed from the first – it is on the first space above the first pitch.

(11) a.



b.



Within the intonational system of this particular Ashkenazi cantillation tradition, intonational cohesion also includes the movement of pitch by intervals of a third and a fourth. Example (11c) exhibits an interval of a third because the second pitch is two pitches removed from the first. Example (11d) exhibits an interval of a fourth because the second pitch is three pitches removed from the first.

(11) c.



d.



Disjunct melodic motion, which signals intonational discontinuity, is observed between *ṭə'āmîm* whose intervals are a fifth or greater. Example (11e) exhibits an interval of a fifth because the second pitch is four pitches removed from the first.

(11) e.



The pitch patterns of conjunctive *ṭə 'āmîm* show that phonologically cohesive units form when the coda of a conjunctive merges with the onset of an adjacent *ṭa 'am* via an interval of a unison, a second, a third, or a fourth. Example (12a) illustrates intonational cohesion between the pitch patterns of the conjunctive *mērka'* (-C-) and the disjunctive *ṭippəḥā'* (-D-), where the conjunctive merges with the disjunctive via an interval of a unison. Example (12b) illustrates intonational cohesion between the conjunctive *munnaḥ* and the disjunctive *'etnaḥtā'*, where the conjunctive merges with the disjunctive via an interval of a second.

- (12) a. Conjunctive *mērka'* (-C-) followed by the disjunctive *ṭippəḥā'* (-D-) – an interval of a unison:

וַיְהִי דְבַר־יְהוָה  
*wayhî-C dəbar-YHWH-D*  
**and.was** word.of-LORD  
 1 Kings 17:2



MER – CHA TIP – CHA \_\_\_\_\_

(see Pitcher 2017:84)

- b. Conjunctive *munnaḥ* followed by the disjunctive *'etnaḥtā'* form an interval of a second:



MU NACH\_ ET NACH TA

The phonological units in (12a) and (12b) clearly exhibit conjunct melodic motion as these consecutive pitches are no more than one pitch apart. Based on the nature of the intonational structure of conjunctive *ṭə 'āmîm* and their role in melodically connecting adjacent pitches, conjunct melodic motion is a phenomenon particularly suited to phonological processing in that it allows the ear to perceive an uninterrupted intonational sequence between consecutive pitches, thereby phonologically connecting prosodic constituents within cohesive prosodic units.

The conjunctive relationships in (13a) and (13b), however, differ slightly from those found in (12a) and (12b) because these intervals are two and three pitches apart – that is, they form intervals that jump or skip pitches as the intonational contour of the prosodic unit proceeds.

- (13) a. Conjunctive *munnāḥ* followed by the conjunctive *mahpāk* form an interval of a third:



- b. Conjunctive *tālīšā' qəṭannā* followed by the conjunctive *kadmā'* form an interval of a fourth:



The examples in (14a) and (14b) illustrate more clearly the melodic steps of intervals of a unison and a second, and the intermediate melodic jumps of intervals of a third and a fourth.

- (14) a. Melodic steps are intervals of a unison and a second:



- b. Intermediate melodic jumps are intervals of a third and a fourth:



While the melodic intervals of a third and a fourth cannot strictly be identified as conjunct melodic motion because they form melodic jumps instead of melodic steps, these intervals are nonetheless intonationally cohesive. This premise is valid not only because this particular Ashkenazi cantillation tradition consistently associates intervals of a third and fourth with conjunctive *ṭə'āmîm*, but also because there is evidence that, at least with regard to an interval of a third, the ear can perceive this interval more like a step and less like a major jump (Huron 2016:73). Perhaps more importantly though, within this particular cantillation tradition, there are no attested conjunctive combinations with intervals of a fifth or greater. This intonational system, then, treats the melodic intervals of a third and a fourth as not so great as to be considered acoustically discontinuous or a distinctly separate prosodic unit. However, intervals of a fifth or more are clearly perceived as disjunct melodic motion. These intervals, like the one in example (14c) comprise large jumps that signal clear intonational discontinuity.

- (14) c. Large melodic jumps are intervals of a fifth or greater:



Some conjunctives, like *munnaḥ*, have multiple pitch patterns that accommodate the different disjunctives they precede. This versatility in pitch patterns preserves the intonational continuity between conjunctives and their adjacent *ṭa'āmîm*, as in (15).

- (15) a. The pitch patterns of the conjunctive *munnaḥ* followed by the disjunctive '*etnaḥtā*' exhibit conjunct melodic motion, where the coda and onset form an interval of a second:

(בָּרָא אֱלֹהִים)  
 (barā-C 'ēlōhîm-D)  
 (created God)  
 Genesis 1:1



MU NACH\_ ET NACH TA

(see Pitcher 2017:93; Pitcher 2020:105)

- b. The pitch patterns of the conjunctive *munnaḥ* (same symbol and name as in (15a), but different pitch pattern) followed by the disjunctive *zāqēp qāṭōn* exhibit conjunct melodic motion, where the coda and onset form an interval of a perfect unison:

(וְרוּחַ אֱלֹהִים)  
 (wəruḥ-C 'ēlōhîm-D)  
 (and.Spirit.of God)  
 Genesis 1:2



MU NACH\_ KA - TON\_

(see Pitcher 2017:93; Pitcher 2020:105)

The examples in (16) demonstrate that the coda of a conjunctive *ṭa'ām* must conform to the onset of an adjacent *ṭa'ām*. This ensures that the conjunctive is able to function conjunctively, forming a cohesive phonological unit with the *ṭa'ām* that follows. In other words, if a conjunctive does not conform to its adjacent *ṭa'ām*, the ear will not perceive intonational continuity between the two words. This phenomenon is easily illustrated in (16) by interchanging the pitch patterns of the two forms of the conjunctive *munnaḥ* in (15).

