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The Resh Riddle: Identifying The Biblical Hebrew Rhotic

MA Thesis

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Abstract

In this study, I will reconstruct the Biblical Hebrew rhotic, *resh*, basing the analysis on its phonological behavior. I will examine the phonological phenomena related to *resh* on a quantitative basis, and will argue that it is best identified as the alveolar tap – ɾ.

Rhotics are a very diverse class of segments that are present in the majority of the world's languages. This class contains sounds with different places and manners of articulation, and thus cannot be defined solely by articulatory or acoustic properties. In light of their different nature, it can be difficult to identify a rhotic's phonetic realization in a dead, unrecorded language, such as Biblical Hebrew. According to some accounts, *resh* should be categorized as some kind of back consonant, while other accounts classify it as an alveolar segment. Others still, relying on descriptions made by medieval grammarians, reached the conclusion that *resh* had a twofold pronunciation depending on its phonological environment. None of these accounts was based on a systematic examination of the phonological phenomena related to *resh*, which suggest that it should be grouped with the coronals in the same natural class.

In order to reconcile between my account and the others, I will assume a diachronic transition, during which an original alveolar trill lenited to a transitional alveolar tap, which in turn changed into the back consonant described in the early sources. This assumption will be supported by a typological review of the rhotics' diachronic changes. Moreover, I will propose a possible timeline for this diachronic change, basing it on extra-Biblical sources, such as transcriptions of Hebrew words in cuneiform characters and in the Greek alphabet, and a comparative examination of the rhotics in the Semitic languages.

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Contents

List of Figures

List of Tables

Chapter 1

Introduction

The Biblical Hebrew rhotic, also known as *resh*, has been a thorny issue for a long time. Biblical Hebrew, being a dead language, lacks the recordings that would enable a swift and unambiguous identification of its segments. Throughout the years, researchers have proposed several contradictory reconstructions, ranging from front rhotics such as the alveolar trill *r*, to back rhotics such as uvular fricative ʁ. These proposals were mostly based on the accounts of medieval grammarians, and usually did not explain the phonological peculiarities of the segment.

First, a clarification about the language researched in this study is needed. The Hebrew variety on which I focus is the *Tiberian* one. The biblical text has been written for several centuries in an abjad writing system, which did not explicitly mark the vowels of the language. A punctuation system was created in the last centuries of the first millenium in Tiberias, which reflected the reading tradition of the local population. Nonetheless, it is my opinion that this system recorded the effects of an older pronunciation of *resh*, that by the times of the Jewish scribe-scholars had already changed. Therefore, aware of this discrepancy, I opted to use another more general name for the language, i.e. "Biblical Hebrew".

In the current study, I argue that *resh* is best identified with the alveolar tap, ɾ. My analysis is not confined to a philological analysis of the early grammarians' texts. The main drive for my reconstruction is *resh*'s phonology itself, which is, in my opinion, pivotal for correctly reconstructing the segment. This research also provides a diachronic description of the segment, following its development over the ages. For simplicity, throughout the research *resh* is transcribed as *r* (it being the most prototypical sign for a rhotic). This choice will help avoiding confusion, since it will be apparent during the diachronic description that *resh* has changed over

time.[1]

The study is organized as follows: chapter 2 provides the background for the study, containing the required notions both about the language and the research methodology; chapter 3 is an in-depth description of *resh*'s phonological behavior; chapter 4 reviews the previous research done in the field, focusing specifically on the medieval descriptions of the language; chapter 5 is dedicated to the reconstruction of *resh*, and thereby describes the phonological behavior of the guttural segments; chapter 6 discusses the phonological evolution of *resh*; chapter 7 summarizes the main arguments and conclusions.

[1]I transcribe Biblical Hebrew words with IPA characters in italics, next to the word in original script, like this: בְּרֵאשִׁית *bəreʃiθ*, 'in the beginning'. General terms and names in Hebrew and other Semitic languages are written with Semitic romanization. Tables of Biblical Hebrew letters and punctuation signs, together with their phonetic value and romanization, can be found in appendices A and B.

Chapter 2

Background

This chapter covers all the relevant fields for dealing with the reconstruction of *resh*. Section 2.1 deals with the relevant background on Biblical Hebrew, chiefly focusing on the language's segments and their properties. Section 2.2 is an overview of the rhotics' natural class, comprising their diversity, their properties and some theoretical issues. Finally, section 2.3 is a discussion of the methodologies used in historical linguistics for *paleophonological* research, i.e., for reconstructing the sounds of dead languages.

2.1 Biblical Hebrew

2.1.1 General remarks

Biblical Hebrew is the language in which most of the books of the Bible (*Tanakh*) are written. It is a Semitic language, belonging to the Canaanite branch of North-West Semitic, together with Phoenician, Moabite, Ammonite and Edomite (Edzard 2011; Hornkohl 2019). Biblical Hebrew was spoken in the area known as Israel, roughly west of the Jordan River and east of the Mediterranean Sea, possibly attested for the first time in the *Gezer Calendar* inscription, dating to the 10 century BCE (Ahituv 2008). Apart from the biblical text, more materials are available in the language – a sizable number of inscriptions (ranging from ca. 1000 BCE to the first CE years), the biblical scrolls from the Dead Sea (Qumran) and the Samaritan Pentateuch are some noted examples (Edzard 2011).

Although the literary text of the Bible spans several centuries, the language in which it is written presents an astonishing degree of uniformity, since it was leveled by scribal conventions and by hundreds of years of transmission. Nonetheless, this uniformity is not manifested to the same degree in all aspects of the language – the variations in vocabulary and phraseology between one period and another are significant, while the variations in syntax are generally less so (Joüon and Muraoka 2006). And yet, it is possible to distinguish roughly between three stages of Biblical Hebrew according to its linguistic features (Hurvitz 2000; Hornkohl 2013):

1. Archaic Biblical Hebrew (early Iron Age, ca. 1200-1000 BCE) – parts of the poetic sections of the bible, that are thought to predate even the earliest inscriptional sources and are known to preserve salient features of an earlier linguistic stratum.

2. Standard/Classical Biblical Hebrew (ca. 1000-500 BCE) – the majority of the Biblical Hebrew corpus, linguistically similar to the Iron Age inscriptional evidence.

3. Late Biblical Hebrew (ca. 500-200 BCE) – the language of the books written after the Babylonian Captivity, during the period of Restoration: Esther, Daniel, Ezra, Nehemiah and Chronicles (Kaltner and McKenzie 2019; Garr and S. E. Fassberg 2016; Hurvitz 2013).

Apart from these diachronic stages, one can also distinguish between two synchronic regional varieties of Biblical Hebrew: Judahite Hebrew, referring to Judah and its capital Jerusalem, and the Israelian Hebrew, referring to settlements in Samaria, Galilee, and Transjordan. Nearly 80% percent of the Hebrew Bible is generally thought to represent the Judahite variety, although the morpho-phonological differences to Israelian Hebrew are very minor (Edzard 2011).

The biblical text consisted originally only of consonantal script with *matres lectionis* (consonant letters that sporadically indicate vowels), without any vocalization symbols (Blau 2010). These symbols were added during later stages, within different traditions (Edzard 2011; Hornkohl 2019). The Bible is partially preserved in the Babylonian vocalization tradition (Yeivin 1985) and the Palestinian vocalization tradition, but it is only completely preserved in the Tiberian tradition, arguably the most prestigious one (Yeivin 1980a; Malone 1993; Churchyard 1999). This last tradition originated somewhere in the second half of the first millenium in Tiberias, by scholars known as "*Masoretes*", who recorded the Biblical Hebrew text with an

inventory of vowel, punctuation, and cantillation signs devised by them (Edzard 2011).

Besides the Jewish traditions of vocalization, there are some existing non-Jewish traditions, including the Samaritan written and reading traditions of the Pentateuch (Ben-Hayyim and Tal 2000; Florentin 2013), along with the Greek phonetic transcription as recorded by Origen, and Jerome's commentaries and transcriptions in the Latin Vulgate (Yuditsky 2013; Kantor 2017). Lastly, some other medieval sources cover the pronunciation of the Tiberian Masoretic system, such as the *Hidāyat al-Qāri'*, 'Guide for the reader' (Eldar 1981).

2.1.2 Consonant inventory

Table 2.1 represents the consonant inventory of Biblical Hebrew in the Tiberian tradition (Goerwitz 1996; Khan 1997; Rendsburg 1997):

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	*p* *b*			*t* *tˤ* *d*			*k* *g*	*q*		*ʔ*
Nasal	*m*			*n*						
Fricative		[*f*] [*v*]	[*θ*] [*ð*]	*s* *sˤ* *z*	*ʃ*		[*x*] [ɣ]		*ħ* *ʕ*	*h*
Glide	*w*					*j*				
Lateral				*l*						

Note: The table does not contain the Biblical Hebrew rhotic, whose identity is the topic of this study. Sounds between square parentheses are allophones.

Table 2.1: Biblical Hebrew consonants

By the times of the Tiberian Masoretes, some phonological mergers occurred, resulting in a few sounds derived from two phonemes in the earlier history of North-West Semitic (Blau 1982; Steiner 2005). Among those, *ħ* and *x* merged into *ħ*, and *ɣ* and *ʕ* merged into *ʕ*. These mergers seemingly took place around 200 BCE, as attested by the transcriptions of Hebrew proper names from the Septuagint: these transcriptions, dating from 250 BCE, show that the distinction between *ħ* and *x*, and between *ɣ* and *ʕ* was still audible, indicating that these mergers occurred afterwards.

Moreover, the graphical sign שׂ was shared for two sounds, *ʃ* and *ɬ*. The *Masoretes* introduced diacritical dots (שׁ vs. שׂ) in order to distinguish between them (Diem 1974). Still, one of those sounds, *ɬ*, merged with *s* in Late Biblical Hebrew, as witnessed by orthographic doublets in the biblical text (Blau 2010; Edzard 2011).

The plosives *b*, *g*, *d*, *k*, *p* and *t* have fricative allophones in post-vocalic environments, both within a word and at word boundaries (although in the latter case fricativization would arise only with specific prosodic conditions).[2] In these environments, the plosives surfaced as *v*, *ɣ*, *ð*, *x*, *f* and *θ* respectively.[3] This process was blocked when the stops were geminated. According to some studies (Rendsburg 1997; Woodard 2008), these allophones originated under Aramaic influence, in ca. 400 BCE.

2.1.3 Vowel inventory

Table 2.2 shows the vowel system of Biblical Hebrew in Tiberian times:[4]

	Front	Back
Open	*i*	*u*
Open-mid	*e*	*o*
Close-mid	*ɛ*	*ɔ*
Close	*a*	

Table 2.2: Biblical Hebrew vowels

In the Tiberian tradition, vowels were distinguished by quality, unlike the Proto-Semitic vowel system that also distinguished vowels by quantity (Blau 2010; Wright and Caspari 2011; Edzard 2011; Hornkohl 2019). Although the earlier quantity distinction is lost in the Tiberian tradition, it is still reflected by the vowels' quality differences – the vowel *ɔ* usually derives from pre-Tiberian long *aː*, while *a* derives from short *a* (Blau 2010).

Length in Tiberian Biblical Hebrew was phonetic and conditioned by certain factors, such as stress pattern, syllable structure and diachronic origin – stressed vowels, vowels in open syllables and vowels derived from the monophthongization of *aw* and *ej* were pronounced long (Khan 1997; Khan 2020).

Apart from the vowels presented in table 2.2 , Biblical Hebrew presents also a

[2] Although exceptions do exists, as the pronoun אַתְּ *ʔat*, 'you (sg. f.)'.

[3] It is possible that *b* and *p* surfaced as *β* and *ɸ* instead.

