Remarks on syllable structure and metrical structure in Biblical Hebrew

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Abstract

In the Middle Ages Biblical Hebrew was transmitted in a variety of oral reading traditions, which became textualized in systems of vocalization signs. The two most important oral traditions were the Tiberian and the Babylonian, which were represented by different vocalization sign systems. These two oral traditions had their origins in ancient Palestine. Although closely related, they exhibit several differences. These include differences in syllable and metrical structure. This paper examines how the syllable and metrical structure of the two traditions reflected by the medieval vocalization sign systems should be reconstructed. The Tiberian tradition exhibits an ‘onset typology’ of syllabification, where word-internal /CCC/ clusters are syllabified /C.CC/ and word-initial clusters are syllabified within the onset /CC-/. The Babylonian tradition exhibits a right-to-left computation of syllables resulting in a ‘coda typology,’ whereby the second consonant of a word-internal sequence /CCC/ is syllabified as a coda, viz. /CC.C/, and word-initial clusters are syllabified C.C, with the first consonant extra-syllabic.

Keywords

Tiberian Hebrew – Babylonian Hebrew – syllable – syllabification – foot – vowel length – epenthesis – onset typology – coda typology

In this paper I shall examine some features of the structure of syllables and metrical structure in the Tiberian and Babylonian reading traditions of Biblical Hebrew.

The Tiberian reading tradition is recorded by the Tiberian vocalization system, which is the system that appears in modern printed Bibles. This system of vocalization was developed by the Masoretes of Tiberias in the early Islamic period. It appears in a standardized form in medieval Bible manuscripts, which form the basis of modern printed editions. Although the Tiberian vocalization has come down to us as the standard form of written vocalization, the oral Tiberian reading tradition that it originally reflected was largely lost to knowledge in the later Middle Ages and Jewish communities read the Tiberian signs with other local traditions of pronunciation. The Tiberian reading tradition can now be reconstructed to a large degree on the basis of a variety of extant medieval sources. The reading tradition that is reconstructed from such sources does not correspond in many details to the descriptions of the pronunciation of Biblical Hebrew that appear in current reference grammars. In order to study the phonology of the Tiberian tradition of Hebrew, therefore, it is essential first to reconstruct through philological research the original form of the tradition.¹

The Tiberian reading tradition of Biblical Hebrew has its roots in an ancient reading tradition that was transmitted orally in the first millennium C.E. before the creation of the written notation of vocalization signs. Another reading tradition of Biblical Hebrew was transmitted in Babylonia in the first millennium C.E., which, in the early Islamic period, came to be recorded in another type of sign notation created by Babylonian Masoretes, known as Babylonian vocalization. The Tiberian and Babylonian reading traditions are historically closely related and are likely to have derived from the same source, which can be identified as a proto-Masoretic type of reading existing in the Second Temple period. The Babylonian reading tradition has been preserved in numerous manuscripts with Babylonian vocalization.² Although the Tiberian and Babylonian traditions are closely related, there are, nevertheless, numerous small differences in phonology and morphology between the two. Some of these differences can be attributed to historical change that took place in the traditions over the course of their transmission in the first millennium. It is also possible that some differences reflect variations that existed already within the Proto-Masoretic reading in the Second Temple period. What is of interest to us in this

1 For a description of the current state of philological research see Khan (2020). Short overviews can be found in Khan (2013a, 2013c).

2 For a comprehensive description of this vocalization see Yeivin (1985). Short overviews are provided by Khan (2013d) and Heijmans (2016).

paper is that the Babylonian tradition differed from the Tiberian in a number of aspects of syllable structure and metrical structure.

1 The Tiberian reading tradition

In order to understand the syllable structure in the Tiberian reading tradition it is important to know the distribution of vowel length. Long vowels in the reading tradition include those that are represented by full vowel signs when they are either (i) in a stressed syllable or (ii) in an open unstressed syllable. Elsewhere a vowel represented by a full vowel sign is pronounced short. Examples: מֶלֶךְ ['mɛ:lɛχ] 'king', שָׁמַע [jɪf'ma:aɪ] 'he hears', חֵכְמָה [ħɛχ'mɔ:] 'wisdom', הָהוּא [ħa:'hu:] 'that', יָעֹלָה [ya:'a'lɛ:] 'he goes up', בְּרַכְיָהוּ [bɛ:rɛχ'jɔ:hu:] 'Berechiah' (1 Chron. 2.24).³

In order to establish the synchronic phonological representation of the vowels of the Tiberian reading tradition one must distinguish between (i) vowels which are invariably long and include length in their underlying phonological representation and (ii) vowels whose length is determined by syllable structure and stress so are of unspecified length at a phonological level (Khan 2013e).

The long vowel phonemes include: long *qames* /ɔ̄/, *holem* /ō/, *šere* /ē/, long *shureq* /ū/, long *hireq* /ī/ (typically written with *yod*), e.g. יָד /jɔ̄d/ [jɔ:ɔ̄d] 'hand', כֹּהֵן /kōhēn/ [kʰo:he:en] 'priest', יִרְשׁוּ /jir'šū/ [ji:rɪ'ʃu:] 'they inherit'.

The vowel phonemes unspecified as to length include: *pataḥ* /a/, *seghol* /ɛ/, *hireq* /i/, *qibbuš/shureq* /u/. In principle these are long when syllabified with two moras in open syllables to compensate for historical gemination, e.g. הָהוּא /haahū/ [ħa:'hu:] 'that' (< **hahhū*) and מִחוּץ /mihūs/ [mi:'ħu:us^c] 'outside' (< **mihhūs^c*), or when they bear stress, e.g. נָעַר /na'ar/ ['na:'aɾ] 'boy', מֶלֶךְ /mɛ:lɛχ/ ['mɛ:lɛχ] 'king'. In unstressed closed syllables they are short.