If the conjunctive *munnaḥ*, intended to precede *zāqēp qāṭōn*, were placed in front of '*etnaḥtā*' (16a), it would no longer be able to produce a cohesive phonological unit with the adjacent

*ṭa'am* because the interval between the coda and the onset is a sixth. This interval would produce clear intonational discontinuity and is not attested.

- (16) a. The pitch patterns of the conjunctive *munnaḥ* (intended to precede the disjunctive *zāqēp qāṭōn*) followed by the disjunctive *'etnaḥtā* exhibit melodic disjunction because the coda and onset form an interval of a sixth:



NOT ATTESTED

(see Pitcher 2017:94; Pitcher 2020:106)

A similar phenomenon occurs if the conjunctive *munnaḥ*, intended to precede *'etnaḥtā*', is placed in front of *zāqēp qāṭōn* (16b).

- (16) b. The pitch patterns of the conjunctive *munnaḥ* (intended to precede the disjunctive *'etnaḥtā*) followed by the disjunctive *zāqēp qāṭōn* exhibit melodic disjunction because the coda and onset form an interval of a fifth:



NOT ATTESTED

(see Pitcher 2017:95; Pitcher 2020:107)

The intonation-based theory predicts that the type of melodic structures for conjunctive *ṭa'amim* represented in (16a) and (16b) are not attested. This prediction is based on 1) the melodic nature of conjunctive *ṭa'amim* extrapolated from this particular cantillation tradition, 2) the principles of conjunct and disjunct melodic motion, and 3) the absence of counter examples during a manual search of the Prose Books (see Pitcher 2017).

Phonological units created by conjunctive and disjunctive *ṭa'amim* form three prosodic domains above the prosodic word: the phonological phrase domain, the intonational phrase domain, and the domain of the utterance. Intonational phrases are internally unified by sustained intonational connectivity between phonological phrase constituents. This means that a cohesive intonational phrase is comprised of phonological units whose disjunctive phrase boundaries exhibit conjunct melodic motion. Conjunct melodic motion, then, not only connects adjacent prosodic words marked by conjunctives, but also adjacent words marked by disjunctives. For example, in the first three words of Genesis 1:1, conjunct melodic motion connects *barā-C* – the prosodic word bearing the conjunctive *munnaḥ* – to the following word *'elōhîm-D*, shown in (17a). However, since the disjunctive *tippaḥā* on *bərēšît-D* also exhibits conjunct melodic motion (an interval of a unison), this disjunctive connects *bərēšît-D* to the larger prosodic unit comprised of the two prosodic words, *barā-C* and *'elōhîm-D*, shown in (17b).

- (17) a. Conjunct melodic motion connects conjunctive *ṭə'āmîm* to the disjunctives they precede:

(בְּרָא אֱלֹהִים) (בְּרֵאשִׁית)  
 (bārēšît-D) (barā-C 'ēlōhîm-D)  
 (In.beginning (created God)  
 Genesis 1:1

- b. Conjunct melodic motion also connects disjunctives to adjacent *ṭə'āmîm* in larger cohesive prosodic units.

((בְּרֵאשִׁית) (בְּרָא אֱלֹהִים))  
 ((bā-rēšît-D) (barā-C 'ēlōhîm-D))  
 ((In.beginning) (created God))  
 Genesis 1:1

Disjunctives within cohesive prosodic units connect to adjacent *ṭə'āmîm* using the same conjunctive-like intervals of a unison, a second, a third, and a fourth. Example (18) exhibits conjunct melodic motion connecting *haššāmayim-D* (bearing the disjunctive *təbîr*) to *wəhā'āreš-D* (bearing the disjunctive *ṭippəhā'*); this is done via an interval of a unison.

- (18) a. The pitch patterns of adjacent disjunctives *təbîr* (*haššāmayim-D*) and *ṭippəhā'* (*wəhā'āreš-D*) exhibit conjunct melodic motion with an interval of a unison between the coda and onset:

((אֵלֶּה תּוֹלְדוֹת הַשָּׁמַיִם) (וְהָאָרֶץ))  
 (('ēllē tōlədōt haššamayim-D) (wəhā'āreš-D))  
 ((These generations.of the.heavens) (and.the.earth))  
 Genesis 2:4



T' VIR \_\_\_\_\_ TIP CHA \_\_\_\_\_

(see Pitcher 2017:90; Pitcher 2020:102)

Disjunctives at intonational phrase boundaries signal the end of this larger prosodic unit by forming intervals of a fifth or greater with adjacent *ṭə'āmîm* (18b); these intervals mark clear melodic discontinuity. Only disjunctives encode intonational discontinuity – the coda of a conjunctive cannot form intervals of a fifth or greater with the onset of adjacent *ṭə'āmîm*.