[4] The reconstruction of Biblical Hebrew's vowel system is still somewhat debated. The system presented here is based mostly on Blau (2010). For more details, see Goerwitz (1996), Khan (1997) and Rendsburg (1997). For other opinions regarding the system as a whole, see Suchard (2018) and Khan (2020).

reduced vowel, ə,[5] which appears subsequently to stress shift in place of a diachronically short vowels in open syllables, e.g. *kɔˈθav + u → kɔθəˈvu* (Joüon and Muraoka 2006; Blau 2010). This reduced vowel, called "*shewa*", has three allophones, the *ḥaṭef*s, which surface in a few phonological environments (although several of their instances do not seem to have a sound phonological reason). Since the *ḥaṭef*s are believed to be quantitatively identical to short vowels (Hornkohl 2019), they are usually transcribed with a *breve* sign, in order to distinguish between them and full vowels: *ă*, *ĕ* and *ŏ*.[6]

2.2 Rhotics

The term "rhotics" encompasses a class of segments informally referred as r-sounds, usually symbolized by the letter <r> and its derivations in the various alphabets of the world (Ladefoged and Maddieson 1996). Unlike most of the traditional sound classes, which are defined by some articulatory or auditory property common to their members, rhotics are heterogeneous, and cannot be defined by a particular place or manner of articulation (Ladefoged and Maddieson 1996). This situation raises two questions: first, if it is not possible to define rhotics based on sound articulatory or auditory grounds, are there any reasons at all for claiming that they form a natural class? Second, if there are indeed good reasons for defining the rhotics as such, is it possible to detect a feature that unifies them? Before considering these two questions, I will present the main sounds usually categorized as rhotics.

The most prototypical rhotic consonants are the trills made with the tip or blade of the tongue (Ladefoged and Maddieson 1996). Trills in general are primarily characterized by the vibration of one speech organ against the other, driven by aerodynamic conditions. The two articulators are placed close to each other, so that when a current of air flows through the aperture between them, a repeating pattern of closing and opening of the current channel occurs. Since quite small deviations can cause the failure of the trill's articulation (the aperture size and airflow must fall within critical limits), trills tend to vary with non-trilled realizations. Because of that, an actual trill realization of the segment is not as common as it might be expected – even in languages where the rhotic is labeled as a trill, it is not realized as such by all speakers, and those that do, have tap and approximant allophones (Lindau 1985).

[5]The exact phonetic realization of the reduced vowel is somewhat contested. In this work I will use ə to represent it. Further information on the topic can be found in Khan (2020).

[6]Some sources add a fourth *ḥaṭef*, *ĭ*.

Trills are more easily produced if the vibrating articulator has a small mass, and hence the most common trills are articulated either with the tip of the tongue vibrating against the dental/alveolar region (henceforth: apical trills), or with the uvula vibrating against the back of the tongue. Nevertheless, apical trills are by far more common than uvular trills. Lindau (1985) found that apical trills typically consist of two or three pulses of vibration, while uvular trills tend to be longer, consisting of four to six. That could be explained by a faster rate of vibration for the uvula, which is smaller than the tongue tip. In languages that distinguish between single and geminate forms of the segments, the contacts between the articulators tend to be reduced to one or two, while the geminated forms show multiple contacts, that can arrive up to eight. Uvular trills show a high third spectral peak (F3), in contrast to the apical ones. Nonetheless, apical trills display an important variation in this regard, mainly because they are not produced with the same place of constriction in different languages (Lindau 1985).

Another major category of rhotic sounds are the taps/flaps. These segments are generally apical, and are invariably realized with a single short closure. Usually linguists do not make any distinctions between the terms tap and flap, but Ladefoged and Johnson (1975) suggested distinguishing them by the active articulator movement: while in flaps the contact between the articulators is made by moving it tangentially to the site of the contact, in taps the movement is directly towards the roof of the mouth. Nevertheless, in this study I will use the term "taps" in order to refer to both types. Taps are usually coronal, though their production is varied between languages and speakers. This is caused by the variation in the precise articulatory location of the closure, which creates some differences in regard to the formants' foci (Lindau 1985). In addition, some taps show a certain amount of acoustic energy during their closure, while others do not. Taps can occur also as allophones of other non-rhotic segments, as in American English, in which post-stress pre-syllabic alveolar stops alternate with taps.

Unlike these two categories, which involve some contact between the articulators, there are also rhotics whose articulation does not include any contact, but only an approximation between the articulators – fricative and approximant rhotics. These sounds are rarer than trills and taps, but tend to be common in some linguistic areas, especially in Europe (Ladefoged and Maddieson 1996). Approximant rhotics show formants like vowels, indicating that the vocal tract has no constriction smaller than those for vowels. Moreover, coronal approximants usually display a lowered third formant (conspicuously so in American English dialects). Fricative rhotics' production is accompanied by the friction typical to other fricatives, and tends to

be less vowel-like than the approximants' one (Lindau 1985).

As it is possible to notice from the review in the previous paragraphs, rhotics are extremely varied in regard to their phonetic properties: this class includes trills, taps, fricatives and approximants, which can be articulated as coronals, retroflexes, velars and uvulars. Hence, it looks like neither the place nor the manner of articulation could be used as the shared property for the class. This factor casts doubt upon the very idea that rhotics could be grouped together into a natural class: natural classes are based on some common articulatory or auditory properties shared by each of the class members (Chomsky and Halle 1968; Kenstowicz and Kisseberth 1977) – hence, how possibly could the multifarious rhotics form one? And yet, although rhotics are not particularly similar phonetically, their phonological behavior seems to indicate that they are members of the same phonological class.

In stark contrast to the dubious phonetic basis of the rhotics' class, its phonological unity is commonly acknowledged by linguists (Wiese 2001). There are several generalizations that demonstrate the common phonological behavior of those segments (Lindau 1985; Wiese 2001):

1. Rhotics tend to share the same phonotactic patterns across languages, occupying the same syllabic positions. Rhotics mostly occur close to the syllable nucleus, making them vowel-adjacent elements. Thus, in languages with consonant clusters, the rhotics will exhibit the pattern *CrVrC*.

2. Post-vocalic rhotics tend to become vowels or disappear altogether. This is true for different kinds of rhotic segments – it happens both with the post-alveolar approximant in Southern British English, and with uvulars in German, Danish and Southern Swedish.

3. Although rhotics are generally non-syllabic consonants, they often have a syllabic variant. It appears that languages which allow for syllabic consonants at all, will allow for syllabic rhotics.

4. Rhotics have similar phonological effects on their environments: vowels occurring before them tend to lengthen, as in English, Swedish and Italian (especially before non-geminated rhotics). Vowels occurring either before or after them tend to lower, as in French and Danish with their uvular r-sounds, as well as with standard Swedish and Spanish with their apical r-sounds.

5. Rhotics often alternate with other rhotics (synchronically and diachronically), without changing their phonotactic nature. Alternation between rhotics and

other non-rhotic segments occurs as well, but the frequency and range of rhotic-internal alternation is noteworthy and is found in families which are otherwise quite diverse. For example, in Persian, the alveolar trill has a tap allophone in intervocalic position, and a voiceless trill variant in word-final position. In Fula (West Atlantic), a trill is realized as an approximant before a consonant, and as a trill elsewhere. In Hausa (Chadic), the rhotic is realized as a tap or approximant between vowels, and as a trill before a consonant or in initial position.

This list of generalizations shows clearly that rhotics share a wide range of phenomena in many different languages, and therefore the idea of a rhotic's natural class cannot be easily dismissed. Nonetheless, it is difficult to understand what the unifying property of such a heterogeneous class of sounds is. Given the variation in both place and manner of articulation, a single articulatory property cannot be seriously proposed. Consequently, linguists tried to identify elsewhere the elusive common quality of the rhotics.

An early proposal made by Ladefoged and Johnson (1975) and Lindau (1978) suggested that rhotics' common acoustic factor was a lowered third formant. The lowering of the formant would be manifested in the relatively steady-state formant structure of approximants and other continuant rhotics, in the formant structure of the brief intervals between the closures of trills, and in the transitions to and from the consonant in any adjoining vowel (Ladefoged and Maddieson 1996). It seems that lowered third formants are a well-justified specification for the all the various articulations of the American English rhotic, as well as for some other languages' rhotics: the approximant of Izon (Niger-Congo) showed a considerably lowered F3 (Lindau 1985), similarly to the Italian's trill (Ladefoged and Maddieson 1996). The formant lowers also in all the different trills of Toda (Dravidian).

However, subsequent studies disproved the validity of that claim. This feature is not a pervading property of rhotics: the rapid closure of taps does not display any formants (Lindau 1985). Similarly, both voiceless and fricative r-sounds contain acoustic noise but no formants. Furthermore, some rhotics actually show a high third formant. This is not surprising since the location of the formants is affected by the articulatory configurations implemented for realizing the segment (Lindau 1985). Approximants with different constriction locations vary in regard to their F3 – the Hausa retroflex approximant has a third formant at the same level as that surrounding *a* vowels. A constriction within the velar-uvular area creates a high F3, that being the case for Swedish, French and German uvulars (Ladefoged and

Maddieson 1996). Some dental rhotics also have a relatively high third formant (in contrast to Italian's trills), as in Spanish, though their formants are not as high as the uvulars' (Ladefoged and Maddieson 1996). In fact, a lowered F3 is rather unusual among rhotics, and can only signal a particular set of them. Thus, it seems a poor candidate for the unifying property of the rhotic class.

A more theoretical approach was implemented by Wiese (2001). He argued that none of the rhotics' generalizations mention any segmental feature – rather, they reference the phonotactics of these sounds. Consequently, the common feature to all rhotics should not be sought in their segmental properties, but in prosody: in his opinion, rhotics should be defined as "the point on the sonority scale between laterals and vowels" (Wiese 2001). The sonority scale defines an ordered hierarchy of sound classes, and determines their relative order within a syllable: high-sonority sounds tend to be closer to the peak of a syllable than low-sonority ones (Sievers 1901; Jespersen 1913). Accordingly, Wiese maintains that rhotics must be seen as a constant point of their own on the sonority scale, disregarding their actual segmental properties. He supports his claim by examining the behavior of Standard French rhotics. Those rhotics have two instantiations – the main one as voiced uvular trills, and as voiceless uvular fricatives following a voiceless stop or fricative in the same word (Tranel 1987). French allows for some obstruent-sonorant cluster in onset position, while obstruent-obstruent clusters are not permitted. Nevertheless, rhotics can occur in those clusters irrespective of their segmental properties. It is possible to draw the conclusion that devoiced or fricative rhotics occur in positions which are generally restricted to sonorant consonants. Accordingly, French rhotics behave phonotactically as sonorant consonants, even when their segmental features are those of obstruents (Wiese 2001). Moreover, Wiese asserts that the overwhelming tendency of rhotics to be voiced (Maddieson and Disner 1984) derives from their high ranking on the sonority scale.

Still, rhotics' nature poses a major problem to the proposal of Wiese (2001): the quality, and thus the sonority, of r-sounds varies from fricative to vocalic. The sonority scale relates directly to these qualities, making it impossible to tie all rhotics systematically and uniquely to a specific point on it. To deal with this problem, Wiese (2001) suggests that points on the sonority scale should not be defined in terms of fixed segmental features – the sonority scale must be redefined as an abstract ordering of points. In this case, the positions of the sound classes are not defined by some inherent segmental features, but only by their relative position on the scale. Subsequently, rhotics would be defined by their position on this abstract scale. This analysis would explain the contrast between the arbitrary segmental features of

rhotics, and their non-arbitrary phonotactic patterns.

Unfortunately, this last revision also raises several problems: first, this system is totally unbound, and should vastly over-generate non-existing phonological systems. Since rhotics are only defined by a point on an abstract sonority scale, it is impossible to predict which sounds will be chosen as rhotics in a certain language – we should witness languages with velar stops or bilabial nasals rhotics, but no such language was ever recorded. Second, several rhotic sounds, such as Russian and Polish trills, do not fit the phonotactic pattern claimed for r-sounds. Lastly, some sounds, as rhotacized vowels, would relate to two different positions on the abstract sonority scale proposed by Wiese (2001).