To the second category of vowels we should add also /e/ and /o/ without specified length. These are represented by the *šere* and *holem* vowel signs respectively in the stressed syllable of certain forms. Since stressed vowels are always long, on a phonetic level these are not distinguishable from *šere* and *holem* representing phonemes with underlying length. This is necessary to account for apparent discrepancies in the historical development of vowels in several morphological forms, in which *pataḥ* (a vowel with no specified length feature) occurs in parallel with *šere* and *holem* (Sarauw 1939, 56–64; Khan 1994). This applies, for example, to nouns with an originally doubled final

3 For the evidence for this distribution of vowel length see Khan (1987).

consonant. In forms deriving from the **qall* pattern the vowel is *pataḥ*, e.g. רָב /'rav/ 'much', and in forms deriving from the **qill* and **qull* pattern, the vowel is *šere* and *holem* respectively, e.g. לֵב ['le:ev] 'heart', עֹז ['ʔo:oz] 'strength'. Such words would all have a vowel of unspecified length on the phonological level /'rav/, /'lev/, /'ʔoz/ and the length would have been a consequence of stress. There is, therefore, no discrepancy in their pattern. The same applies to the underlying phonological representation of the *pataḥ*, *šere* and *holem* in verbal forms (קָטַל, קָטַל, קָטַל, יִקְטֹל, יִקְטֹל, יִקְטֹל) and in segholate nouns (קֶדֶשׁ, סִפָּר, נִעַר), which would have the phonemes /a/, /e/ and /o/ respectively.

In syllables that do not have the main stress the vowels /e/ and /o/ are generally realized phonetically as [ɛ] or [ɔ] respectively, which overlap in quality with the phonemes /ɛ/ and /ɔ/, e.g. /vajjēreð/ [vajje:ɾeð] וַיֵּרֶד 'and he came down', /sʕo'ri/ [sʕʕ:ri:] צָרִי 'balm', /qoððʕim/ [qɔðð:ʕim] קִדְּשִׁים. A secondary stress may be marked on short [ɔ] and lengthen it to [ɔ:], as in קִדְּשִׁים [qɔ:ðð:ʕim] 'holinesses' (Exod. 29.37).

Another key starting point for analyzing the syllable structure of the Tiberian reading tradition of Biblical Hebrew is understanding the original function of the *shewa* sign. The quality of vocalic *shewa* in the Tiberian tradition was generally the same as that of the *pataḥ* vowel sign, i.e., the maximally low vowel [a]. When occurring before a guttural consonant or the letter *yod* it was realized with a different quality through an assimilatory process. Before a guttural it was realized as a short vowel with the quality of the vowel on the guttural, e.g. בְּאֵר [be'ʔe:ɾ] 'well', מְאֹד [mo'ʔo:ð] 'very', מְחִיר [miħi:ir] 'price', מְעוֹנוֹ [moʕo:no:] 'his dwelling place'. Before *yod* it was realized as a short vowel with the quality of short *hireq* [i], e.g. בְּיוֹם [bi'jo:om] 'on the day'. The default pronunciation of vocalic *shewa* with the quality of [a] was equivalent to that of the *ḥaṭef pataḥ* sign (ֲ). Both the vocalic *shewa* and the vowels expressed by *ḥaṭef* signs were short vowels that, in principle, had the same quantity as short vowels in closed unstressed syllables, which were represented in standard Tiberian vocalization by a simple vowel sign. So, the vocalic *shewa* in a word such as תְּדַבֵּר 'you (ms) speak / she speaks' would have been read with the same quality and quantity as the *pataḥ* in the closed syllable that follows it: [tʰaðabbe:ɾ]. Likewise, the *ḥaṭef pataḥ* in הַמֶּלֶךְ [ha'me:ɬɛχ] 'interrogative + king' would have been read with the same quality and quantity as the *pataḥ* in הַמֶּלֶךְ [ham'me:ɬɛχ] 'the king'. Evidence for this is found in the Masoretic treatise on the *shewa* published by K. Levy:

ותבת אן כל מכפף פלא בד לה מן שוא בתה אלא אן ימנעה אلدגש כמא מתלנא פי אול
קולנא המלך המלך או ימנעה שוא יכון אלי גאנבה אעני בעדה כקולך אברָהם אלא
כפיף ולולא אלשוא אלדי בעדה געלנא לה שוא

It is an established fact that every letter that has a 'light' (i.e. short) vowel requires a *shewa* unless this is precluded by a *dagesh* (in the following letter), as we exemplified at the beginning of our treatise, הַמֶּלֶךְ—הַמֶּלֶךְ, or by a *shewa* that is adjacent to it, i.e. after it, as in אֶבְרָהָם; the 'alef' has a short vowel, and were it not for the *shewa* that comes after it, we would have given it a *shewa*.⁴

The author of this treatise did not feel that there was a quantity difference between the vowel written with the *ḥaṭef* sign and the vowel represented by the full vowel sign. In his view it was the syllable structure which necessitated the notational distinction and not the quantity of the vowel segment. The shortness of the vowel in a closed syllable was indicated by the *dagesh* or *shewa* on the subsequent consonant. For the sake of economy of notation no additional sign was added to the vowel sign.

Further evidence for the quantitative equivalence of *shewa* and *ḥaṭef* vowels, on the one hand, and short vowels represented by full vowel signs in closed unstressed syllables, on the other, can be found in the use of the *shewa* and *ḥaṭef* signs in a variety of non-standard Tiberian manuscripts from the Cairo Genizah. These manuscripts sometimes represent a short /a/ vowel in a closed unstressed syllable with a *ḥaṭef pataḥ* or a *shewa* sign.⁵ Even some of the standard Tiberian Masoretic codices contain a few cases of such a phenomenon, e.g. in Codex Leningradensis (L): בְּחִרְטָמִם 'on the magicians' (Exod. 9:11), הָעֶרְבִים 'the evening' (Exod. 30:8), וְהִרְגֵנוּ 'and we will kill him' (Jdg 16:2).⁶ Furthermore in medieval Judaeo-Arabic texts with Tiberian vocalization *shewa* and *ḥaṭef pataḥ* are used to represent Arabic short /a/ in both open and closed syllables.⁷

In the Tiberian Masoretic literature a consonant with a vocalic *shewa* or a *ḥaṭef* vowel sign was not considered to stand independently, but was said to be bound to the following consonants. Thus the word תִּסְפְּרוּ 'you shall count' (Lev. 23:16) was considered to have been composed of two prosodic units [tʰis-pʰaʁu:]. The sources refer to these prosodic units by the Arabic term *maqṭaʿ*, which is used in the Arabic grammatical literature to refer to a syllable. The treatise *Hidāyat al-Qārī* 'The Guide for the Reader', written by the Karaite grammarian 'Abū al-Faraj Hārūn in the first half of the eleventh century C.E., notes that syllables thus formed have the status of words, i.e., they can stand independently:

4 Levy (1936, כב). The lacunae in Levy's text can now be supplied from the Geniza manuscript, CUL Or. 1080. 13.3, fol. 2v; cf. Yeivin (1981, 46), Eldar (1988, 127).