- (18) b. The pitch patterns of the disjunctives *'azlā'* (*hā'āreš-D*) followed by *təlišā'gədōlā* (*deše'-D*) produce an intonational phrase boundary (ι) of disjunct melodic motion – the interval between the coda and the onset is a fifth:

... (וְהָאָרֶץ) (וְהָאָרֶץ) (וְהָאָרֶץ)  
 ((wattōšē' hā'āreš-D))ι ((deše'-D) ...  
 ((And.brought.forth the.earth))ι ((vegetation) ...  
 Genesis 1:12



(see Pitcher 2017:92)

#### 4. Preliminary Intonation-based Prosodic Model for TH

The intonation-based prosodic hierarchy for TH presented in (19) corresponds to Selkirk's cross-linguistic prosodic hierarchy (see also Pitcher 2017).<sup>11</sup> The biblical verse corresponds to the domain of the utterance, and like Selkirk's model, the TH model exhibits an intonational phrase domain. The intonation-based model differentiates three types of intonational phrases: 1) the Terminal-1 intonational phrase, signalled by *'etnahtā*'; 2) the Terminal-2 intonational phrase, signalled by *sillûq*; and 3) Nonterminal intonational phrases, signalled by other adjacent *ṭə'āmîm* whose intervals are a fifth or greater. As with Selkirk's hierarchy (2000, 2011), the TH hierarchy is comprised of a MiP domain and a MaP domain. Conjunctive and disjunctive *ṭə'āmîm* form distinct MiPs that group into larger, intonationally related MaPs, according to the parameters of merging outlined in examples (12)-(18).

(19) a. Selkirk's Cross-linguistic Prosodic Hierarchy	(19) b. Intonation-based Prosodic Hierarchy for TH:
Utterance (U)	Biblical verse (U)
Intonational phrase (i)	Terminal-1, Terminal-2, and Nonterminal (i) <ul style="list-style-type: none"> <li>Terminal-1 (i) boundary is signalled by <i>'etnahtā</i></li> <li>Terminal-2 (i) boundary is signalled by <i>sillûq</i></li> <li>Nonterminal (i) boundaries are signalled by adjacent disjunctive <i>ṭə'āmîm</i> with intervals <math>\geq</math> an interval of a fifth</li> </ul>
Major phonological phrase – MaP ( $\varphi_a$ )	Major phonological phrase – MaP ( $\varphi_a$ ) <ul style="list-style-type: none"> <li>a phrase of related disjunctives from the same intonational family</li> </ul>
Minor phonological phrase – MiP ( $\varphi_i$ )	Minor phonological phrase – MiP ( $\varphi_i$ ) <ul style="list-style-type: none"> <li>a phrase of a single disjunctive and the conjunctive(s) that precede it</li> </ul>
Prosodic word ( $\omega$ )	Prosodic word ( $\omega$ ) <ul style="list-style-type: none"> <li>any word bearing its own conjunctive or disjunctive <i>ṭə'ām</i></li> </ul>

<sup>11</sup> The prosodic model for TH proposed in this study accords with the model presented in Pitcher (2017:206). However, note that this model uses the term *sillûq* in place of *sōf-pāsûq*, and identifies both *sillûq* and *'etnahtā* as Terminal intonational phrases. Also note that this model replaces the terms “phonological phrase” and “phonological phrase complex” with MiP and MaP, respectively.

The intonation-based prosodic model applied to a biblical verse is represented in (20). The prosodic phrasing of this utterance exhibits two intonational phrases. The first intonational phrase is comprised of two MaPs; the first with two MiPs, the second with one MiP. The second intonational phrase exhibits one MaP that contains two MiPs. Conjunct melodic motion not only connects prosodic words bearing conjunctives (shaded lightly) to prosodic words bearing disjunctives (shaded darkly), but it also connects prosodic words bearing disjunctives to adjacent *tə ʿāmîm* that occupy separate phonological phrases. In example (20), disjunct melodic motion is represented by the intonational phrase boundary between the prosodic words אֱלֹהִים /**God** and לֹא /**not**. This intonational phrase boundary is signalled by the melodic interval of a fifth. The melodic intervals between *tə ʿāmîm* in the examples below are represented by superscript numerals: a unison = 1, a second = 2, a third = 3, a fourth = 4, and a fifth = 5. No interval is indicated following *ʿetnahtā* or *sillûq* because these pitch patterns signal terminal intonational phrase boundaries (see Pitcher 2020:169).

- (20)  $\iota_{(a\varphi(i\varphi^5(\text{אֱלֹהִים}^1 \text{אָמַר}^1)))}$   $a\varphi(i\varphi^1(\text{בְּתוֹךְ-הַגַּן}^1 \text{אֲשֶׁר}^1 \text{הָעֵץ}^1 \text{וּמִפְרֵי}))$   
 $(((\hat{u}mippər̄t^1 \text{hā ʿēs})^1\varphi_i \quad (\text{ʿāšer}^1 \text{bətōk-hagān})^1\varphi_i\varphi_a \quad ((\text{ʿamar}^1 \text{ʿēlohîm})^5\varphi_i)\varphi_a)\iota$   
 $(((\text{but.from.fruit.of}^1 \text{the.tree})^1\varphi_i \quad (\text{that}^1 \text{in.midst.of.the.garden})^1\varphi_i\varphi_a \quad ((\text{said}^1 \text{God})^5\varphi_i)\varphi_a)\iota$
- $\iota(\dots a\varphi(i\varphi(\text{מִמֶּנּוּ}^1 \text{לֹא}^1 \text{תֹאכְלוּ}^1 \text{מִן-הַמָּקוֹם}^1 \text{אֲשֶׁר-אַתָּה}^1 \text{שָׁם}^1)))$   
 $(((\hat{l}ō^1 \text{tō ʿkəlû})^3\varphi_i \quad (\text{mimmennû})\varphi_i)\varphi_a \dots)\iota$   
 $(((\text{not}^1 \text{you.shall.eat})^3\varphi_i \quad (\text{from.it})\varphi_i)\varphi_a \dots)\iota$   
 “But from the tree that is in the midst of the garden, God said: ‘You shall not eat from it’”  
 Genesis 3:3

## 5. The prosodic phrase structure of Tiberian Hebrew relative clauses

The relative clause domain is used to assess how accurately the intonation-based model reflects cross-linguistic prosodic features of restrictive and non-restrictive relative clauses. Relative clauses are syntactically embedded clauses that modify nouns. Relative clauses have two fundamental semantic types: restrictive and non-restrictive (see Holmstedt 2016:5-7). A restrictive relative modifies the head noun by restricting its scope of reference as shown in (21a), where the identity of the head noun “the place” is being restricted to “where you are there”.