In the end, it seems that the most reliable model for describing the class of rhotics is that of family resemblance, proposed by Lindau (1985) and further developed by Magnuson (2007). This model is based on the philosophical idea made popular by Wittgenstein (1969), arguing that some things which are thought to be connected by one essential common feature are in fact connected by a series of overlapping similarities, where no one feature is common to all of the things. Wittgenstein himself applied this concept to games: although hardly anything can be found in common between card games, board games, ball games and games like ring-a-ring-a-roses, there is a "complicated network of similarities overlapping and criss-crossing [between them]" (Wittgenstein 1969). This model is applicable to the class of rhotics: each member of the rhotic class resembles some other member with respect to some property, but it is not the same property that constitutes the resemblance for all the members of that class; two members of the class may not be much alike, but it is possible to express the relationship between them as a set of steps across some other members.

All trills, without regard to their place of articulation, show pulsing patterns that could explain the changes from tongue-tip trills to uvular trills which occurred historically in French, German, Southern Swedish and Danish (Lindau 1985). Uvular rhotics have similar spectral shapes with a peak in the area of the third formant, a feature shared with dental trills and some approximants, which also have a fairly high F3. Moreover, we can find acoustic similarity also between trills and taps – from an acoustic point of view, a trill is a series of taps. Sometimes trilling and frication can co-occur (Ladefoged and Maddieson 1996), resulting in fricative-approximant variants noted in some varieties of French. Additionally, the production of trills tends to be instable (as already noted before), which could lead to trills with a prolonged open phase. Those trills can alternate, and even change into approximants. This concatenation of similar features shows clearly that even though none is shared

among all rhotics, it is possible to derive a relation between any two of them, creating a network of interconnected sounds.

2.3 Paleophonological methodology

Historical linguistics (also called "diachronic linguistics") is the discipline concerned with the change of language over time (Bynon 1977; Campbell 2013). Being one of the broadest sub-fields of linguistics, historical linguistics encompasses several research areas, such as describing and accounting for observed changes in particular languages, reconstructing the pre-history of languages, developing general theories about how and why a language changes and etymology – the study of the history of words (Radford et al. 2009). Usually, this discipline is contrasted with synchronic linguistics, which deals with a language at a single point in time (Campbell 2013; Millar and Trask 2015). A related field of study, often confused with historical linguistics, is philology. Philology deals primarily with the written attestations of ancient languages, which are used to shed light on some aspects of the languages' history (Campbell 2013). Philology is complementary to historical linguistics, since it attempts to get systematic information about a language from written texts, which in turn is used for analysing the changes that the language underwent.

A research area related both to historical linguistics and to philology is that of *paleophony*, defined by Catford (2001) as "the reconstruction and study of ancient pronunciation". Paleophony was extensively implemented for reconstructing the phonetic system of dead languages, such as Latin and Ancient Greek (Allen 1987; Allen 1989). The reconstruction of dead languages' sounds requires a thorough analysis of the written data with different techniques that may vary greatly depending on the source materials (Campbell 2013). Several of these will be considered in the following paragraphs.

One of the most important sources for the reconstruction process are the statements made by contemporary (or nearly contemporary) grammarians and writers, who spoke the language in question (Allen 1987). The writings of these scholars may contain important information that could be crucial for understanding the nature of a specific sound. For example, Dionysius of Halicarnassus (1^{st} ce. BCE) described in his *De Compositione Verborum* the sound of the letter *rho*, ρ, as being articulated with "the tip of the tongue rising to the palate near the teeth" (cited in Allen 1987), and Plato (4^{th} ce. BCE) affirms in *Cratylus* that "the tongue is least quiet and most rapidly shaken in pronouncing [the letter ρ]" (cited in Catford 2001). Both

descriptions indicate that ρ was produced as an alveolar trill in Ancient Greek: the place of articulation is "near the teeth", and the tongue is "least quiet", meaning that its movement was repetitive and protracted. In a similar way, Latin's rhotic is reconstructed either as a tap or a trill, based on the late grammarian Terentianus Maurus (2^{nd} ce. CE), who states that "the letter [r] shakes out a dry sound with rapid blows" (cited in Catford 2001). Unfortunately, grammarians' notes are rare, and are found mostly for languages with ancient traditions of grammatical analysis, such as Latin, Ancient Greek and Sanskrit. Hence, historical linguists and philologists must resort to other sources.

Evidence for the phonetic realizations of ancient languages' sounds can be found in rhymes, word-play of various kinds, puns and contemporary etymologies (Allen 1989; Campbell 2013). For example, the word <night>, nowadays pronounced *nart*, rhymed only with other words spelled with <gh> in Middle English texts, such as <wight>, 'strong', and never with words which contain the same vowel but lack that spelling, as <white>. For that reason, it is assumed that in Middle English <gh> represented a distinct sound, which was lost in Modern English (Lass 1992). In a similar way, we know that in Middle French the sound represented by the letter <e> was lowered before rhotics, since François Villon (c. 1431 – c. 1463) rhymed the word <terme> with the word <arme> (Taylor 2001). Finally, Latin's back pronunciation of Ancient Greek *y* is supported by a pun of Plautus in his *Bacchides*, where he plays on the Greek name Λυδος, *lydos* and on the Latin word <ludo> (Allen 1989).

Another indirect source of knowledge about the pronunciation of specific sounds are spelling variants and orthographic errors. Those variants are not arbitrary, and derive from the relative perceptual similarity between the two phonemes (Johnson 2012). Therefore, knowing the phonetic instantiation of one of the sounds, it is possible to retrieve important information regarding the second one. For instance, several pre-classical Latin inscriptions display an alternation between <r> and <d>, e.g. <arvenas> for <advenas> (Pultrová 2013). Since <d> is known to have been an alveolar stop, the confusion between <d> and <r> would suggest an alveolar tapped articulation (Allen 1989).[7] Likewise, occasional spellings of English words during the 17^{th} century provide clues regarding the changes that took place in the vowel system of the language. For example, variants such as <ceme>/<came>, <credyll>/<cradel> 'cradle', and <teke>/<take> show that former *a* had changed to something closer to modern *e(j)* in these words. Moreover,

[7]It should be noted that alternations between <d> and <r> occurred also in dissimilatory processes, as shown by <medi> + <diēs> → <meridiēs>, 'noon'.

doublets such as <symed>/<semed> 'seemed' and <stypylle>/<stepel> 'steeple', reflect the transition from *eː* to *iː* of the Great Vowel Shift (Campbell 2013).

Loanwords and transcriptions to other languages are also valuable, since the graphic system of the second language could be explicit about phonetic features unwritten in the original one. And indeed, the transcriptions of Hebrew proper names in the Septuagint (the earliest Greek translation of the Hebrew Bible, dating from 250 BCE ca.) were used to demonstrate that the Hebrew letters ע and ח still had a double pronunciation in the last centuries BCE. The letters were transcribed in two ways: they were either dropped in the Greek transcription, or were transcribed as γ for ע and as χ for ח (Knobloch 1995). This show that during the Septuagint times ע stood both for ʕ and for ɣ, while ח for ħ and *x*. Hence, the first letter of חֲנוֹךְ, transcribed to $E\nu\omega\chi$, was pronounced as ħ, while in חֶבְרוֹן, $X\epsilon\beta\rho\omega\nu$, as *x*; similarly, $A\mu\alpha\lambda\epsilon\kappa$ (representing עֲמָלֵק) started with ʕ while $\Gamma o\mu o\rho\rho\alpha$ (for עֲמֹרָה) started with ɣ (Edzard 2011).

The phonological behavior of the language itself, and its subsequent phonological developments, can be illuminating regarding the nature of the language's phonemes. Thanks to the behavior of the Latin lateral approximant, *l*, it was possible to pinpoint its allophonic alternation. Front vowels became back when occurring before pre-consonantal and final *l*, thus <velim>, 'I may want' remains unchanged, while original <veltis>, 'you want' becomes <voltis> (Allen 1989). This phonological change induced by the Latin *l* points towards a velarized realization of the phoneme, involving a raising of the back part of the tongue (similarly to the English "dark l"). Hence, in Latin, ɫ occurred as an allophone of *l* in coda position, which turned previous front vowels into back ones (Allen 1989).[8] This reconstruction is corroborated also by the changes occurred in Old French: Latin ɫ turned into Old French *w*, as in <talpa> → <taupe>, 'mole' (Alkire and Rosen 2010).[9] This change is found also in other unrelated languages, such as Polish and Cockney English (Sivertsen 1960; Rocławski 1986).

Sometimes, the interpretation of texts written in dead languages can be facilitated by the comparison with more well known, attested related languages (Campbell 2013). Returning to the case of Middle English <gh>, it is possible to reconstruct the original sound of this digraph comparing English to other Germanic

[8]Latin's grammarians were aware of this alternation, and distinguished between *exilis l* for *l* and *pinguis l* for ɫ. The term *pinguis* was used to refer to the acoustic quality of back vowels, as against *exilis* for front vowels.

[9]This development took place already in late Latin, as attested by the spelling of <Aubia> for <Albia>, 'the river Albia' (Allen 1989).

languages. Although <night> in Modern English stands for *naɪt*, the corresponding German and Dutch words contains the voiceless velar fricative *x* (German *naxt*, Dutch *naxt*). Therefore, it can be assumed that originally the English word too contained this sound, spelled out as <gh> (Lass 1992). The reconstruction of a dead language's sound can be carried out as well by finding systematic correspondences among its daughter languages' sounds. For example, let's consider the Romance words listed in the table below (taken from Millar and Trask 2015):

	Sardinian	Italian	Romansh	French	Spanish
'100'	*kɛntu*	*t͡ʃɛnto*	*t͡sjɛnt*	*sɑ̃*	*θjen*
'sky'	*kɛlu*	*t͡ʃɛlo*	*t͡sil*	*sjɛl*	*θjelo*
'stag'	*kɛrbu*	*t͡ʃɛrvo*	*t͡sɛrf*	*sɛʀ*	*θjɛɾbo*
'wax'	*kɛra*	*t͡ʃɛra*	*t͡saira*	*siʀ*	*θeɾa*

Table 2.3: Comparison among Romance languages

The data from table 2.3 reveal a rigid pattern that distinguishes among the languages: words starting with *k* in Sardinian start with *t͡ʃ* in Italian, with *t͡s* in Romansh, with *s* in French and with *θ* in (European) Spanish. Since all these languages are genetically related, being derived from Latin, their initial sounds are all reflexes from an ancestral Latin sound, written as <c>. This sound can be reconstructed by knowing the typological tendencies of sound changes – it is more likely that the original phoneme was *k* (preserved in Sardinian), which became either a fricative or an affricate in the other derived languages, a well-known phonological process called "spirantization" (Millar and Trask 2015).

Chapter 3

Phonological behavior

This chapter will deal with the phonological behavior of *resh*, Biblical Hebrew's rhotic. *Resh* shows a more complex phonological picture, that sets it apart from all the other consonants in Biblical Hebrew. There are three main phonological processes related to *resh*:

1. Unlike most consonants, *resh* cannot be geminated and triggers compensatory lengthening. This phenomenon, shared with a certain group of consonants (known as "gutturals"), is called "degemination" (Blau 2010);
2. *Resh* tends to lower the vowels found in its proximity, a process known as "vowel lowering" (Blau 2010);
3. Similarly to other Semitic languages, the distribution of *resh* in roots was restricted according to the natural class to which it belongs (Greenberg 1950).

Since the reconstruction of *resh* in my research is mostly based on its phonological properties, a thorough analysis of *resh*'s phonological behavior is of pivotal importance.

3.1 Degemination

Several Semitic languages (and many other languages around the world) exhibit a phonemic contrast between single consonants and doubled ones. The latter type consists of a sequence of two identical consonantal sounds, known as geminated consonants (Catford 1988). Such a contrast is found also in Biblical Hebrew, where

the gemination of a consonant may produce a change in meaning, as in גִּלָּה *gillɔ*, 'he made known' vs. גִּלָה *gilɔ*, 'rejoicing' (Yeivin 1985). Graphically, in Biblical Hebrew the gemination of a consonant is represented by the *dagesh* symbol, a dot marked within the letter: מּ. This symbol is also used to indicate the plosive realization of the consonants *b*, *g*, *d*, *k*, *p*, *t*. In order to distinguish the two uses of this graphic symbol, the former one, used for gemination, is usually called *dagesh forte*, while the second one *dagesh lene* (Khan 2020).