5 See Khan (1991) and Blapp (2017) for examples.

6 Yeivin (1968, 18), Dotan (1985).

7 For examples see Khan (1992, 2010).

ומן עלאמאתה איצא אנה יקסם אללפטה מתאבה כלם לאן כל חרף פי אכר כלמה הו סאכן אדא ערי מן מלך יכון מעה פיוכן דלך אלחרף אלעארי מן מלך הו מחט אלכלמה ומקטעהא נחו בראשית אלדי אלתו מחט אלכלמה ונחו אור אלדי אלריש מחט אלכלמה אלי גיר דלך פאלשווא אלסאכן פי וסט אלכלמה יגרי הדא אלמגרי לאנה קד צאר מחט עלי וגה לסכונה מתל והאחשדרפנים המצפצים צארת כל לפטה מן האתין אללפטין במתאבה תלת כלם לאגל אלשווא אלסאכן

Another of its features is that it divides a word into (units) that have the status of words. This is because every letter at the end of a word is quiescent when it is deprived of an accompanying vowel and this letter that is deprived of a vowel is the stopping point (*maḥaṭṭ*) of the word and its place of division (*maqṭaʿ*), as in בְּרִאשִׁית, in which the *taw* is the stopping point of the word, and אִוֹר, in which the *resh* is the stopping point of the word, as so forth. A quiescent *shewa* in the middle of a word has the same status, for it is in a sense a stopping point on account of its quiescence, for example הַמְצַפְצִפִּים 'and the satraps' (Esther 9.3), הַמְצַפְצִפִּים 'those who chirp' (Isa. 8.19). Each of these two expressions has the status of three words (*kalim*) on account of the quiescent *shewa*

Hidāyat al-Qārī, Long version, ed. Khan 2020, § 11.L.2.10.3

In various passages in *Hidāyat al-Qārī* there are references to the fact that a vocalic *shewa* or *ḥaṭef* vowel is read more quickly than a following full vowel sign, e.g. 'The *shewa* makes a letter mobile and causes it to be uttered quickly, so that one cannot tarry on that letter',⁸ 'The *shewa* moves quickly forwards'.⁹ By contrast a vowel is read more slowly, e.g. 'A vowel has an indissoluble feature, namely slowness and steadiness'.¹⁰ These descriptions can be interpreted as referring to the rhythmic structure of the prosodic unit consisting of a vocalic *shewa* followed by a vowel whereby this unit is a prosodic foot consisting of an iambic metrical pattern with a weak syllable followed by a strong syllable, which can be represented (. *). On a prosodic level, therefore, a word such as תִּסְפְּרוּ would consist of three syllables parsed into two feet, thus:

- (1) [tʰis. pʰa.ʔu:]
(*) (.*)

8 *Hidāyat al-Qārī* (Long Version, ed. Khan 2020, § 11.L.2.12.4.2): אלשווא יחרך אלחרף ויסרע: בנטקה חתי לא ימכן אחד אן ילבת בדלך אלחרף.

9 *Hidāyat al-Qārī* (Long Version, ed. Khan 2020, § 11.L.2.12.4.2): אלשווא יתחרך בסרעה אלי: קדאם.

10 *Hidāyat al-Qārī* (Long Version, ed. Khan 2020, § 11.L.2.12.7): ללמלך עלה לא תפארקה והי: אלתבאטי ואלתבאת.

In the representation above of the prosody of תִּסְפָּר [tʰis. pʰa.ʔɹu:] it will be noticed that the first syllable by itself has the status of a foot, i.e. [(tʰis). (pʰa.ʔɹu:)], where feet are marked by rounded brackets. This is in conformity with the current state of research on the typology of the metrical phonology of the world's languages. The foot (pʰa.ʔɹu:), as remarked, is iambic, i.e. it consists of two syllables, of which the second is the stronger. It is a binary foot consisting of a light syllable with one mora, viz. CV, and a heavy syllable consisting of two mora, viz. CVV. It is represented here (. *), where the star * represents the strong prominent syllable and the dot the weak syllable. In many languages with metrical phonology with binary feet, the feet may be binary either in the number of their syllables, as in the foot (CVCVV), which is known as a syllabic foot, or in the number of their morae, known as a moraic foot. This means that a heavy syllable with two morae, viz. CVV or CVC, normally represented in metrical phonology by (*), could function as a foot in the metrical scansion of a word alongside a syllabic foot.¹¹ The metrical parsing of תִּסְפָּר [tʰis.pʰaʔɹu:] would, therefore, be [(/*), (. *)]. The CVC syllable with a vowel [tʰis], which constitutes an independent foot, would be metrically stronger than the first syllable of the foot (. *), which is represented by a *shewa* sign. This would conform to the medieval descriptions cited above, which state that a vowel has the feature of 'slowness and steadiness' whereas a *shewa* 'moves quickly forwards'. These differences in prominence can be represented by a metrical grid.¹² In the grid the relative prominences are marked by differences in heights of columns of index marks:

(2)

(tʰis)	(pʰa.	ʔɹu:)	
(*)	(.	*)	
x	x	x	Level 1
x		x	Level 2
		x	Level 3

As can be seen, the syllable with the main stress is the most prominent. This stress occurs on the strong syllable of the (. *) foot.

The Masoretic notion of *maqṭaʕ*, therefore, can be equated with the notion of foot in the prosodic hierarchy rather than syllable. The foot is of relevance for some phonological processes in the Tiberian pronunciation tradition. This is a

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For the typology of feet in iambic metrical systems see Hayes (1985, 1995), Kager (1993, 383, 2007, 200–201).