- (21) a.  $\text{שָׂא נָא עֵינֶיךָ וּרְאֵה}$   
 $\text{śā} \quad \text{nā} \quad \text{ʿēnēkā} \quad \text{ûrā ʿē}$   
 lift.up please your.eyes and.look
- $\text{מִן-הַמָּקוֹם אֲשֶׁר-אַתָּה שָׁם}$   
 $\text{min-hammaqôm ʿāšer-ʿattâ šām}$   
 from-the.place where-you there  
 “Lift up your eyes and look from the place where you are there.”  
 Genesis 13:14

A non-restrictive relative provides supplemental information for an already identifiable referent as shown in (21b), where the relative clause “which I am giving to the sons of Israel” provides additional information regarding “the land of Canaan”.

- (21) b. שְׁלַח-לָךְ אֲנָשִׁים  
*šalah-lākā ’ānāšīm*  
 send-for.yourself men
- וַיִּתְּרוּ אֶת-אֶרֶץ כְּנָעַן  
*wāyāturū ’et ’eres kəna’an*  
 and.they.will.spy ACC-land.of Canaan
- אֲשֶׁר-אֲנִי נֹתֵן לְבָנֵי יִשְׂרָאֵל  
*’āšer-’ānī nōtēn libnē yisrā’el*  
**which-I giving to.sons.of Israel**  
 “Send men to spy out the land of Canaan, which I am giving to the sons of Israel.”  
 Numbers 13:2

Relative clauses provide an accessible syntactic domain to test the intonation-based prosodic model because they have attested cross-linguistic prosodic features (Selkirk 1978, 1984, 1995; Drescher 1994:13; Nespor and Vogel 2007:57; see also Birkner 2012:37). Non-restrictive relative clauses form intonational phrases separate from their head nouns, while restrictive relative clauses form cohesive intonational phrases with their head nouns.

Each overtly-headed *’āšer* (“that/which”) relative clause in the twenty-one Prose Books were categorised as prosodically restrictive or non-restrictive according to the intonation-based model. The expectation was that restrictive relatives would form a cohesive intonational phrase with their head nouns, while non-restrictive relatives would form a separate intonational phrase apart from their head nouns. Although a semantic classification apart from the prosodic classification was not confirmed for all of the relative clauses in this study, a representative sample was established based on the general semantic features of relative clauses described above (see Pitcher 2017:224-275 for this representative sample).

The intonation-based prosodic structure of TH relative clauses (Pitcher 2017:330-351) largely accords with cross-linguistic prosodic features of restrictive and non-restrictive relatives (see Pitcher 2017:224-301).<sup>12</sup> The intonation-based model distinguishes three types of overtly-headed relative clauses: 1) prosodically marked restrictives, 2) prosodically marked non-restrictives, and 3) prosodically undifferentiated relatives. The characteristic feature of a prosodically marked restrictive relative clause is that its constituents (the head noun, relativiser, and relative clause) are all members of a single MaP within a cohesive intonational phrase. These relative clauses exhibit intervals of a unison, a second, a third, or a fourth between their head noun and clause constituents. The characteristic feature of a prosodically marked non-restrictive relative clause is that it exhibits clear intonational discontinuity – an interval of a

<sup>12</sup> The Prose Books refer to the following twenty-one books of the Hebrew Bible: Genesis, Exodus, Leviticus, Numbers, Deuteronomy, Joshua, Judges, Samuel, Kings, Isaiah, Jeremiah, Ezekiel, The Twelve (Hosea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Zephaniah, Haggai, Zechariah, Malachi), Song of Songs, Ruth, Lamentations, Ecclesiastes, Esther, Daniel, Ezra/Nehemiah, Chronicles.

fifth or greater – between the head noun and relative clause, separating these constituents into distinct intonational phrases. Prosodically undifferentiated relative clauses do not make a prosodic distinction with regard to restriction. The characteristic feature of these relatives is that the head noun and relative clause belong to the same intonational phrase, but not the same MaP.

Example (22a) exhibits a semantically and prosodically restrictive relative clause, where the head noun, shaded lightly (**הָעֵץ**/the-tree), and the relative clause, shaded darkly (**אֲשֶׁר בְּתוֹךְ הַגָּן**/that in midst of the garden), both comprise a single MaP. The interval between these constituents is a unison.