The main case of consonant gemination is a reflex of the morphological patterns of verbs and nouns. Hebrew verbs are conjugated according to some specific templates (called "*binyanim*"), typically consisting of three radical consonants, into which vowels and affixes can be slotted. Some of those patterns are characterised by the gemination of their second radical consonant, the main three ones being *qiṭṭel*, *quṭṭal* and *hitqaṭṭel* (The radical consonants are supplanted by *q*, *ṭ* and *l*). In a similar way, some of the nominal templates have a doubled second or third radical, as *qaṭṭɔl* – דַּיָּן *dajjɔn*, 'judge' (Blau 2010). Another kind of morphological gemination, inherent to some roots, arises when the second and the third radical are identical.[10] Since in Biblical Hebrew geminated consonants are not allowed word-finally, we see alternations such as עַמּוֹ *ʕammo*, 'his people' vs. עַם *ʕam*, 'people' (Khan 2020).

The gemination of a consonant may also originate from its assimilation to an adjacent one. This is quite common with the nasal *n*, both when it occurs in the root (יִפֹּל *jippol*, 'he falls' ← יִנְפֹּל *jinpol*[11]), and when it occurs in the template (יִכָּתְבוּ *jikkɔθevu*, 'they shall be written' ← יִנָּכְתְבוּ *jinkɔθevu*[12]). Assimilation processes are also triggered by the preposition *mi-* 'from', the complementizer *ʃɛ-* and the definite article *ha-*, which geminate the following consonant: מִשָּׁם *miʃʃɔm*, 'from there'; שֶׁנָּתַן *ʃɛnnɔθan*, 'who gave'; הַמָּיִם *hammɔjim*, 'the water'. Finally, the template *hitqaṭṭel* shows a special case of assimilation with the stop in its prefix: when the voiced alveolar stop *d* or the pharyngealized voiceless alveolar stop $t^ʕ$ follows it, the *t* undergoes voicing and pharyngeal assimilation respectively – מִדַּבֵּר *middabber*, 'speaking' ← מִתְדַּבֵּר *mitdabber*; הִטַּהֲרוּ *hit^{ʕ}t^{ʕ}ahăru*, 'they purified' ← הִתְטַהֲרוּ *hitt^{ʕ}ahăru* (Joüon and Muraoka 2006). In general, gemination can also arise from the contact of two identical contiguous morphemes, as with the person and number morphemes at the word ends: כָּרַתִּי *kɔratti*, 'I cut off' ← תִּי + כָּרַת *kɔrat* + *ti*.

[10] Another theoretical approach posits that these roots are bi-consonantal, with the spreading of the second consonant to an adjacent phonological slot. See: McCarthy (1981).

[11] Root *n-p-l*, template *qɔṭal*.

[12] Root *k-t-b*, template *niqṭal*.

Apart from distinguishing between singletons and geminated consonants, and between fricativized and non-fricativized stops, the *dagesh* is implemented graphically also in a construction called "*conjunctive dagesh*".[13] In this case, the *dagesh* appears in the first consonant of words with initial stress, when they are preceded by a word ending in unstressed ɔ or ɛ: מִי־אֵלֶּה לָךְ *mi ʔellɛ͡(l)lɔx* 'who are these for you?'.[14] In Babylonian vocalization the *dagesh* occurs between the words, while in the Palestinian vocalization it is found sometimes in the last letter of the first word (Blau 2010). Its phonetic value is not certain: Dotan (1965) and Blau (2010) argue that it does not indicate doubling, although Khan (2020) states that it involves the gemination of the word-initial consonant. Nonetheless, he too concedes that the *conjunctive dagesh* should be identified primarily as a marker of a boundary between two words that were closely connected prosodically.

Some consonants cannot be geminated in Biblical Hebrew, and when occurring in a phonological environment that requires doubling, they will go through a process of degemination. The first four of these consonants, *ʔ*, *h*, *ħ* and *ʕ*, are usually called "gutturals", and will be dealt in subsection 5.1.1. The last one, *resh*, will be the focus of this section. While avoiding the gemination, those consonants sometimes go through another phonological process, called "compensatory lengthening": in order to preserve the length unit (or *mora*) lost by the geminated consonant's elimination, the preceding vowel is lengthened. We should bear in mind that by the *Masoretes*' times Biblical Hebrew has lost the length contrast in its vowels, and therefore the so called compensatory lengthening process does not actually change the duration of the preceding vowel, but rather its quality – *u* exhibits a marked tendency to shift to *o*; to a lesser degree *a* changes to ɔ; and least often *i* shifts to *e* (Blau 2010).

In all the Biblical text, there are only 17 cases of a *resh* marked with a *dagesh*.[15] Of those, eight are cases of *conjunctive dagesh*.[16] Among the remaining nine, five are 'non-etymological' geminations: they are not motivated by some morphological reason.[17] Only four among those are truly 'etymological' geminations – in *Ezek. 16:4* we find the noun שָׁרֵךְ *ʃɔrrex*, 'your navel', from the root *ʃ-r-r*, which also appears in *Prov. 3:8*, לְשָׁרֶךָ *ləʃɔrrɛxɔ*, 'to your navel'.[18] Similarly, the noun מָרַת *mɔrraθ*,

[13]This phenomenon is traditionally referred as *deḥiq* or *ʔate meraḥiq* in Hebrew grammar.

[14]Irregular cases of *conjunctive dagesh* are not rare, such as אַחֲרֶיךָ נָרוּצָה *ʔaħărɛxɔ͡(n)nɔrusˁɔ*, 'let us run after you', where the second word is not stressed on its first syllable (Blau 2010).

[15]The full list is found in appendix C.

[16]In *Jer. 39:12*, *Hab. 3:13*, *Psa. 52:5*, *Prov. 11:21*, *Prov. 15:1*, *Job 39:9*, *Ezra 9:6* and *2Chr. 26:10*.

[17]In *1Sam. 1:6*, *1Sam. 10:24*, *1Sam. 17:25*, *2Sam. 6:32* and *Ezek. 16:4*.

[18]A third instance of this word is found in *Song 7:3* with a reduced vowel separating the consonants: שָׁרְרֵךְ *ʃɔrərex*.

'bitterness' in *Prov. 14:10* derives from the geminated root *m-r-r*. Finally, in *Song 5:2* a geminated *resh* is found in the word שֶׁרֹּאשִׁי *ʃɛrroʃi*, 'that my head', caused by the complementizer *ʃɛ-*.

In the vast majority of cases, *resh* loses its geminated status, and in the verbal system we find only one case of gemination (the one on *Ezek. 16:4*). In order to examine the phonological behavior of *resh* regarding compensatory lengthening, all the verbs having *resh* as the second radical in the templates *qiṭṭel*, *quṭṭal* and *hitqaṭṭel* were mapped, together with all the verbs having *resh* as their first radical in the template *niqṭal*. In total, there were 705 tokens comprised into 216 types, divided into 59 different roots. All the verbs in the *niqṭal* template (where *n* was assimilated to *resh*) showed compensatory lengthening of the *i*→*e* kind. In the geminated templates *qiṭṭel*, *quṭṭal* and *hitqaṭṭel* we find only six cases without compensatory lengthening, making them about 0,85% of the total forms. Among the lengthened forms, 425 display *a*→ɔ mutation, 212 the *i*→*e* one, and only 62 *u*→*o*. The percentages are summarized in table 3.1 below.

	Tokens	Types	Roots	Lowering pct.	Phonological change
qiṭṭel	507	125	28	99.6%	*a*→ɔ 76% *i*→*e* 23.6%
niqṭal	92	29	13	100%	*i*→*e*
quṭṭal	62	30	17	100%	*u*→*o*
hitqaṭṭel	44	32	12	90.9%	*a*→ɔ
Total	705	216	59	99.15%	

Table 3.1: Summary of the compensatory lengthening process

The six non-lengthened tokens are divided into two types: the verb תִּתְחַר *tiθħar* (instead of **tiθħɔr*), 'fret!' found four times[19] and תְּעַר *təʕar* (instead of **təʕɔr*), 'leave empty, defenseless!' found twice.[20] Both types derive from roots with a *j* as third radical (*ħ-r-j* and *ʕ-r-j* respectively), and share the same morphological form: five of the tokens are in the jussive mood, used for indicating the speaker's wish or will, and usually implemented for negating the imperative (Joüon and Muraoka 2006). The sixth token is in the *inverted future* (also known as *waw consecutive*), which is morphologically similar to the jussive (apart from the prefixed particle *wa-*). Verbs having a root ending in *j* show an apocopated *waw consecutive* form, losing their final vowel in the 3rd sg. masc. person (Joüon and Muraoka 2006). While the first type comprises all the appearances of the root *ħ-r-j* in the geminated templates, there are 9 other tokens from the root *ʕ-r-j* that take part in the lengthening

[19] In *Psa. 37:1*, *Psa. 37:7*, *Psa. 37:8* and *Prov. 24:19*.
[20] In *Gen. 24:20* and *Psa. 141:8*.

process. It is uncertain why those specific examples do not show signs of lengthening – it cannot be ascribed to the morphological form, since other apocopated verbs participate in the lengthening process, as תִּתְנַּר *tiθgɔr*, 'provoke!' from *Deut. 2:9* and *Deut. 2:19*. Nor can it be ascribed to some peculiarity of those roots, since even verb from the root ʕ-*r*-*j* show compensatory lengthening. Nonetheless, those are the only cases where an apocopated verb end with a guttural-vowel-*resh* sequence, which could explain why those forms are unique.

We can therefore conclude that *resh* avoids gemination, and almost always displays a compensatory lengthening process.

3.2 Vowel lowering

Generally speaking, vowel quality can be affected by the adjacent segments. These segments may, among other things, lower the height of the vowel – turning high vowels into mid or low vowels, or mid vowels into low. These changes are typical when vowels occur before uvular and pharyngeal consonants: the lowering influence of pharyngeals, attested in several unrelated language families such as Semitic (McCarthy 1994; Rose 1996), Cushitic (K. M. Hayward and R. J. Hayward 1989), Chadic (Odden 1987) and Athabaskan (Prunet 1990), seems to derive from the fact that low vowels involve some pharyngeal constriction, with associated acoustic similarities between them and the vowel *a*, such as a high F1 formant (McCarthy 1994). Lower vowels might also influence other vowels in their proximity through processes of vowel harmony, such as in the historical development of the Dravidian languages (Campbell 2013), although vowel harmony tends to be more common with high vowels. Finally, and pertinent to the current discussion, lowering processes can be also induced by certain types of rhotics: the aerodynamic requirements of the rhotics *r* and *ɾ* necessitate the lowering and retraction of the tongue dorsum, which is antagonistic with the articulation of high and mid vowels (Bradley 2011).

In order to assess the influence of *resh* on the surrounding vowels, I compiled a list of all the verbal environments in which *resh* is adjacent to a non-low vowel. The list comprises 7489 verbal forms, from all the *binyanim* and tenses, including nominal forms such as participles and infinitives. After analysing the data, *resh* showed a weak tendency to lower adjacent non-low vowels: only between 62 and 122 forms displayed lowering, amounting to 0.8% $\sim$ 1.6% of all the data. While the lower percentage, 0.8%, consists of all the lowering cases unquestionably resulting from *resh*, the higher percentage, 1.6%, incorporates lowered verbal forms that might not

be lowered by *resh*.[21] Specifically, those are forms from the *binyanim qiṭṭel* and *hitqaṭṭel* with a lowering of *e*→*a* (*qiṭṭal*, *hitqaṭṭal*) that also appears with other consonants.[22] In both figures, lowering occurs by far more word-finally than in any other environment – between 72% and 86% of all cases. Regarding the phonological change triggered by the lowering, the vast majority of cases show lowering of a mid to a low vowel – *e*→*a* (between 86% and 93%). This seems to be correlated with the fact that *e* is pretty common in the word-final environment.[23] The lowering of a high vowel to a low one, *i*→*a*, is quite rare, occurring only four times (between 3% and 6%). The data are summarized in 3.2.[24].