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For hierarchical arrangement of linguistic rhythm on a grid see, for example, Liberman and Prince (1977), Hayes (1995, 26–31) and Halle and Vergnaud (1987).

key justification for the reality of such metrical constituents (Nespor and Vogel 2012). The occurrence pattern of the allophones of Tiberian *resh* is a clear example of this. Tiberian *resh* had an advanced uvular allophone [ʁ], which can be considered its default realization,¹³ and a pharyngealized, apico-alveolar allophone [r^ʕ], which was conditioned by certain environments (Khan 1995, 2013b). According to the medieval sources the apico-alveolar allophone occurred when *resh* is preceded by the consonants דּוּצַת־טַסֶּלֶן or followed by לֵן and when either *resh* or one of these consonants has *shewa*. This can be reformulated as the rule that apico-alveolar *resh* occurs when in immediate contact with a preceding alveolar, e.g., בְּמִזְרָה [bamiz'r^ʕɛ:] 'with a pitch fork' (Jer. 15.7), or in the same foot as a preceding alveolar, e.g., דְּרָכּוֹ [dar^ʕkʰo:] 'his way' (Gen. 24.21), or when the *resh* is in immediate contact with or in the same syllable as a following ל or ך, e.g., עָרְלִי־לֵב [ʕar^ʕle:-'le:ev] 'uncircumcised in heart' (Jer. 9.25), רַנְּנוּ [r^ʕanna'nu:] 'rejoice (mpl)! (Ps. 33.1). What is of significance for the reconstruction of prosodic structure is that a *resh* preceded by an alveolar consonant with vocalic *shewa* was realized with the apico-alveolar allophone, e.g., צְרוּפָה [s^ʕar^ʕu:'fɔ:] 'refined (fs)' (2 Sam. 22.31), whereas in a form such as צָרוּף 'refined' (Ps. 12.7), where the alveolar has a vowel sign, the *resh* has its default realization as an advanced uvular [s^ʕɛ:'ʁu:uf]. This reflects the fact that one of the conditions for the occurrence of apical *resh* is, indeed, that it occurs in the same foot as a preceding alveolar, since in צְרוּפָה [s^ʕar^ʕu:'fɔ:] the alveolar צ is not in the same phonetic syllable but is in the same foot as the following *resh*—it is bound to the *resh* by the *shewa*, according to the description of the medieval sources—whereas in a form such as צָרוּף [s^ʕɛ:'ʁu:uf] 'refined (ms)' the צ is in a separate foot from that of the *resh*.

The distribution of the allophones of *resh*, therefore, reflects the phonological reality of the notion of foot (*maqṭaʕ*) in the Masoretic sources, viz., that a consonant with vocalic *shewa* belongs to the foot of the segments immediately following it.

The vocalic *shewa* can be regarded as having the synchronic status of an epenthetic vowel. In many cases vocalic *shewas* in the Tiberian reading tradition occur where historically there were originally lexical vowels. These vowels were of different qualities, e.g., יִכְתֹּבוּ [yixtʰa'vu:] 'they (m) write' (< **yaktubū*), סְפָרִים [safɔ:'ʁi:im] 'books' (< **siparīm*), דְּבָרִים [davo:'ʁi:im] 'words' (< **dabarīm*). The vocalic *shewa*, however, does not preserve the quality of the historical lexical vowel; rather, the *shewa* is a vowel with a neutralized quality, i.e.,

13 Cf. *Hidāyat al-Qārī*, long version (ed. Khan 2020, § 11.1.1.9.5): פהדא מא כלאמהם עליהא ... 'This is their normal pronunciation (of the letter)'.

the maximally open vowel [a], in some circumstances modified by assimilation to its phonetic environment. As remarked, before a guttural it was realized as a short vowel with the quality of the vowel on the guttural and before *yod* it was realized as a short vowel with the quality of short *hireq* [i]. Shortness and non-rounded vowel quality and also the copying of the quality of an adjacent vowel are characteristic features of epenthetic vowels (Hall 2011, 1581). In examples such as those cited for the reduction of lexical vowels to epenthetic vocalic *shewa*, the motivation for the vowel is no longer lexical but rather phonotactic, in that it breaks illicit clusters of consonants on the phonetic level. Lexical vowels can be reduced to zero in contexts where licit sequences of consonants are the result, e.g. מְלָכִי [mal'χe:] 'kings of' (< **malakē*), לְשִׁמוּעַל [lɪʃmu:'e:el] 'to Samuel' (< **la-Šamū'ēl*). According to this analysis of vocalic *shewa*, it would have to be assumed that the original vowel is absent at some underlying level of the phonological derivation of words and an epenthetic vowel is introduced at the phonetic surface level. A /CC/ cluster at the onset of a syllable in word-initial position is broken by an epenthetic and this can be represented thus:

- (3) /mqō.mō/ [ma.qo:.'mo:] 'his place' מְקוֹמוֹ

The only exception was the *shewa* in forms of the feminine numeral שְׁתֵּי / שְׁתַּי 'two', which was silent [ʃta:jim] / [ʃte:]. The silent *shewa* in שְׁתֵּי / שְׁתַּי could be explained by the analysis of the *shin* as extrasyllabic and not part of the onset of the syllable. Moreover, if the cluster /ʃt/ were considered an onset, this would violate the normal principle of rising sonority of syllable onsets (Ewen and Hulst 2001, 136–141, 147–150; Hoberman 1989):

- (4) /ʃ.tē/ [ʃ.'te:] שְׁתֵּי

By contrast, in a word such as שִׁתָּה 'drink (ms)!' (Gen. 24.14) the *shin* and the *taw* form the onset of a syllable and are split by an epenthetic: /ʃθē/ [ʃa.'θe:]. We should mention here the exceptional form אֶזְרִיעַ [ʔez.'rʰo:.aʔ] 'arm' with prosthetic *ʔalef*, which is attested in the Tiberian Masoretic text as a variant of זְרִיעַ [za.'rʰo:.aʔ] (Job 31.22; Jer. 32.21).