- (22) a.  $u_{(a\varphi(i\varphi^5(\text{אֲלֵהִים}^1 \text{אָמַר}^1)))}$   $a\varphi(i\varphi^1(\text{אֲשֶׁר}^1 \text{בְּתוֹךְ הַגָּן}^1))$   $i\varphi^1(\text{הָעֵץ}^1 \text{וּמִפְרֵי})$   
 (((*umippərī*<sup>1</sup> *hā'ēs*<sup>1</sup> $\varphi_i$  (*āšer*<sup>1</sup> *bətōk-hagān*)<sup>1</sup> $\varphi_i$ ) $\varphi_a$   
 (((but.from.fruit.of<sup>1</sup> **the.tree**)<sup>1</sup> $\varphi_i$  (**that**<sup>1</sup> **in.midst.of.the.garden**)<sup>1</sup> $\varphi_i$ ) $\varphi_a$   
 ((*āmar*<sup>1</sup> *ēlōhīm*)<sup>5</sup> $\varphi_i$ ) $\varphi_a$ )<sub>t</sub>  
 ((said<sup>1</sup> God)<sup>5</sup> $\varphi_i$ ) $\varphi_a$ )<sub>t</sub>  
 “But from the tree that is in the midst of the garden, God said ...”  
 Genesis 3:3

Example (22b) also illustrates a semantically and prosodically restrictive relative clause, where the head noun (**בְּנֵי**/son-his) and the relative clause (**אֲשֶׁר יָלְדָהּ הַגֵּר**/that bore Hagar) comprise a single MaP. The interval between these constituents is a third.<sup>13</sup>

- (22) b.  $u_{(a\varphi(i\varphi(\text{בְּנֵי})))}$   $u_{(a\varphi(i\varphi^5(\text{לְאַבְרָם})))}$   $i\varphi^1(\text{הַגֵּר}^1 \text{וְיָלְדָהּ}^1))$   
 (((*wattēled*<sup>1</sup> *hāgār*)<sup>1</sup> $\varphi_i$  (*lā'ābrām*)<sup>5</sup> $\varphi_i$ ) $\varphi_a$ )<sub>t</sub> (((*bēn*) $\varphi_i$ ) $\varphi_a$ )<sub>t</sub>  
 (((and.bore<sup>1</sup> Hagar)<sup>1</sup> $\varphi_i$  (to.Abram)<sup>5</sup> $\varphi_i$ ) $\varphi_a$ )<sub>t</sub> (((son) $\varphi_i$ ) $\varphi_a$ )<sub>t</sub>

<sup>13</sup> Although this study identifies an interval of a fifth between *tipphāhā'* and *'etnahtā'* (see the constituents **לְאַבְרָם**/to-Abram and **בְּנֵי**/son in the first intonational phrase), this interval is likely an anomaly of this particular cantillation tradition, incorrectly signalling the disjuncture of an intonational phrase boundary. One indication that the interval between *tipphāhā'* and *'etnahtā'* is anomalous is that *tipphāhā'* and *sillūq* form an interval of a unison within this same tradition (see the interval between the final constituents in the MaPs of the second intonational phrase in this same example (**הַגֵּר**/Hagar and **יִשְׁמַעֵאל**/Ishmael)). Furthermore, in this tradition, when the conjunctive *munnāh* appears between the *tipphāhā'* and *'etnahtā'*, all three constituents belong to a melodically cohesive intonational phrase (cf. the three constituents **נָתַן**/giving, **לְבָנָי**/to.sons.of, and **יִשְׂרָאֵל**/Israel) at the end of the second intonational phrase in example (24a). The prosodic model and intonational classification of the *ṭā'āmīm* according to Tone Groups proposed in Pitcher (2020) supports the analysis that there is no underlying intonational discontinuity between *tipphāhā'* and *'etnahtā'*, as these disjunctives are always treated as members of the same Tone Group and are shown to always form cohesive intonational phrases (see Pitcher (2020:83-86, 113-120, 145-157) for a detailed description of the Tone Groups and pitch inventory for TH). Given the evolution of the melodies of the *ṭā'āmīm* over the centuries, no one particular extant cantillation tradition can be expected to entirely reflect the system's underlying intonational features. According to Pitcher (2020), adjacent *ṭā'āmīm* that belong to the same Tone Group are considered to be a more reliable indicator of the constituency of an intonational phrase than the interval structure of any one extant cantillation tradition. Therefore, the melodic interval of a fifth between *tipphāhā'* and *'etnahtā'* most likely does not reflect the core intonational and structural features of the TH prosodic system. For a more fully developed, complexity-based prosodic model for TH that is not dependent on the intonational instantiation of any one extant cantillation tradition, see Pitcher (2020).

$u_{(a\phi(i\phi(:\text{ישמעאל}')))} a_{\phi(i\phi^1(\text{אשר-ילדה-הנה}))} i_{\phi^3(\text{שם-בנו})}^3 \text{אברם}^1 \text{אברהם}^1 \text{ויקרא}^1$   
 (((wayyiqra<sup>1</sup> 'abram<sup>1</sup> šem-banô)<sup>3</sup>φ<sub>i</sub> ('ăšer-yālādâ<sup>1</sup> hāgār)<sup>1</sup>φ<sub>i</sub>)φ<sub>a</sub>  
 (((and.called<sup>1</sup> Abram<sup>1</sup> name.of-son.his)<sup>3</sup>φ<sub>i</sub> (that-bore<sup>1</sup> Hagar)<sup>1</sup>φ<sub>i</sub>)φ<sub>a</sub>

$((\text{yišmā} \text{ 'ē} \text{ 'l})\phi_i)\phi_a$   
 ((Ishmael))φ<sub>i</sub>)φ<sub>a</sub>⊔

“And Hagar bore to Abraham a son, and Abraham called the name of his son that Hagar bore, Ishmael.”  
 Genesis 16:15

Example (23) illustrates a semantically and prosodically non-restrictive relative clause where the proper head noun phrase (יהוה/**the LORD**) and the relative clause (אשר הוצאתיך/**who caused.you.to.go.out**) are in separate intonational phrases, as signaled by the disjunct melodic motion in the interval of a fifth between these two constituents.