	Higher %	Lower %
__*r*#	72%	86%
*r*__	23%	5%
other	5%	9%

(a) phonological environment

	Higher %	Lower %
e→*a*	93%	86%
i→*a*	3%	6%
other	4%	8%

(b) phonological change

Table 3.2: Cases of vowel lowering by phonological environment and change

All in all, it can be concluded that *resh*'s tendency to lower vowels is pretty low, and it tends to lower non-high vowels to low ones. Nonetheless, such lowering is virtually absent with other non-rhotic consonants. Another class of segments that lower adjacent vowels is that of the gutturals, discussed on subsection 5.1.1.

3.3 Restriction on roots

The tri-consonantal verb roots of Semitic languages show some interesting restrictions regarding the possible co-occurrence of consonants in them (Greenberg 1950; Koskinen 1964). In the first two positions, not only identical consonants, but even

[21]In both calculations, 20 lowered cases were omitted, since the lowering was triggered by a guttural consonant rather than *resh*. Moreover, in *Job 36:2* a lowered form seems to derive from Aramaic rather than Hebrew.

[22]In *qiṭṭel* the lowered alternant appears only in 3rd masc. sing. perf., while *hitqaṭṭel* shows lowered variants as well in all imperf. forms. In *qiṭṭel*, 44.4% of the verbal forms without *resh* show the lowered variant, vs. 53.6% of lowered forms with *resh*. Conversely, for *hitqaṭṭel* there are 19.7% of lowered forms without *resh*, while only 15.3% with *resh*.

[23]The vowel *e* occurs in this environment in most of the future paradigm of the *binyanim niqṭal*, *hitqaṭṭel* and *qiṭṭel*. *e* is also quite common in the jussive form of *hiqṭil*. Finally, this vowel appears as well in some forms of the imperative, participle and infinitive of all these *binyanim*.

[24]The column labelled "Lower %" includes only the lowering cases that are unequivocally caused by *resh*; "Higher %" includes lowering cases that could be caused by other factors.

homorganic ones (consonants sharing articulatory traits) are almost always excluded. For example, no Semitic language has tri-consonantal verb roots in which C_1 and C_2 (where C_n stands for the n-consonant in the root) are *b-m* or *g-k* respectively, since in the first case C_1 and C_2 would involve two labials, while in the second case they would involve two velars. Likewise, homorganic consonants are excluded in positions C_2 and C_3 (though not as rigorously as in the first two positions). Finally, in C_1 and C_3 there is a marked, but less rigorous, exclusion of homorganic (and identical) consonants than in other combinations of positions. An important exception to this rule is that identical consonants in C_2 and C_3 are not precluded, thus allowing "geminated type" verbal roots.

These restrictions are usually attributed to similarity effects, which would reduce the likeliness of the co-occurrence of two homorganic consonants as a function of their similarity (McCarthy 1981; Frisch, Pierrehumbert, and Broe 2004). The phenomenon is accounted by the *Obligatory Contour Principle* (*OCP* henceforth) which restricts the occurrence of adjacent identical elements. According to McCarthy (1986), root consonants and vocalic patterns are independent morphological units, located on different tiers. Since stem consonants are adjacent on their tier, the *OCP* rules out roots containing adjacent identical elements. Geminated roots are explained as bi-consonantal roots whose second consonant fills two consonantal slots, and therefore not violating the *OCP* (McCarthy 1981).

Greenberg (1950) thoroughly analyzed the patterning of the root consonants in Classical Arabic, going through 3775 roots, and arrived at the conclusion that it is possible to divide Arabic consonants into different categories, which he called "sections". Consonants within any of those sections cannot (or at least, do not tend to) co-occur with another consonant of the same section in a verbal root, but can co-occur freely with those of any other section. Those sections, further elaborated by Rose (1996), are (the rhotic in Classical Arabic is an alveolar trill):

1. Labials – *f*, *b*, *m*;
2. Coronal sonorants – *l*, *r*, *n*;
3. Coronal stops – *t*, *d*, d^{ς}, t^{ς};
4. Coronal fricatives – $\int$, *s*, *z*, s^{ς}, θ, $\eth$, θ^{ς};
5. Velars – *k*, *g*, *q*;
6. Gutturals – ʔ, *h*, $\hbar$, ʕ, χ, ɣ.

Similar restrictions exist also for Biblical Hebrew, as shown by Koskinen (1964), whose research analysed 1099 Biblical Hebrew roots, excluding "weak radicals" (i.e., roots that contain a consonant that is like to disappear or trigger a phonological change in the verb). I have replicated his findings by performing the Chi-Square Test of Independence on a corpus containing all 1351 roots found in the Biblical text.[25] The test was meant to find whether *resh* displayed a tendency to occur, or not to occur, next to specific segment classes in the tri-consonantal roots. I used the same classes found by Greenberg (1950) and Rose (1996), and checked the various position in the tri-consonantal roots, namely position C_1-C_2, C_2-C_3 and C_1-C_3 (without including geminated roots). In all positions *resh* displayed a tendency not to occur next to other coronal sonorants, i.e. *l* and *n*: the p-value in all of these cases was smaller than 0.05. The specific values are presented in table 3.3.

Table 3.3: Results of the χ^2 test

Root	p-value	χ^2-value
resh-cs-C_3	< 0.001	22.9
cs-resh-C_3	< 0.001	29.88
C_1*-resh-cs*	< 0.001	38.6
C_1*-cs-resh*	< 0.001	45.1
resh-C_2*-cs*	< 0.001	14
cs-C_2*-resh*	0.021	5.28

[1] Degrees of freedom = 1.

[2] *cs* stands for *coronal sonorant*.

Most of the other classes did not display any statistically significant trend, apart from some groups that tended to occur more frequently with *resh* – those were velars in C_1, C_2 and C_3 positions, labials in C_1 position, coronal fricatives in C_2 and C_3 positions, coronal stops in C_2 position and gutturals in C_3 position. Moreover, labials tended to appear more in C_3 position when *resh* was in position C_1. It can be assumed then that the main restrictions on *resh* were similar to those found in Classical Arabic: *resh* did not occur next to other coronal sonorants in the tri-consonantal roots. These findings are similar to those of Koskinen (1964) – the slight differences in figures may originate from the different list of roots.

[25] I thank Dr. Ruvik Rosenthal for kindly letting me use this corpus.

Chapter 4

Previous research

In the following chapter, I cover the research done on the reconstruction of *resh*. This chapter is divided into two parts – 4.1 covers the description of *resh* made during the *Masoretes* times (6^{th}–10^{th} centuries), while 4.2 part focuses on the modern research (from the 19^{th} century onward) as to how different scholars reconstructed the pronunciation of *resh*.

4.1 Early descriptions of Resh

4.1.1 Sources

Several sources, written throughout the early middle ages, describe the pronunciation of *resh*, maintaining that this segment had a twofold realization.[26] In general, these sources fall into two main groups (Revell 1981):

- Manuscripts with Babylonian pointing and *Sefer Yeṣira*, in which *resh* follows the same phonological pattern of the plosives *b*, *g*, *d*, *k*, *p*, *t*.
- Sources describing the pronunciation of *resh* in the Tiberian reading tradition, in which the determining factor for the allophony is the presence of the consonants *d*, *t*, $t^{\text{ʕ}}$, *s*, $s^{\text{ʕ}}$, *z*, *l*, *n* as neighboring *resh*.

The earliest of these sources is *Sefer Yeṣira* (Hebrew: סֵפֶר יְצִירָה), the most ancient book on Jewish mysticism which also deals with linguistic theory (Kaplan

[26] A complete bibliography of the sources can be found in Allony (1970) and Dotan (2017). The following discussion will be concerned only with the main ones.

1997). The dating of this source is somewhat disputed, varying between the *Mishnaic* period around the 2nd-3rd centuries CE (Hayman 1987; Benton 2004), the 3rd-6th centuries CE (Scholem 1972), the 6th-7th centuries CE (Weiss 2011), or even later (Allony 1982). *Sefer Yeṣira* mentions two important points regarding the nature of *resh*: first, it maintains that the segment had two different types of pronunciation, similarly to the phonemes *b*, *g*, *d*, *k*, *p*, *t*, which have fricative allophones in post-vocalic environments (see 2.1.2) – "There are seven double letters, *bgd kprt* [...] these are pronounced in two ways, which are two opposites – soft and hard, a strong structure as opposed to a weak one". Second, it classifies *resh* among the consonants pronounced at the front of the mouth, "between the teeth and with the tongue",[27] suggesting that during the time of *Sefer Yeṣira*, *resh* was either alveolar or dental. Several researchers (Morag 1960; Revell 1981; Khan 1995, among others) noted that the inclusion of *resh* among *b*, *g*, *d*, *k*, *p*, *t* is typical of the Babylonian vocalization tradition, in which *resh* is marked with a *dagesh lene* (see 3.1) in the same environments as of these plosives (Yeivin 1985).[28]

Apart from *Sefer Yeṣira*, all the other grammatical sources state that *resh*'s pronunciation is affected by the alveolar segments *d*, *t*, t^{ς}, *s*, s^{ς}, *z*, *l*, *n*, although the exact phonological environments vary according to the specific sources. Dotan (2017) analyzed seven different sources,[29] arriving at the conclusion that the variety of phonological environments should be ascribed to scribal errors and contrasting conflated traditions. In his opinion, the original source (from which the different accounts stemmed) mentioned only two environments – *resh*'s realization is affected when the segment is preceded by *d*, *t*, t^{ς}, *s*, s^{ς}, *z* or followed by *l*, *n*:

1. *d*, *t*, t^{ς}, *s*, s^{ς}, *z* + *resh*.
2. *resh* + *l*, *n*.

Nonetheless, albeit providing crucial information about the allophones' phonological environment, none of these sources deal with the actual realization of *resh*. An anonymous source from the *Cairo Geniza*, dated to the 10th century, states that "[*resh*'s allophone] is pronounced with a turning of the tongue", which would suggest a retroflex place of articulation (Allony 1969; Khan 2013b). This interpretation

[27] Both translations are from Khan (1995).

[28] There are a few anomalous cases in which *resh* is not marked exactly as *b*, *g*, *d*, *k*, *p*, *t*. These cases are satisfactorily explained by Morag (1960).

[29] *Leningrad Codex*, Egypt, 1008 CE; *Cairo Codex*, Egypt, 1028 CE; *'Adat Devorim*, Constantinople, 1060; *Michlol*, France, 12th century; *Machberet ha-Tijan*, Yemen, 13th century; *Qafiḥ Manuscript*, Yemen, 13th/14th century; *British Library Manuscript*, Yemen, 1586.

is contested by Eldar (1984) and Dotan (2017), maintaining that the Arabic term (*taqallub*) is better translated to "change" – therefore, the *Geniza*'s fragment only affirms that the allophone is realized with some "change of the tongue", without giving precise information about it.

A more substantial source regarding the phonetic value of *resh* is Saadya Gaon's commentary on *Sefer Yeṣira*, written in 931 CE. There, Saadya records that "As for the double nature of the resh, the Tiberians have it in their reading of the Bible, whereas the Iraqis have it in their speech but not in their reading of the Bible. They call one type *resh makruːx* and the other *ɣajr makruːx* ("not *makruːx*"). As for the customs of the Iraqis in this matter, we have examined them but have found no principle uniting them".[30] He then continues to explain the phonological environment conditioning the two allophones, which is similar to the one already described, although not identical: Revell (1981) ascribes the difference to Saadya's misinterpretation of the *Geniza*'s fragment, while Dotan (2017) attributes it to the fact that Saadya did not distinguish between *shewa naḥ* (designating a zero-vowel) and *shewa naʕ* (designating the reduced vowel ə), which were marked with the same diacritical mark (therefore, Dotan (2017) is of the opinion that Saadya treated *resh*'s allophony as a textual phenomenon, not necessarily reflected in speech). The importance of this comment of Saadya lies in the introduction of the terms *makruːx* and *ɣajr makruːx* (whose interpretation is contested and further discussed below), which should illustrate the nature of the two allophones.