One could argue that the conditioning of the allophones of the *resh* discussed above operated within the domain of the underlying syllable and ignored epenthetics introduced at the phonetic level, operating on a word such as צְרֻפָּה [sʰarʰu:.'fɔ:] as if the *šade* and the *resh* were in the same syllable:

- (5) /sʰrū.'fɔ/ [sʰa.rʰu:.'fɔ:] 'refined (fs)' צְרֻפָּה

would have been conditioned by a constraint against superheavy syllables consisting of codas greater than two morae. Following the analysis by Kiparsky (2003) of Arabic syllable structure, we may say that such unsyllabifiable consonants are licensed by moras adjoined to the higher node of the prosodic word rather than the syllable node. Kiparsky refers to these consonants as ‘semisyllables’:

(7) /((qō).l/ [ˈqoː.ɒl] ‘voice’

(8) /((ḡ).m.(rū)/ [ḡoː.ɔm.ˈʁuː] ‘they guarded’

On the phonetic level the extrasyllabic consonants were syllabified by means of epenthetics. There was a constraint against word-final short CV syllables, since such syllables had to be combined in an iambic foot with a following bimoraic syllable. So the epenthetic came before the consonant, forming a trochaic foot on the phonetic level: [ˈqoː.ɒl] (*.). This process of epenthesis in word-final position was extended by analogy to similar syllabic configurations in word-internal position.

The discussion above concerning the epenthetic vocalic *shewa* has been concerned so far with cases in which it has developed from a historical lexical vowel. Another motivation for an epenthetic vowel was to introduce an ahistorical vowel between two consonants for orthoepic purposes. This applies in particular to the frequent insertion of an epenthetic after a guttural consonant (אהתח) where there was no historical lexical vowel in a sequence where the guttural originally closed a syllable in word-medial position and was in contact with a following consonant. These epenthetics are regularly written

with *ḥaṭef* signs in the standard Tiberian tradition. The process can be analysed as involving the following stages.

- (i) The historical syllable structure reflects the morphological pattern of the grammatical form in question, e.g. the prefix conjugation verb יָעֲלוּ 'they go up' would have the historical syllable structure *jaʕ.lū, in line with, for example, יָשָׁתוּ 'they drink'. This can be regarded also as the underlying phonological syllable structure /jaʕ.lū/.
- (ii) A short epenthetic is added after the guttural. This creates a short open phonetic syllable [CV], viz. [ja.ʕa.lu:].
- (iii) The vowel in the syllable preceding the guttural is lengthened, viz. [ja:ʕa.lu:]. This is likely to have come about due to a metrical constraint on having a sequence of a light CV syllable and a following weak epenthetic syllable.

In such syllabifications involving gutturals in word-medial position the epenthetic copies the quality of the preceding vowel:

- (9) /jaʕ.lū/ > [ja:ʕa.'lu:] יָעֲלוּ 'they go up'
- (10) /heʕ.lō/ > [he:ʕe.'lō:] הָעֵלָה 'he brought up'
- (11) /tʰoh.rō/ > [tʰo:ħe.'rō:] טָהַר 'cleansing'

The motivation for the introduction of the epenthetic between a guttural and a following consonant was orthoepic. Gutturals were weak consonants in the reading tradition and efforts were made to ensure that they were not slurred over. Acoustically the epenthesis made the gutturals more perceptible when separated from the following consonant¹⁴ and this facilitated their preservation in the reading.

Although there is a tendency for gutturals to be followed by *ḥaṭef* vowels where parallel forms have silent *shewa*, this is not a universal rule. It is sometimes possible to identify additional phonotactic and metrical factors that appear to have conditioned the occurrence of the *ḥaṭef* vowels in certain forms with gutturals in contrast to other forms that have silent *shewa*. As shown by de Caen (2003) and Alvestad and Edzard (2009) one factor that conditions the occurrence of *ḥaṭef* vowels on gutturals, at least on *het*, is sonority of the following consonant. They have shown that a *ḥaṭef* vowel tends to occur when the following consonant is high in sonority, e.g. in יִהְרֹשׁ 'he ploughs' (Hos. 10.11),

14 Cf. Hall (2011, 1577–1578), who discusses this function of epenthesis in languages.

where the consonant is a sonorant rhotic, but exhibits a greater tendency to be omitted when the following consonant is lower in sonority, e.g. יָהֲדָל 'he ceases' (1Sam. 9.5). This is motivated by the principle that the optimal contact between two adjacent syllables is where the onset of the second syllable is stronger than the offset (coda) of the preceding syllable (Vennemann 1988, 40), and so the contact is eliminated with a following weak sonorous onset by the intervening *ḥatef* vowel.

Variations, however, occur in inflections of the same verb, where the same consonants are involved, e.g. יִחְשְׁבוּ 'they consider' (Isa. 13.17) vs. יִחְשְׁבוּן 'they consider' (Psa. 35.20). In such cases the *ḥatef* appears to have been motivated by a metrical factor, namely the disfavouring of a rhythmic clash. This is seen in a metrical grid representation of the two forms. In these grids feet are marked in the first row. It will be assume that feet after the main stress are extrametrical (marked with angular brackets < >). Evidence for this extrametricality is presented below.

(12)	jah.	'fo:.	vu:	
	(*)	(*)	<*>	
	x	x	x	Level 1
	x	x	x	Level 2
		x		Level 3

(13)	ja:.	ħa	fo:.	'vu:.	un	
	(*)	(.)	(*)	(*	.)	
	x	x	x	x	x	Level 1
	x		x	x		Level 2
			x			Level 3

The grid representation displays the varying degrees of the relative prominence of syllables. These include epenthetic syllables, syllables containing a vowel without the main accent, and syllables with the main accent (represented as levels 1, 2 and 3 respectively in the grids above). It is likely that the insertion of the syllable with the *ḥatef* vowel in the second form was favoured since it created grid euphony by repairing a potential rhythmic clash caused by two syllables of the same prominence before the stress,¹⁵ as shown in the following grid:

15 A clash is the occurrence of two adjacent metrically strong elements with the same prominence. A lapse is the occurrence two adjacent metrically weak elements; cf. Prince (1983), Selkirk (1984).

- (14) *jah. fo:. 'vu:. un
 (*) (*) (*) .)
 x x x x Level 1
 x x x Level 2
 x Level 3

In the standard Tiberian tradition a *shewa* is in principle silent on a guttural when the syllable of the guttural receives the main accent and it is followed by another syllable, e.g. שָׁמְעוּ [ʃɔ:. 'ma:.aʃ.nu:] 'we heard' (Deut. 5.24), שָׁלַחְתִּי [ʃɔ:. 'la:.aʃ.tʰi:] 'I sent' (Num. 22.37). If the accent moves forward after the attachment of a suffix in such forms, however, a *hatef* appears, e.g. שָׁמְעוּהָ [ʃa.ma:.ʃa. 'nu:.hɔ:] 'we heard it' (Psa. 123.6). These phenomena can also be explained on metrical grounds if we posit, as remarked above, that syllables after the main accent are extrametrical and unfooted. Extrametrical syllables at the right periphery of words commonly occur in iambic metrical systems (Kager 2007, 2014). The word שָׁמְעוּ can be represented thus (extrametrical syllables in angular brackets):

- (15) ʃɔ:. 'ma:. aʃ. nu:
 (*) (*) .) <*)

Here, since the syllable following the guttural is extrametrical and unfooted there is no rhythmic motivation for a *hatef*, which is a weak syllable that is obligatorily footed and metrically bound to a following strong syllable.