(23)  $u_{(a\phi(i\phi(\text{אלי})))} u_{(a\phi(i\phi^5(\text{ויאמר})))}$   
 (((wayy 'ōmer)<sup>5</sup>φ<sub>i</sub>)φ<sub>a</sub>)⊔ ((( 'ēlāyw)φ<sub>i</sub>)φ<sub>a</sub>)⊔  
 (((and.he.said)<sup>5</sup>φ<sub>i</sub>)φ<sub>a</sub>)⊔ (((to.him)φ<sub>i</sub>)φ<sub>a</sub>)⊔

$u_{(a\phi(i\phi^5(\text{יהוה} \text{ אני})))}$   
 ((( 'ānî<sup>1</sup> YHWH)<sup>5</sup>φ<sub>i</sub>)φ<sub>a</sub>)⊔  
 (((I.am<sup>1</sup> the.LORD)<sup>5</sup>φ<sub>i</sub>)φ<sub>a</sub>)⊔

$u(\dots a_{\phi(i\phi^2(\text{כשדיים} \text{ מאור} \text{ אשר הוצאתיך}))} i_{\phi^3(\text{אשר הוצאתיך})}^3 \text{מאור}^1 \text{כשדיים}^1 \text{אשר הוצאתיך})$   
 ((( 'ăšer<sup>1</sup> hōšē' tīkā)<sup>3</sup>φ<sub>i</sub> (mē'ur<sup>1</sup> kaśdīm)<sup>2</sup>φ<sub>i</sub>)φ<sub>a</sub> . . . .)⊔  
 (((who<sup>1</sup> caused.you.to.go.out)<sup>3</sup>φ<sub>i</sub> (from.Ur<sup>1</sup> Chaldeans)<sup>2</sup>φ<sub>i</sub>)φ<sub>a</sub> . . . .)⊔  
 “And he said to him: ‘I am the LORD, who brought you out from Ur of the Chaldeans ...’”  
 Genesis 15:7

In (24a), the proper head noun (אֶת־אֶרֶץ־כְּנָעַן/**land.of Canaan**) and relative clause (אשר נתתי/**which-I giving**) are a part of the same intonational phrase, but they form separate MaPs. This example, therefore, illustrates a semantically non-restrictive relative that is prosodically undifferentiated.

(24) a.  $u_{(a\phi(i\phi^5(\text{אנשים} \text{ לה} \text{ שלח-לך})))}$   
 (((səlah-ləkā<sup>1</sup> 'ānāšīm)<sup>5</sup>φ<sub>i</sub>)φ<sub>a</sub>)⊔  
 (((send-for.yourself<sup>1</sup> men)<sup>5</sup>φ<sub>i</sub>)φ<sub>a</sub>)⊔

$a_{\phi(i\phi^3(\text{אֶת־אֶרֶץ־כְּנָעַן}))} i_{\phi^3(\text{וינתתי}))}^3$   
 (((wəyātūrū)<sup>3</sup>φ<sub>i</sub> ('et-'eres<sup>1</sup> kəna'an)<sup>3</sup>φ<sub>i</sub>)φ<sub>a</sub>  
 (((and.they.will.spy)<sup>3</sup>φ<sub>i</sub> (ACC-land.of<sup>1</sup> Canaan)<sup>3</sup>φ<sub>i</sub>)φ<sub>a</sub>

$\iota_{(a)\varphi(i)\varphi(\text{לְבַנְיֵי־יִשְׂרָאֵל}^1)}$   $a\varphi(i)\varphi^1(\text{אֲשֶׁר־אֲנִי־נֹתֵן}^1)$   
 $((\text{'}āšer\text{' }āni^1\text{ }nōtēn)^1\varphi_i)$   $((\text{libnē}^1\text{ }yisrā\text{' }ēl)\varphi_i)\varphi_a)\iota$   
 $((\text{which-I}^1\text{ giving})^1\varphi_i)\varphi_a)$   $((\text{to.sons.of}^1\text{ Israel})\varphi_i)\varphi_a)\iota$   
 “Send men to spy out the land of Canaan, which I am giving to the sons of Israel.”  
 Numbers 13:2

In (24b), the head noun (**הַמָּקוֹם**/the.place) and the relative clause (**אֲשֶׁר־אַתָּה־שָׂם**/where-you there) form separate MaPs within a cohesive intonational phrase. As such, this example illustrates a semantically restrictive relative that is prosodically undifferentiated.

(24) b.  $a\varphi(i)\varphi^1(\text{הִרְאֵה}^1)$   $i\varphi^3(\text{נָא־עֵינֶיךָ}^1\text{ שֶׁאֵינְךָ}^3)$   
 $((\text{'}šā\text{' }^3\text{ }nā\text{' }^1\text{ }ēnēkā)^3\varphi_i)$   $(\text{'}ūrā\text{' }ē)^1\varphi_i)\varphi_a)$   
 $((\text{(lift.up}^3\text{ }please^1\text{ }your.eyes)^3\varphi_i)$   $(\text{and.look})^1\varphi_i)\varphi_a)\iota$