Finally, the last major source dealing with the pronunciation of *resh* is *Hidāyat al-Qāri'* ("Guide to the reader"), written in the first half of the 11$^{\text{th}}$ century by the Karaite grammarian 'Abū al-Faraj Hārūn (Eldar 1984; Khan 2020). This source is very detailed, and states clearly the place of articulation of *resh*: "g, j, k, r, q are articulated at the middle of the tongue with the breadth of it".[31] *Resh* is grouped together with other velar/uvular consonants, and is described as being articulated with "the breadth" of the "middle of the tongue", clearly identifying it as a back consonant. Moreover, *Hidāyat al-Qāri'* elaborates that one of *resh*'s variants is articulated as "a stage between two stages", which would make it longer than a singleton, but not as long as a geminated consonant (Khan 1995). Regarding the phonological environments affecting *resh*, this text expands them greatly, assuming that *resh* is affected by alveolar consonants even if there is an intruding vowel between the segments, and that the consonants *l*, *n* influence *resh*'s pronunciation either when they precede or follow it:

[30] Translation from Khan (1995).

[31] Translation of Revell (1981). Khan (2013b) translates "the middle third of the tongue".

1. *d*, *t*, *tˤ*, *s*, *sˤ*, *z*, *l*, *n* + (V) + *resh*.

2. *resh* + (V) + *l*, *n*.

In this case too, Dotan (2017) argues convincingly that the extended environments are later additions, not anchored in a real speech tradition but rather a rationalization of the text's author. The *Hidāyat al-Qāri'* does not use the term *makruːx* in relation to *resh*, but it mentions a special type of realization of the phoneme *z*, called *zay makruːx*, although he admits that "I do not understand their intention in calling it [= the *zay*] *makruːx*", and does not give further explanations (Eldar 1984). This uncertain variant of *z* is also recorded by *Machberet ha-Tijan* from the 13$^{\text{th}}$ century (Eldar 1984; Dotan 2017).

4.1.2 Reconstructions

There are several reconstructions of the sound of *resh* based on the sources cited above. Gumpertz (1953) argues that the original realization of *resh* was uvular (although he does not specify the manner of articulation). His analysis is based on the similar phonological behavior of *resh* and the gutturals, especially in regard to vowel lowering. According to Gumpertz (1953), this lowering is also reflected in the Septuagint's transcriptions: words containing the sequence *jir-* are usually transcribed as <ιερ> (<ier>), with the high vowel lowered. For example, the name יִרְמְיָהוּ *jirməjɔhu*, 'Jeremiah', is transcribed to <ιερεμιας> (<ieremias>). This ancient pronounciation went through diachronical changes, and developed the allophonic alternation described by the medieval sources. Gumpertz (1953) interprets the term *makruːx* as derived from the Arabic *kaːrxa*, which was used to designate the throat by some medieval Arabic grammarians. Therefore, in his opinion *resh* was *makruːx*, i.e., pronounced by the throat (uvular) in unmarked environments, and became alveolar in the presence of *d*, *t*, *tˤ*, *s*, *sˤ*, *z*, *l*, *n* (through an assimilatory process).

In contrast to Gumpertz (1953), which posits different places of articulation for the two allophones, Morag (1960) thinks that the opposition is one of manner of articulation. In his opinion, *resh* is always an alveolar segment: its unmarked realization is a trill *r*, which becomes a tap *ɾ* in the proximity of *d*, *t*, *tˤ*, *s*, *sˤ*, *z*, *l*, *n* (that would be, in his words, a "dissimilatory process" from the alveolar consonants). Morag (1960) bases his analysis on the fact that, apart from the Jewish communities of France and Germany (and later Eastern-Europe), all the Jewish communities realized *resh* as an alveolar segment, which would reflect the original

segment. The terms *makruːx* and *ɣajr makruːx*, he argues, should be understood in relation to the speech of the Iraqis Jews (either Arabic or Aramaic), and not to the reading tradition of the Tiberians. Indeed, the Arabic dialect spoken by Iraqis Jews contains two *phonemic* rhotics, *r* and ɣ, which would also explain Saadya statement that "no principle uniting them" could be found (Mansour 1956). Furthermore, Morag (1960) explains that the rise of an *r*∼ɾ allophony would explain the fact the *resh* cannot geminate: since both the allophonic and gemination contrasts are based on the number of trills, the geminated *resh* would have been absorbed into the "trilled" allophone, undermining the phonemic contrast between geminated and singleton *resh*.[32]

Liebes (1992), criticizes the analysis of Morag (1960), arguing that the double pronunciation of *resh* should be analogous to that of stops *b*, *g*, *d*, *k*, *p*, *t*, since *resh* is cited among them in *Sefer Yeṣira*. Liebes (1992) maintains that the phonological analysis found in *Sefer Yeṣira* was influenced by the Greek grammatical tradition, and therefore the double pronunciation of *resh* should be analyzed through it. The Ancient/Koine Greek rhotic had two allophones, a plain alveolar trill *r* and an aspirated one r^h,[33] which should be, according to Liebes (1992), the same ones for *resh*. This pronunciation would have allegedly disappeared by the time of the newer sources, and therefore it is not mentioned in them.

Another reconstruction is given by Allony (1969) and Allony (1970), basing his analysis on the *Geniza* fragment, which he attributes to Eli ben Yehudah ha-Nazir, a Hebrew grammarian from the 10th century, cited by David Qimḥi in the *Michlol*.[34] As said, Allony (1969) interprets this source as saying that *resh* is pronounced "with a turning of the tongue", meaning that one of the allophones was retroflex, either ɽ or ɻ. In order to substantiate his claim, he turns to Saadya's term *makruːx*: he derives the term from the Hebrew word *kɔrux*, meaning "covered up, wrapped up, twisted", conveying the idea of retroflection. In a similar way, he claims that *zay makruːx* should be identified with the retroflex fricative ʐ.

Other scholars prefer to base their reconstruction on the *Hidāyat al-Qāri'* account: Revell (1981) reconstructs a "palatal" rhotic (without specifying the manner of articulation), on the grouping of *resh* among *g*, *j*, *k*, *q*, with an alveolar allophone in proximity of *d*, *t*, $t^ˤ$, *s*, $s^ˤ$, *z*, *l*, *n*. The reconstruction of Eldar (1984) in more

[32]It should be pointed out that a threefold contrast between *rr*∼*r*∼ɾ does exist in some languages, such as Italian (Ladefoged and Maddieson 1996).

[33]This sound is usually reconstructed as a voiceless alveolar trill r̥, rather than an aspirated rhotic (Allen 1987; Joseph 2009).

[34]Both Eldar (1984) and Dotan (2017) are of the opinion that this claim cannot be supported by the argumentation given by Allony (1969).

detailed: he posits that *resh*'s main realization was that of the uvular trill ʀ, since the uvular fricative ʁ was already an allophone of *g*.[35] Since the allophonic variant is described by *Hidāyat al-Qāri'* as being of intermediate length between a singleton and a geminated consonant, Eldar (1984) holds that the contrast between the two variants is one of length: generally *resh* is realized as a single ʀ, but in proximity of alveolar consonants it became longer, by his notation ʀᴿ. The few instances of *resh* with a *dagesh forte* should be interpreted as a fully geminated uvular trill ʀʀ. Moreover, Eldar (1984) argues that the classification of *resh* among alveolars, found in *Sefer Yeṣira*, should refer only to the Babylonian reading tradition and not to the Tiberian one. Finally, Eldar (1984) is of the opinion that the term *makruːx* was originally confined to the phoneme *z*, and Saadya erroneously uses it in regard to *resh*.

A synthesis between Revell (1981) and Eldar (1984) is the reconstruction of Khan (1995), further elaborated in Khan (2013b) and Khan (2020). Similarly to Revell (1981), he posits a contrast between a back and a front rhotic, one being an "advanced" uvular, while the other an alveolar. Khan (2020) also agrees with Eldar (1984) that the alveolar allophone should be of intermediate length, and that the geminated version of *resh* is the uvular one. Regarding the manner of articulation, he hypothesizes for the uvular variant either a trilled ʀ͡ʀ or a "frictionless continuant" ʁ̞ realization. Khan (2020), unlike Eldar (1984), thinks that the term *makruːx* is relevant to the realization of *resh*, and interprets it as a calque of the Arabic phonetic term *muṭbaq*, "closed, covered", used to refer to pharyngealized consonants. Accordingly, the alveolar allophone is reconstructed as being a pharyngealized trill $r^{\text{ˤ}}$. This would also explain the term *taqallub*, "turning", used in the *Geniza* segment, since retroflection is often associated with pharyngealized alveolar rhotics in modern spoken Semitic languages (Khan 2008a; Khan 2008b). In a similar way, Khan (1995) argues that *zay makruːx* should be identified with $z^{\text{ˤ}}$.

Finally, Dotan (2017) holds the opinion that the contrast between the two allophones is one of place of articulation: a uvular/velar rhotic vs. an alveolar one.[36] This conjecture is strengthened by the fact that the Arabic grammarian Sībawayhi used the terms "hard" (*shadīd*) and "soft" (*rixwah*) in order to contrast between *r* and ɣ, and those exact terms are also used in the Jewish sources to contrast the two allophones of *resh*. Dotan (2017) thinks that the term *makruːx* should be interpreted as "closed", meaning a consonant without a vowel after it (i.e., with a *shewa*

[35] Although usually *g*'s allophone is usually reconstructed as ɣ.

[36] Dotan (2017) uses the IPA symbols *r* and ɣ, but it is not clear whether he thinks that there is also a contrast in the manner of articulation.

naḥ).[37] Therefore, *resh makruːx* would be a *resh* not followed by a vowel, while *ɣajr makruːx* designates a *resh* followed by a vowel. Unlike other reconstructions, Dotan (2017) thinks that the process occurring in the presence of *d*, *t*, *tˤ*, *s*, *sˤ*, *z*, *l*, *n* is dissimilation: the basic pronunciation of *resh* is alveolar, and adjacent to other alveolars it becomes a back rhotic.

Overall, the different reconstructions assume that the two allophones are differentiated by either place of articulation, manner of articulation, secondary articulation or length. Gumpertz (1953), Revell (1981), Dotan (2017) and Khan (2020) posit a different place of articulation, while Morag (1960) posits a different manner of articulation. Allony (1969) seems to posit both a difference in place and manner (since he contrasts an alveolar rhotic to a retroflex one), which is possibly also the position expressed by Dotan (2017), although it is not stated clearly. Liebes (1992) thinks that the allophones are differentiated by secondary articulation, *aspiration*, a factor that is also found in the reconstruction of Khan (2020), *pharyngealization*. Finally, Eldar (1984) argues that the difference is one of length, not too differently from Morag (1960). Table 4.1 summarizes the reconstructions given above.

Author	Elsewhere	Alveolars proximity
Gumpertz (1953)	"uvular"	"alveolar"
Morag (1960)	*r*	*ɾ*
Allony (1969, 1970)	*r*	*ɽ*/*ɻ*
Revell (1981)	"palatal"	"alveolar"
Eldar (1984)	*ʀ*	*ʀˤ*
Liebes (1992)	*r*	*rʰ*
Khan (1995, 2013, 2020)	*ʀ̟*/*ʁ̠*	*rˤ*
Dotan (2017)	*r*	*ɣ*

Table 4.1: *Resh*'s reconstructions based on early descriptions

4.2 Modern research

Among the modern grammar books, written from the 19th century until nowadays, there are two main ways of classifying *resh* – either as some sort of guttural back segment, which should be interpreted as a velar or uvular sound; or as a lingual/dental sound, that is, a coronal segment.