The metrical structure of שָׁמְעוּהָ is:

- (16) ʃa. ma:. ʃa. 'nu:. hɔ:
 (. *) (. *) <*)

Here the accent on the syllable after the guttural licenses the *hatef* in that it can be footed and bound metrically to this strong footed syllable.

Some short vowels in open syllables are lexical vowels rather than epenthetic vowels. This applies mainly to a set of vowels represented by *hatef qameṣ*. In such cases the *hatef qameṣ* [ɔ] preserves the rounded quality of a historical lexical vowel of the morphological form and there has not been quality reduction and neutralization. They should be represented as the short phoneme /o/ in the phonological form of the word, e.g.

- (17) הַקְּדוֹשִׁים [haq.qɔ.ðɔ:. 'ʃi:.im] /haq.qo.ðɔ:.ʃi.m/ (2 Kings 12.19 'the holy things')
 < *qoððšīm; cf. sing. קְדוֹשׁ ['qo:.ðɛʃ]

(18) צִפּוֹרִים [sʰip.pʰo.ʔri:im] /sʰip.pʰo.rī.m/ (Lev. 14.49 'birds') < *sʰipporīm; cf. sing. צִפּוֹר [sʰip.pʰo:or̥i]

(19) רָאָה [ʔoʔʔi:] /roʔ.j/ (Gen. 16.13 'seeing') < *ruʔ; cf. pausal form רָאָה [ʔo:ʔi:] (1Sam. 16.12)

(20) צָרִי [sʰʔʔi:] /sʰor.j/ ('balm') < *sʰury; cf. pausal form צָרִי (Ezek. 27.17)

In the examples cited above the *ḥaṭef qameṣ* is the reflex of a short round historical vowel. In a few cases *ḥaṭef qameṣ* in an open syllable is the result of the shortening of an original [o:] /ō/ or [ɔ:] /ō/ in an unstressed syllable, e.g.

(21) בְּמִתֵּי [ʔbɔ:mθe:] (Isa. 14.14 'the heights of') < *bōmōṭē

(22) הֶחָלַתִּי [he:ħɔṭa:altʰi:] (Jud. 9.9, 'shall I cease?') < *ħāṭāltī

Yeivin (1980, 283) identifies some cases of *ḥaṭef seghol* on non-guttural consonants as a lexical vowels ('morphological use' in his terminology). These are found mainly in Biblical Aramaic, e.g. בְּנִיתָהּ (Dan. 4.27 'I built it'), קָרִי (Ezra 4.18 'it was read'), גָּלִי (Dan. 2.30 'it was revealed'). A Hebrew example is וּבְצִלְצִלִּים (A, C 2Sam. 6.5 'and with cymbals', L has simple *seghol* here: וּבְצִלְצִלִּים). It is not clear, however, whether these preserve the original quality of a lexical vowel or whether they reflect some kind of assimilation to the phonetic environment.

The qualities of *ḥaṭef qameṣ* [ɔ] and *ḥaṭef seghol* [ɛ] share the property of being lax vowels, in that they were produced in the central vowel space.

The form רָאָה [ʔoʔʔi:] (Gen. 16.13 'seeing') indicates that a *ḥaṭef qameṣ* that represents a lexical vowel does not assimilate to the quality of the vowel after a following guttural, unlike epenthetic vowels.

The status of lexical vowel of these cases of *ḥaṭef qameṣ* involved not only the resistance to neutralization of their historical vowel quality and to assimilation to the quality of adjacent vowels but also retention of a stronger metrical structure than epenthetics. This is demonstrated by the distribution of the allophones of *resh*. In the medieval sources the *resh* was said to have its default uvular realization in a word such as צָרִי [sʰʔʔi:] 'balm' (Gen. 43.11),¹⁶ i.e., after an alveolar consonant with *ḥaṭef qameṣ*. As remarked above, when the alveolar has vocalic *shewa* in this environment, as in the word צָרוּפָה [sʰarʰu:'fɔ:] 'refined

16 See the commentary on *Sefer Yešira* by Saadya Gaon (ed. Lambert 1891, 79) and the sources cited in Khan (1995, 70–71).

(fs)' (2 Sam. 22.31), the *resh* was in the same foot as the alveolar and had a pharyngealized apico-alveolar realization. This reflects the fact that the domain of the conditioning of the allophones of *resh* was the foot rather than the syllable:

- (23) [s^ʕa.r^ʕu: 'fɔ:]
 (. *) '(*)

The realization of the *resh* in צָרִי [s^ʕɔ'ɾi:] as an uvular can be interpreted as reflecting the fact that such a *ḥaṭef qameṣ* on a non-guttural consonant was in a separate foot from that of the following syllable:

- (24) [s^ʕɔ 'ɾi:]
 (*) '(*)

The foot containing the *ḥaṭef qameṣ* consists of a light monomoraic syllable CV. Metrical phonologists term this a 'degenerate foot', since feet would normally be expected to be bisyllabic or bimoraic (Prince 1990; Kager 2007, 200–201). Such degenerate feet are tolerated in some languages, but often only under certain conditions, such as peripheral position or main stress. In Tiberian Hebrew a degenerate foot consisting of a light CV syllable is only tolerated with a lax vowel quality of *qameṣ* or *seghol*.

A series of two light CV syllables is not tolerated, and a foot with the syllabic structure CVCV is not licit. So a degenerate CV foot cannot be combined with a preceding monomoraic syllable of a vocalic *shewa* of a preposition or a short /u/ of the conjunctive *waw*. In such cases the *ḥaṭef qameṣ* vowel is elided and in this respect it behaves like a vocalic *shewa*, e.g.