$\iota_{(a)\varphi(i)\varphi(\text{אֲשֶׁר־אַתָּה־שָׂם}^1)}$   $a\varphi(i)\varphi^1(\text{מִן־הַמָּקוֹם}^1)$   
 $((\text{(min-hammaqôm)}^1\varphi_i)\varphi_a)$   $(\text{'}āšer\text{' }attā^1\text{ }šām)\varphi_i)\varphi_a)\iota$   
 $((\text{(from-the.place)}^1\varphi_i)\varphi_a)$   $(\text{where-you}^1\text{ there})\varphi_i)\varphi_a)\iota$   
 “Lift up your eyes and look from the place where you are.”  
 Genesis 13:14

Birkner’s (2012) study on the prosodic formats of German relative clauses provides support for the prosodically undifferentiated format of TH relative clauses. Birkner (2012:20) tested the “correlation between the semantic features and the prosodic phrasing of relative clauses in spoken German” and found that prosody does not always disambiguate the restrictive nature of relative clauses. Empirical data from an analysis of 801 overtly-headed German relative clauses (with their obligatory relative connectors) showed that only 10% exhibited the prototypical prosodic formats for non-restrictives, while 26% exhibited the prototypical prosodic formats for restrictives. A far greater proportion of the total – 63% – exhibited more ambiguous or undifferentiated prosodic formats, neither prototypically non-restrictive nor prototypically restrictive (Birkner 2012:33-34). The intonation-based analysis of the prosodic formats for the 4,171 overtly-headed *’āšer* relative clauses in the Prose Books (see Pitcher 2017), as delimited by the melodic structures put forth in this study, largely corresponds to Birkner’s findings (25): 478 clauses – 11% – have non-restrictive prosodic formats; 1,326 clauses – 32% – have restrictive prosodic formats; and 2,367 clauses – 57% – have ambiguous prosodic formats. These relative clause data provide additional evidence that the prosodic phrase structures delimited by the intonation-based model for TH correspond to the prosodic phrase structures of modern spoken languages.

(25) TH and German Relative Clause Data		
	TH	German
Nonrestrictives with prototypical prosodic formats	478/4,171 = 11%	84/801 = 10%
Restrictives with prototypical prosodic formats	1,326/4,171 = 32%	211/801 = 26%
Ambiguous or Undifferentiated prosodic formats	2,367/4,171 = 57%	506/801 = 63%

## 6. Pausal forms or lengthened forms – and where?

The preliminary intonation-based prosodic model for TH proposed in this study provides a solution to Dresher’s (1994; see also Dresher and DeCaen 2018; DeCaen and Dresher 2020) pausal form conundrum in that it allows for a fully-functioning intonational phrase domain and can explain the presence of so-called pausal forms at lower levels within the prosodic hierarchy. Dresher’s LCD-based model for TH, as illustrated in (26), is unable to reconcile the intonational phrase domain with the distribution of so-called pausal forms on boundaries other than the intonational phrase. Within Dresher’s (1994:12) LCD-based model, only the disjunctives *’etnaḥtā’* and *sillûq*, which produce major pauses, qualify as suitable boundaries for the intonational phrase.<sup>14</sup> However, since so-called pausal forms appear not only at the boundaries of *’etnaḥtā’* and *sillûq*, but also at the boundaries of “lesser accents” and even some conjunctives, Dresher (1994:12-14; see also DeCaen and Dresher 2020) concludes that the intonational phrase domain as represented by the *ṭa ’āmê hammiqrā’* is inoperable.

(26)

Cross-linguistic Prosodic Hierarchy	Dresher’s (1994) TH Hierarchy (see also DeCaen and Dresher (2020))
Utterance	Biblical Verse
Intonational phrase	Defunct/Non-existent
Phonological phrase	Disjunctive phrase Conjunctive phrase
Prosodic word	Prosodic word

For example, the same word is shown in (27a) in its non-lengthened, contextual form marked by a “lesser accent” (*tippəḥā’*) and in (27b) in its lengthened or so-called pausal form marked by *’etnaḥtā’*. Note the lengthening of the vowel in the highlighted syllable from a schwa to a full i-class vowel. This is the pattern for phonological lengthening that Dresher expects to find (see also Revell 1980, 2016).

- (27) a.   
*bəyādākā*  
 “in your hand”  
 Jeremiah 36:14
- b.   
*bəyādekā*  
 “by your hand”  
 Isaiah 42:6

However, as illustrated in (27c), the TH data also exhibit instances where “lesser accents” (like *zāqēp qāṭōn*) mark these lengthened forms.

<sup>14</sup> Dresher’s classification of the *ṭa ’āmê hammiqrā’* into four groups (D0, D1, D2, D3) is modelled after Cohen (1969). The D0 disjunctives are identified as “major disjunctives” that produce long pauses in the text, while the other disjunctives are “lesser accents” and fall into the D1, D2, D3 categories. The “lesser accents” also produce pauses in the text, however these *ṭa ’āmîm* are understood to indicate increasingly shorter pauses.

- (27) c.   
*bayādekā*  
 “in your hand”  
 2 Kings 9:1

The intonation-based model for TH offers a solution to the unexpected patterns of lengthening in Drescher’s LCD-based model in the following two ways. First, it rejects the notion that pausal segmentation is the only or most relevant feature of the *ṭə ʿāmīm* for discerning the prosodic structure of TH, and instead advances a prosodic structure for the *ṭa ʿāmē hammiqrā* based on intonation, the system’s most salient feature. This yields a prosodic model for TH that not only corresponds to Selkirk’s cross-linguistic prosodic hierarchy, but also yields intonational phrase boundary junctures other than *ʿetnaḥtā* and *sillûq*. Second, it rejects the notion that so-called pausal forms are only found at junctures of “major” pause, and instead proposes that these forms should be considered lengthened forms, which cross-linguistically exhibit wider distribution within the prosodic domains of the utterance (Beckman 1992; Rao 2007, 2010; Fletcher 2010:536, 542-543; Cho 2016; Gósy and Krepesz 2018).