[37] This is the original use of this term in *Diqduqe haṭṭēʿāmim* of Aaron ben Asher, from the 10th century.

Gesenius and Kautzsch (1910), first published in 1842, hold that the prevailing pronunciation of *resh* was as a "palatal", which they further explains that was articulated "with a vibrating uvula", thus classed in some respect with the gutturals. Therefore, it seems that according to Gesenius and Kautzsch (1910), *resh* was pronounced as ʁ. Nonetheless, Gesenius and Kautzsch (1910) also express the opinion that *resh* had a second pronunciation, articulated in the front of the mouth, which they call "lingual". This second instantiation of *resh* should, according to them, be classified as a sonorant, among *m*, *n*, *l*, *j* and *w*. Hence, it seems that Gesenius and Kautzsch (1910) thought that *resh* was either pronounced as a uvular trill ʀ or an alveolar trill *r*. Nonetheless, the status of these pronunciations is not clear: Gesenius and Kautzsch (1910) do not specify whether these are allophonic variants or phonemes, or whether we are dealing with different diachronic stages or dialects.

The notion of a double pronunciation was shared also by Stade (1879), who further hypothesizes that the original "lingual" pronunciation of *resh* was gradually replaced by a uvular one. This idea about a phonological change that *resh* went through is shared by Lambert (1931), although he claims that the segment changed to a "guttural" segment under Aramaic influence. A more modern source that also posits a phonological change is Laufer (2008), who claims that the original pronunciation was "fronted" (that is, coronal), basing it on alternations between *resh* and *l*. It is likely that Luzzatto (1853) had a similar opinion regarding the twofold pronunciation of *resh*, although expressed in a more ambiguous way: in his opinion, *resh* should be classified as a dental, similarly to *s* and *z*, adding that "the similarity between *resh* and *lamed* [the dental lateral *l*] conveys to the latter [i.e., to *l*] some guttural properties". This account creates some confusion regarding the categorization of *resh* among dental segments, stating that it has "guttural" properties, and possibly alluding to a double pronunciation, or a secondary articulation, of the consonant.

In contrast to the former accounts, that acknowledge some allophonic variation (or at least some unspecified "guttural" property of the phoneme), other sources disregard its dual nature: Olshausen (1861) classifies *resh* as a *Vibrationslaut*, i.e., a segment produced through the repeated vibration of the tongue (that is, some sort of trill), and Bauer and Leander (1922) state that *resh* is produced with "the tip of the tongue [hitting] on the alveolar ridge". The writers acknowledge that *resh* shares certain traits with the guttural consonants, but in their opinion it does not justify the reconstruction of *resh* as a uvular segment. Similarly, Harper (1912) argues that *resh* is "[a] Rolled sound [...] in which the tongue rapidly taps the teeth or the ridge of the teeth" without taking into account the properties shared by resh and

the gutturals. Joüon and Muraoka (2006) stress that *resh* is a "lingual", similarly to *l*, consisting of "one or more vibrations of the tongue as in the Arabic *r* and the Italian and Spanish *r*". The last source goes as far as saying that "one must be very careful not to pronounce *resh* like the fricative guttural" and that "the fact that *resh* is to some extent treated like a guttural does not allow us to consider it to be guttural". Finally, Blau (2010) writes that resh should be reconstructed as a dental-alveolar voiced liquid, sharing some properties of the gutturals. It seems that only few Biblical Hebrew grammars are of the opinion that *resh* is unambiguously identified with a guttural, as Van der Merwe and Naudé (2017).

The more modern accounts of Biblical Hebrew phonology seem to favor the notion that *resh* had some kind of allophonic variation between an alveolar trilled consonant, and some back uvular/velar segment, although they do not clarify the phonological environment of this alternation: Edzard (2011) reconstructs *resh* as an alveolar trill, while positing a uvular or pharyngealized realization in Tiberian times. Similarly, Hornkohl (2019) is of the opinion that the Tiberians realized *resh* "as the voiced uvular trill ʀ [...] but it underwent partial assimilation adjacent to an alveolar consonant, producing the pharyngealized apico-alveolar trill $r^{\text{ʕ}}$".

Table 4.2 summarizes the different opinions regarding the pronunciation of *resh*:

Author	Reconstruction
Gesenius (1842, 1910)	ʀ and *r*/ɾ
Luzzatto (1853)	"Dental with guttual properties"
Olhausen (1861)	*Vibrationslaut*, maybe *r*
Stade (1879)	Originally "lingual", changed to uvular
Harper (1912)	*r*
Bauer (1922)	*r*/ɾ
Joüon and Muraoka (1923, 2006)	*r*/ɾ
Lambert (1931)	Originally "fronted", became "guttural"
Van der Merwe (1977, 2017)	"Guttural"
Laufer (2008)	*r*
Blau (2010)	*r* with "guttural" properties
Edzard (2011)	*r*, realized as ʀ or ʁ
Hornkohl (2019)	ʀ, $r^{\text{ʕ}}$ when assimilated

Table 4.2: *Resh* pronunciation according to grammars

At this point, it should be noted that the research conducted on Modern Hebrew's rhotic cannot shed light on the original pronunciation of *resh*. Hebrew stopped being a spoken language around the 3rd century CE (Sáenz-Badillos 2011), and was used only as a liturgical language, without being acquired naturally as a native language.

Therefore, once Modern Hebrew was revived during the 19$^{\text{th}}$ century, its phonology was influenced by the languages spoken by the first speakers, which contributed to the current pronunciation of the rhotic in Hebrew (Laufer 2008). Modern Hebrew's rhotic displays an important allophonic variation, affected by prosodic position. Although the most common instantiation of the segment is as a dorsal approximant, approximant ɻ̟̞, it can also be pronounced as a fricative, trill/tap or even a plosive in certain phonological environments (Cohen, Laks, and Savu 2019).

Chapter 5

Reconstruction of resh

This chapter will deal with the reconstruction of the pronunciation of the Biblical Hebrew rhotic, *resh*. As seen in chapter 4, several attempts were made to reconstruct *resh*'s phonetic realization, but none sought to explain the phonological behavior of *resh* attested in the Biblical text. The reconstruction presented here will use *resh*'s phonology in order to reconstruct its phonetic value, thus anchoring *resh*'s behavior to its reconstructed phonetic realization (which in turn will explain the phonological behaviour of the segment). Phonemes are usually grouped into natural classes, sharing common phonological behavior patterns; therefore, the behaviour of a sound could be used to determine its class affiliation. The following discussion aims to place *resh* within a known natural class of phonemes by analyzing the phenomena described in chapter 3. Two sets of consonants are considered: the "gutturals" and the coronal sonorants. These classes of consonants display some interesting similarities with *resh*, and therefore could shed light on its original value. The reconstruction will be based solely on the phonology of *resh*, and will be dealt with from a synchronic point of view. Considerations regarding early descriptions of *resh* or its diachronical changes will be the topics of chapter 6.

5.1 Resh as a back rhotic

A group of consonants that seemingly shows phonological phenomena similar to *resh*'s is the gutturals. This term refers to four pharyngeal and glottal consonants characterized by the same, or almost the same, phonological behavior (For the double pronunciation of ח and ע see subsection 2.1.2). Similarly to *resh*, the gutturals cannot geminate (see 3.1), tend to lower adjacent vowels (see 3.2) and show co-

occurrence restrictions within roots (see 3.3); unlike *resh*, these consonants trigger the insertion of a low vowel (called *furtive patah*) in certain phonological environments, tend to change the reduced vowel ə to a *ḥaṭef*, have restrictions on occurring in coda position and cause a process called "transguttural vowel harmony". The gutturals are presented in table 5.1.

Name	Grapheme	Phonetic value
Aleph	א	ʔ, glottal stop
He	ה	*h*, glottal fricative
Ḥeth	ח	ħ, voiceless pharyngeal fricative
ʿAyin	ע	ʕ, voiced pharyngeal fricative

Table 5.1: Biblical Hebrew guttural consonants

These segments are all articulated in the the region that encompasses the larynx through the oropharynx, and are acoustically correlated with a relatively high F1 (McCarthy 1994). Pharyngeals are produced by the root of the tongue approaching the pharynx, while glottals are produced in the larynx area, either by pressing the vocal folds together, and obstructing airflow in the glottis, or by opening the vocal folds, and letting the airflow through the glottis (Catford 1988; Ladefoged and Maddieson 1996). No segment produced in this area has "rhotic" properties, therefore the closest segments to the gutturals that can be claimed to be rhotics are either uvulars, such has ʀ and ʁ, or velars, such as ɣ. These segments will be referred to as "back rhotics", and grouping *resh* among the gutturals would require its reconstruction as one of them. Indeed, several researchers claimed this was the original pronunciation of *resh* (either during Tiberian times or before), such as Gumpertz (1953), Eldar (1984), Edzard (2011), Van der Merwe and Naudé (2017), Hornkohl (2019) and Khan (2020). Others, like Luzzatto (1853) and Blau (2010) suggest that *resh* at least had guttural "properties", even if it was not properly part of this natural class of consonants. Examples of such segments are pharyngealized rhotics, as $r^{\text{ʕ}}$ or $\text{ʀ}^{\text{ʕ}}$.

Modern acoustic and articulatory research has indeed found some similarities between back rhotics and pharyngeal sounds – Delattre (1971) discovered that the production of French ʁ and German ʀ was characterized by retraction of the tongue root toward the point of maximum constriction, which created a measurable pharyngeal constriction. Furthermore, Howson and Kochetov (2020) found that the uvular rhotic ʀ in Upper Sorbian is characterized by the retraction of the tongue root, which causes F2 lowering and an F1 increase. These mutations of the formants could affect the neighbouring vowels, since a lowered F2 is characteristic of back vowels, and an increase in F1 is typical of low vowels (Johnson 2012). As summarized by McCarthy

(1994), F1 is at the theoretical maximum in the case of the laryngeals, close to the maximum for the pharyngeals, and higher than any orally articulated consonants in the case of uvulars.

5.1.1 The phonological behavior of the gutturals

As stated before, the gutturals show a wide range of phonological phenomena, which the following subsection reviews. The first three, shared by *resh*, are discussed separately, while those distinctive to the gutturals alone are treated together.

Degemination

The guttural consonants, similarly to *resh*, cannot geminate, and will undergo degemination when occurring in phonological environments that require gemination (Blau 2010). These consonants sometimes go through the compensatory lengthening process, although less consistently than *resh*. On the other hand, there are much fewer cases of gutturals marked with a *dagesh*: as opposed to the 17 cases of *resh* (nine of which are indeed indicative of doubling), only four are found for the gutturals, all with the phoneme *ʔ*.[38] In all of these cases the *dagesh* should not be treated as a *dagesh forte*, denoting doubling, but as a *mappiq*, marking the need of carefully pronouncing the consonant:[39] *ʔ*, in these four cases, is found between two vowels, an environment were it is usually dropped (Khan 2013a).[40]

Unlike their similarity regarding degemination, the gutturals show diverse behavior with respect to compensatory lengthening. In the template *niqṭal*, where the doubling is triggered by the assimilation of *n*, compensatory lengthening always occurs with all gutturals, showing the typical mutation of *i*→*e*. In the templates *qiṭṭel*, *quṭṭal* and *hitqaṭṭel* the situation is different for each consonant. *ʔ* shows lengthening in 82% of the cases, ʕ lengthens the preceding vowel in only 31.25% of the cases, while *h* and *ħ* almost never trigger the process, with just 3.5% and 2.3% of lengthened vowels respectively.[41] This suggests that lengthening is less common with fricative sounds (*h* and *ħ*) than with non-fricative ones.[42] The data are presented

[38] In *Gen. 43:26*, *Lev. 23:17*, *Job 33:21* and *Ezr. 8:18*.

[39] The *mappiq* is usually implemented with the consonant *h* for the same purpose.