- (25) בְּדָמִי [bið'mi:] (Isa. 38.10 'in the silence of') versus דָּמִי (Isa. 62.6 'silence')

- (26) וְצָרִי [wus'ɾi:] (Gen. 37.25 'and balm') versus צָרִי (Gen. 43.11)

Another repair strategy is to lengthen a preceding short vowel, as is found when the degenerate foot is preceded by interrogative *he*, e.g.

- (27) הֲצָרִי אֵין בְּגִלְדֵּאד [ha:s'ɔ'ɾi:] 'is there no balm in Gildead?' (Jer. 8.22)

2 The Babylonian tradition

In this section of the paper I shall briefly examine some of the features of the syllable and metrical structure of the Babylonian tradition of Biblical Hebrew that are distinct from the Tiberian tradition. The medieval manuscripts with Babylonian vocalization reflect a wide diversity of traditions, many of which, exhibit convergence with the Tiberian reading tradition. I shall concentrate on those features that are characteristically Babylonian. These are found in particular in manuscripts belonging to the earlier layers of the tradition (indicated below by the abbreviations OB = Old Babylonian and MB = Middle Babylonian). There are no prescriptive descriptions of the Babylonian pronunciation in Masoretic treatises and the pronunciation has to be reconstructed almost exclusively from the vocalization appearing in the manuscripts.

Whereas in the Tiberian tradition word-initial consonant clusters are broken by epenthetic vowels, it appears that there was no epenthetic in this context in Babylonian. This can be inferred, for example, from a vocalization such as the following (Yeivin 1985, § 8.13):

(28) יִסֹּד [i:so:ð] OB 'the base of' (Lev. 4.25 | BHS יִסֹּד [yaso:oð])

Here the *yod* is vocalized with *hireq*, which appears to have arisen due to the fact that this initial consonant clustered with the second consonant without an epenthetic [jso:ð] > [i:so:ð].

Another feature that reflects the lack of a vowel where Tiberian has vocalic *shewa* is the phenomenon of epenthesis of vowels in forms such as the following (Yeivin 1985, 390):

(29) נִמְלִטוּ [nimil'tʰu:] OB 'they escaped' (Isa 37.38 | BHS נִמְלִטוּ)

(30) נִכְלְמוּ [niχil'mu:] OB 'they were ashamed' (Ezek 43.11 | BHS נִכְלְמוּ)

This type of epenthesis is found mainly before the sonorant letters *lamed*, *nun*, *resh* and *mem*. It arose due to the fact that Babylonian had a different typology of syllabifying word-internal CCC sequences. Unlike Tiberian, which syllabified the second consonant as an onset, viz. C.CC, Babylonian syllabified it as a coda, viz. CC.C. This coda was a cluster, but when it had rising sonority an epenthetic was inserted to repair the violation of the sonority principle. A form such as נִמְלִטוּ [nimil'tʰu:] can be represented as having an underlying form such as the following:

(31) /niml.'tʰu:/ [ni.mil.'tʰu:]

The lexical vowel of the closed syllable /niml/ remains short when the epenthetic is added at the phonetic level.

The first vowel in a form such as נַמְלִטוּ [nimil'tʰu:] was short. This is shown by manuscripts with the so-called compound Babylonian vocalization, which explicitly marks short vowels, e.g.

(32) וַיַּצְבְּרוּ [wyi.sʰiv. ru:] 'they will store up (grain)' (Gen 41.35 | BHS וַיַּצְבְּרוּ)

The metrical structure of a form such as נַמְלִטוּ [ni.mil.'tʰu:] could be represented as follows:

(33)	ni.	mil.	'tʰu:
	(.	.	*)
	x	x	x
			x
			x

In the Babylonian tradition, therefore, a sequence of two weak syllables was tolerated, unlike in Tiberian. So the word above would, presumably, have formed a single anapaest foot (. . *). Two adjacent weak syllables, however, would have constituted a rhythmic lapse and, although tolerated, there appears to have been pressure to repair this by eliding the first of the weak syllables, as shown by forms such as the following, in which the first consonant is vocalized with a *shewa* sign or left without any sign:

(34) תְּגַמְלוּ [tɡilmu:] OB 'you will repay' (Deut 32.6 | BHS תְּגַמְלוּ)

(35) יִדְרְכוּ [jdir'χu:] OB 'they will (not) tread' (1 Sam 5.5 | BHS יִדְרְכוּ)

Similar syllabifications are found where *yod* occurs in word-medial position (Yeivin 1985, 389), e.g.

(36) נִהְיָה [nhɪ:'θɔ:] OB 'it happened' (Jer 5.30 | BHS נִהְיָה)

The underlying syllabification of this would be /nihy.'θɔ/, which would be realized phonetically with an epenthetic [ni.hiy.'θɔ:], and the first short vowel was then elided, resulting in [nhɪ:'θɔ:].

A form such as יִסֹּד [i:.so:ð] can be interpreted as having an underlying syllabification thus /j.so:ð/ with the initial cluster C.C. The first consonant would,

therefore, be extra-syllabic, and the long [i:] on the phonetic level would have arise through a prosthetic vowel [ij.so:ð].

Babylonian, therefore, has a ‘coda typology’ of syllabification, which means that word-medial CCC sequences are syllabified CC.C and epenthetics are added to the coda (Hall 2011, 1580), e.g. CeC.C, rather than to the onset, e.g. Tiberian C.CeC (where e = epenthetic). This can be interpreted as reflecting a right-to-left typology of syllabification, whereby syllables are computed starting at the end of the word (Itô 1989). This typology would explain also the syllabification of word-initial clusters C.C, in that the second consonant is first taken as the onset of the syllable following it, computing from the right, and the remaining stray syllable is left extra-syllabic. By contrast Tiberian has an onset typology, which is left-to-right syllabification, whereby syllables are computed starting at the beginning of the word.