In particular, prosodic research on pausal phenomena and lengthening conducted by Rao (2010:69-70,79) concludes that pauses in Spanish speech are associated with both the intonational and phonological phrase domains. Perhaps more significantly, Rao observes final lengthening of syllables, vowels, and words at the ends of intonational and phonological phrases regardless of pause, although pause increases lengthening over instances with no pause (Rao 2010:70,75-76,79). The distribution of these lengthened forms in Price’s (2006) study accords with the general distribution of lengthening observed by Rao. According to Price (2006:5), 98% of TH “pausal” forms coincide with *ʿetnaḥtā* and *sillûq*. This is expected because *ʿetnaḥtā* and *sillûq* are terminal intonational phrase boundaries, and accordingly they most often coincide with pausal segmentation within the verse (see Pitcher 2020:169-170). Note that the concurrence of pause with *ʿetnaḥtā* and *sillûq* is reflected in their nomenclature: “coming to a rest” and “cessation/separation”, respectively (see Jacobson 2017:345-346; Wickes 1887:16-28; Idelsohn 1929:70). In light of Rao’s findings, it is not surprising, then, that Price’s data show the occurrence of lengthened forms much less frequently at junctures other than *ʿetnaḥtā* and *sillûq*.<sup>15</sup> Therefore, TH “pausal” forms are more appropriately understood as lengthened forms, most often found at phonological and intonational phrase boundaries and associated with or without pauses. Reconceptualising pausal forms as lengthened forms provides a cross-linguistic explanation for their appearance with “lesser” accents.<sup>16</sup>

## 7. Conclusion

This study is based on the premise that the primary phonetic feature of the *ṭa ʿāmē hammiqrā* is not pause, but intonation, and argues that the *ṭə ʿāmīm* delineate distinct intonational groupings that encode prosodic structure and meaning. As research in the field of prosody continues to illuminate the centrality of intonation in organising speech and listening comprehension, scholars of the *ṭa ʿāmē hammiqrā* now have a compelling framework –

<sup>15</sup> Note that after *ʿetnaḥtā* and *sillûq* Price’s data (2006:5) identify *zāqēp qāṭōn* and *rəbīʿa* to be the third and fifth most common *ṭə ʿāmīm* to mark lengthened forms. Also note that Pitcher (2020) identifies these four *ṭə ʿāmīm* as intonational phrase boundary junctures.

<sup>16</sup> This includes instances of these forms marked by phrase-internal conjunctive *ṭə ʿāmīm* as they can be understood as phrase-medial lengthening rather than phrase-medial pause.

namely, modern prosodic phonology – for reconceptualising and decoding the prosodic system that the *ṭə ʾāmîm* represent. Although the melodies of the Masoretic accentual tradition have evolved, the core logic (viz. its “basic logical rules” (Dotan 1978:1410; see also Rubin and Baron 2006:69, 71-72)) for this system remains in the iconicity of the graphemes (Pitcher 2020) and in many of the extant melodies.

The intonation-based analysis of the *ṭa ʾāmê hammiqrā* presented in this study has revealed that the melodic structure of the *ṭə ʾāmîm* organises a coherent and cohesive prosodic structure that corresponds to Selkirk’s model for the cross-linguistic prosodic hierarchy. This study has identified the following three principles that reflect the prosodic phrase structure of TH as represented by the *ṭa ʾāmê hammiqrā*: 1) the orthographic feature of the iconicity of the *ṭə ʾāmîm*; 2) the musical concept of conjunct and disjunct melodic motion, which explains how conjunctive and disjunctive *ṭə ʾāmîm* form intonational continuity and discontinuity within the text, demarcating cohesive prosodic units and their boundaries; and 3) the notion that both conjunctive and disjunctive *ṭə ʾāmîm* have intonational features that enable them to form melodically continuous prosodic units within an utterance. Melodic principles and intonational features such as these were used to establish a preliminary intonation-based prosodic model for TH that corresponds to the cross-linguistic prosodic model for modern spoken languages. A preliminary testing of this model within the syntactic domain of the overtly-headed relative clause revealed TH data that align with attested cross-linguistic prosodic structures and features.

Finally, the intonation-based model for TH provides a preliminary framework for understanding the features and structures of the *ṭa ʾāmê hammiqrā* apart from the LCD. The inability of the LCD to treat phonetic features of the *ṭə ʾāmîm* other than pause is compounded by the limitations it places on a linguistic description of the phenomena that the *ṭa ʾāmê hammiqrā* represent. Dresher demonstrates this by showing that the LCD does not permit a fully-functioning intonational phrase domain because “pausal” forms appear in places where, according to his model, major pauses do not occur. As a result, Dresher concludes that the Masoretic prosodic representation is flawed. However, the intonation-based model is able to accommodate these forms by treating them as phonological lengthening rather than as strictly coinciding with pause. Cross-linguistic data confirm the presence of lengthened forms not only at intonational phrase boundaries, but also at the lower-tiered prosodic boundaries of phonological phrases (including their phrase-internal constituents), which helps explain the distribution of lengthened forms in the Masoretic Text. Furthermore, a preliminary analysis of the TH non-restrictive and restrictive relative clause data provides additional evidence that the intonation-based model for TH corresponds to the prosodic phrase structures of modern spoken languages.

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