A similar phenomenon of the coda type of syllabification is reflected in the pattern of vocalization of guttural consonants, such as the following (Yeivin 1985, 313):

- (37) יָעֵלוּ [jaʕaʕlu:] OB ‘they will come up’ (Job 6.18 | BHS יַעֲלוּ)
- (38) נַעֲרָה [naʕaʕra:] OB ‘young woman’ (1Kings 1.3 | BHS נַעֲרָה)
- (39) יִבְנֶה [jibne:] OB ‘He will build up’ (Prov 29.4 | BHS יִבְנֶה)

A form such as יָעֵלוּ [jaʕaʕlu:] arose from the insertion of an epenthetic into the underlying form /yaʕlū/. The purpose of the epenthetic on the guttural, as in Tiberian, was to make the guttural more perceptible. In Tiberian the guttural is syllabified with the onset of the following syllable, i.e. /CVGC/ > /CV.GC/ (where G = guttural) and an epenthetic is inserted after the guttural in the onset. The first vowel is lengthened due to a metrical constraint on having a sequence of a light CV syllable and a following weak epenthetic syllable: [CVV.GaC]. In Babylonian the guttural is syllabified with the coda of the preceding syllable and the epenthetic is added after the coda, thus /CVGC/ > /CVG.C/ [CVGa.C]. The first vowel remains short when the epenthetic is added.

This results in a metric structure containing a sequence on the phonetic level of two weak open syllables with short vowels:

(40)	ja.	ʕa.	'lu:
	(.	.	*)
	x	x	x
			x
			x

As shown by vocalizations such as נָעֶרָה [nʕa'ɾɔ:] and יַעֲמִיד [jʕa'mi:ð], the first weak syllable is optionally eliminated:

- (41) n. ʕa. 'ɾɔ:
 (. *)
 x x
 x
 x

In word final position there is likewise tolerance of two weak post-stress syllables, which is not licit in Tiberian. This results in forms such as the following (Yeivin 1985, 313):

- (42) נִשְׁבַּעְתִּי [niʕ'ba:ʕati] OB 'I swore' (Psa. 95.11 | BHS נִשְׁבַּעְתִּי)

The metrical structure of this can be represented thus:

- (43) niʕ. 'ba:. ʕa ti·
 (*) (*) ⟨. .⟩
 x x x x
 x x
 x

This contains two weak and presumably unfooted syllables after the main accent. Since there is no absolute constraint against this in the Babylonian tradition, the guttural is followed by a vowel, unlike in Tiberian, where it is not licit due to the strict metrical constraint against two weak post-stress syllables.

The coda typology of Babylonian is also reflected in word-final syllables with long vowels. Babylonian does not have furtive *pataḥ* in such syllables, as is the case in Tiberian. Rather, when the final consonant is *ʕayin*, *pataḥ* is added after the *ʕayin* (Yeivin 1985, 327–328), e.g.

- (44) יָגִיעַ [jaɣ'gi:ʕa] OB 'it will reach' (Isa 8.8 | BHS יָגִיעַ)

- (45) מַדּוּעַ [mad'du:ʕa] OB 'why?' (Jer. 2.14 | BHS מַדּוּעַ)

It occurs also when the long vowel before *ʕayin* is *qameṣ* or *pataḥ*, e.g.

- (46) אֶשְׁמָע [ʔiʕmɔ:ʕa] OB 'I will hear' (Job 4.16 | BHS אֶשְׁמָע).

(47) הָרָעָה [ħa:raʔa] OB ‘evil deeds’ (Deut. 9.18 | BHS הָרָעָה).

A form such as הָרָעָה [jagʕi:ʔa] would have the underlying syllabic structure /jag.gi:ʔ/ and the epenthetic short [a] is added to the coda of the final syllable. This would result in the syllabification [jag.ʕi:ʔa] on the phonetic level. The short epenthetic can stand in word-final position since it does not have to be in the onset of a syllable as it does in Tiberian. The proposed underlying syllabification /jag.gi:ʔ/ would not be subject to a constraint against closed syllables with long vowels. This analysis is supported by the fact that when gutturals other than *ʕayin* that are preceded by long vowels occur in word-final position, there is no epenthetic, e.g. גִּבְהָהּ [gɔ:ʔo:h] ‘high’ (Yeivin 1985, 369) = Tiberian גִּבְהָהּ [gɔ:ʔo:ah]. Babylonian, therefore, differs from Tiberian in its tolerance of CVVC syllables. Tiberian regularly eliminates CVVC syllables by syllabifying the final consonant as a semi-syllable, i.e. CVV.C. According to the interpretation of the syllable structure of Babylonian presented here, Babylonian does not have semisyllables after long vowels. One may explain this difference between the typologies of Tiberian and Babylonian in an optimality framework as the different ranking of constraints. In Tiberian the constraint against CVVC outranks a constraint against semisyllables. In Babylonian, by contrast, a constraint against semisyllables outranks a constraint against CVVC.

The Babylonian tradition, therefore, exhibits a different typology of syllabification and metrical structure from that of Tiberian. It exhibits a right-to-left computation of syllables resulting in a ‘coda typology,’ whereby the second consonant of a word-internal sequence /CCC/ is syllabified as a coda, viz. /CC.C/, and word-initial clusters are syllabified C.C, with the first consonant extra-syllabic. Tiberian, on the other hand, exhibits an ‘onset typology,’ where word-internal /CCC/ clusters are syllabified /C.CC/ and word-initial clusters are syllabified within the onset /CC-/. These variations in syllable typology within varieties of the same language have been identified also, for example, in modern spoken Arabic dialects (Kiparsky 2003; Watson 2007; Hall 2011). The coda typology of syllabification is reflected also by some Latin and Greek transcriptions of Hebrew from an earlier period, as in the following forms: Jerome (c. 347–420 C.E.) *masarfoth* ‘burnings’ Jer. 34.5, cf. Babylonian מַשְׂרָפוֹת [masirʔo:θ] but Tiberian מִשְׂרָפוֹת [misrʔaʔo:θ]). Origen (c. 185–254 C.E.): אַερ-σους ‘let them (not) wink’ (Psa. 35.19, cf. Tiberian יִקְרָאוּ [jɪqɾaʔu:]). Septuagint (last quarter of first millennium B.C.E.): Ιερειμιας ‘Jeremiah’; cf. Babylonian יִרְמְיָהוּ [jirimʔo:hu:], but Tiberian יִרְמְיָהוּ [jirmiʔo:hu:].

The weaker metrical structure of Babylonian, with less constraints against sequences of weak syllables, may reflect a less careful tradition of reading. The

Tiberian tradition, which was the most prestigious tradition and the one that was most rigorously fixed, was evidently a more carefully read tradition and exhibits more constraints on weak syllables.

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