[40] Moreover, in all four cases, apart from *Job 33:21*, there is no etymological reason for the gemination.

[41] Two cases of lengthening caused by *ħ* show an anomalous *i*→*ɛ* rather than the expected *i*→*e*.

[42] The consonant ʕ, although usually described as a fricative, actually has an approximant manner of articulation (Laufer 1996).

in table 5.2.

	Tokens	Types	Roots	Percentage	Phonological change
ʔ	116	60	14	82%	*a*→ɔ 64.3% *u*→*o* 6.3% *i*→*e* 29.4%
ʕ	96	58	18	31.25%	*a*→ɔ 73.3% *u*→*o* 20% *i*→*e* 6.7%
h	228	79	14	3.5%	*a*→ɔ 12.5% *u*→*o* 37.5% *i*→*e* 50%
ħ	263	125	26	2.3%	*a*→ɔ 33.3% *u*→*o* 16.7% *i*→*e* 50%

Table 5.2: Compensatory lengthening among gutturals

No specific phonological condition seems to enable or prevent the lengthening: exactly the same verb could display a lengthened and a non-lengthened form in two different places in the Biblical text. An example of that is the verb 'destroy' – in *Neh. 10:35* it appears as לְבַעֵר *ləvaʕer*, without lengthening, while in *2Chr. 13:11* the lengthening takes place, לְבָעֵר *ləvɔʕer*. Nonetheless, it seems that verbs in the templates *quṭṭal* and *hitqaṭṭel* tend to undergo lengthening, while *qiṭṭel* verbs are less prone to it.[43] The percentage of compensatory lengthening also varies among the different vowels – *u* is lengthened more often than *a* and *i*.[44] Tables 5.3a and 5.3b show the percentages of lengthening per gutturals depending on the template and on the original vowel.

	ʔ	*h*	*ħ*	*ʕ*
qiṭṭel	77.9%	2%	1.8%	20%
hitqaṭṭel	100%	4.2%	2.6%	80%
quṭṭal	100%	100%	9%	100%

(a) Lengthening pct. per template

	ʔ	*h*	*ħ*	*ʕ*
a	89.7%	0.5%	1%	41.5%
i	68.3%	8.8%	4.8%	5.4%
u	100%	100%	8.3%	100%

(b) Lengthening pct. per vowel

Table 5.3: Lengthening percentages depending on template and vowel change

[43]The vast majority of the verbs are in the *qiṭṭel* template, while *quṭṭal* and *hitqaṭṭel* are much rarer.

[44]Although verbs with *u* before the degeminated consonant are very rare.

The impossibility of guttural gemination is not confined only to Biblical Hebrew, and is also found in other languages, such as Gəʕəz (Mittwoch 1926) and Tigre (Leslau 1945; Raz 1983). This phonological constraint is a result of the gutturals' articulation – a long constriction of the pharynx is almost impossible, leading to the degemination of these consonants. Moreover, since the pharyngeal consonants are marked (Major 1987) they are less likely to be geminated: geminates are more marked than singletons, and therefore the gemination of a marked singleton would result in a cumulative complexity. Finally, Biblical Hebrew shows a tendency to avoid gutturals in coda position, a constraint known as the *Coda Condition* (McCarthy 1994). This restriction could further explain the gutturals' degemination process – since gemination obligatorily creates a consonant in coda position, and gutturals are not permitted in that position, gutturals cannot geminate (Zawaydeh 1999).

Vowel lowering

Vowel lowering is a phenomenon typical of the guttural consonants, attested in several unrelated languages around the world (see 3.2). The low articulation of the gutturals tends both to lower and retract the adjacent consonants, meaning that their F1 tends to be higher and F2 lower than in other phonological environments (Flanagan 1955). The gutturals may affect either preceding or following vowels, as was found by Alsager (2020) in Saudi Arabic: the consonants *ħ*, *h* and *χ* tended to increase the F1 formant more significantly when occurring before the vowels, although a higher F1 was also detected for vowels followed by gutturals. The same phenomenon is also found in other Arabic dialects, such as Bedouin Arabic (Johnstone 1967).

As with compensatory lengthening, the percentage of vowel lowering varies among the gutturals in Biblical Hebrew: the consonant *h* displays only 8% cases of lowering, *ʔ* lowers in 25% of the cases, *ħ* in 30% and *ʕ* in 38%. Nonetheless, the lowering is more systematic than in *resh*, and it is possible to find some phonological environments where lowering always (or almost always) occurs. All gutturals, when occurring as first radical, lower the prefix's vowel; as second radical in the imperative of the template *qɔṭal* (also known as *qal*), they lower the preceding vowel. The gutturals *ħ* and *ʕ* also cause lowering of the preceding vowel when they occur in word final position. *ʔ* and *h* do not cause vowel lowering in this environment because of unrelated phonological processes: *ʔ* is considered as the "weakest" consonant among the gutturals (Yuditsky 2010), and is not pronounced in coda position (Joüon and

Muraoka 2006); verbs spelled with a final ה (the letter representing the phoneme *h*) in fact have *j* as the third radical, and therefore do not show any guttural properties (Joüon and Muraoka 2006).[45] The percentage distribution of the different lowering environments is shown in tables 5.4.

h	Percentage
After prefix	95%
Second radical *qal*	5%
Word final	–
Other	–

(a) Lowering environments *h*

ʔ	Percentage
After prefix	95%
Second radical *qal*	5%
Word final	–
Other	–

(b) Lowering environments *ʔ*

ħ	Percentage
After prefix	76%
Word final	20%
Second radical *qal*	2%
Other	2%

(c) Lowering environments *ħ*

ʕ	Percentage
After prefix	86%
Word final	12%
Second radical *qal*	0.8%
Other	1.2%

(d) Lowering environments *ʕ*

Table 5.4: Percentage distribution of the gutturals' lowering environments

In general, the gutturals conditioned the lowering of adjacent vowels that are historically short (Khan 2013a).[46] Both templatic and person prefixes showed lowering when preceding a guttural, with the exception of the first person singular prefix, *ʔɛ-*, which usually retains its original vowel (in a few cases the vowel is lowered to *a*). In many cases, verbs derived from "weak radicals" do not show lowering, or exhibit it even when the vowel is not followed by a guttural.[47]

The imperative form of *qal* in the feminine singular and masculine plural has two consecutive syllables with ə, *CəCə*, which are usually reduced to *i* (with the elimination of the second ə): *CəCə*→*CiC*. This vowel surfaces as *a* when the second consonant is a guttural (while the second ə becomes a *ḥaṭef*): *CəGə*→*CaGV̆*. This phonological change could be addressed either as the lowering of the epenthetic *i* to *a*, or simply by affirming that *a* is the epenthetic vowel licensed by the gutturals. In either case it shows the affinity of this consonant class to low vowels.

[45]There are only a few cases of verbs ending with *h*, which do show the expected lowering: וַתְּלַהּ *wattelah*, 'wasted away'.

[46]The only uncertain case of lowering after a guttural is found in *Psa. 69:24*.

[47]In weak radicals, one (or more) of the consonants display irregular conjugation patterns.

Lowering of vowels in word final position is quite consistent, but not absolute – the lowering process alternates with the insertion of the epenthetic *furtive patah* (see 5.1.1 below) before the non-low vowel. Moreover, the lowering does not occur stem-finally, which causes alternations between low and non-low vowels, such as יְגַלַּח *jəɣallaħ*, 'he will shave' vs. יְגַלְּחוּ *jəɣalleħu* 'they will shave'. A related, but somewhat different, lowering phenomenon occurs when a guttural is the third radical in a participle: in this case, the normal feminine pattern of *CɛCɛθ* becomes *CaGaθ* (מְסֻגֶּרֶת *məsuggɛrɛθ*, 'barred' vs. מְיֻדַּעַת *məjuddaʕaθ*, 'known').

The vowels affected by lowering are always front ones, that is, *i*, *e* and *ɛ*, while front vowels are not affected. Tables 5.5 shows the different lowering patterns that are triggered by the gutturals.

h	Percentage
i→*ɛ*	70%
i→*a*	30%
e→*a*	–
ɛ→*a*	–

(a) Phonological changes *h*

ʔ	Percentage
i→*ɛ*	83%
i→*a*	17%
e→*a*	–
ɛ→*a*	–

(b) Phonological changes *ʔ*

ħ	Percentage
i→*ɛ*	49%
i→*a*	30%
e→*a*	19%
ɛ→*a*	2%

(c) Phonological changes *ħ*

ʕ	Percentage
i→*ɛ*	12%
i→*a*	75%
e→*a*	7%
ɛ→*a*	6%

(d) Phonological changes *ʕ*

Table 5.5: Percentage distribution of the gutturals' phonological changes

Overall, the different changes are dependent on the guttural locus: *i*→*ɛ* and *i*→*a* occur mostly when a guttural follows the prefix, *e*→*a* and *ɛ*→*a* are typical of word-final lowering, and *i*→*a* is predominant in *qal* imperative. It should be noted that cases of total lowering (from a high vowel to a low one) are quite common among the gutturals.

Restriction on roots

Gutturals show restrictions regarding their co-occurrence in Semitic roots, similarly with other classes of segments (McCarthy 1994). These restrictions are caused by similarity avoidance (*Obligatory Contour Principle*), which prohibits the co-

occurrence of two homorganic consonants (McCarthy 1981; Frisch, Pierrehumbert, and Broe 2004, see also 3.3). Greenberg (1950) found that the consonants ʔ, *h*, ħ, ʕ, χ, ɣ almost never appear adjacently to one another in Arabic roots, and Koskinen (1964) showed that the same applies to Biblical Hebrew (although Biblical Hebrew merged χ and ɣ with other guttural segments). The findings of Koskinen (1964) were replicated here, performing the Chi-Square Test of Independence on a corpus containing all 1351 Biblical Hebrew's roots. Each guttural segment was tested separately, and checked against the consonant classes found by Greenberg (1950). The positions checked were C_1-C_2, C_2-C_3 and C_1-C_3.

Each one of the guttural consonants displayed a tendency not to occur next to other guttural consonants. This tendency was not equal for all the gutturals: *h* scored the lowest values, showing the least avoidance of other gutturals' proximity, ʔ and ħ were intermediate, while ʕ almost never co-occurred with other gutturals. In general, gutturals' tendency to co-occur with one another could be summarized as follows (from most avoiding to least ones): *h*<ʔ<ħ<ʕ. The data are shown in tables 5.6 (degrees of freedom = 1 for all tables; *gt* is shorthand for "guttural").

Root	p-value	χ^2-value
h-gt-C_3	0.03	4.5
gt-h-C_3	0.006	7.4
C_1*-h-gt*	0.009	6.66
C_1*-gt-h*	0.02	5.23
h-C_2*-gt*	0.0016	9.95
gt-C_2*-h*	*NS*	*NS*

(a) χ^2 results of *h*

Root	p-value	χ^2-value
ʔ*-gt-*C_3	0.03	4.61
*gt-*ʔ*-*C_3	< 0.001	10.9
C_1*-*ʔ*-gt*	0.01	6.15
C_1*-gt-*ʔ	0.02	5.31
ʔ*-*C_2*-gt*	0.02	5.15
gt-C_2*-*ʔ	0.04	4.22

(b) χ^2 results of ʔ

Root	p-value	χ^2-value
ħ*-gt-*C_3	< 0.001	21.4
*gt-*ħ*-*C_3	< 0.001	11.72
C_1*-*ħ*gt*	0.005	7.7
C_1*-gt-*ħ	< 0.001	13.6
ħ*-*C_2*-gt*	0.002	9.26
gt-C_2*-*ħ	< 0.001	11.9

(c) χ^2 results of ħ

Root	p-value	χ^2-value
ʕ*-gt-*C_3	< 0.001	19
*gt-*ʕ*-*C_3	< 0.001	20.86
C_1*-*ʕ*-gt*	< 0.001	11.2
C_1*-gt-*ʕ	< 0.001	13
ʕ*-*C_2*-gt*	< 0.001	12.9
gt-C_2*-*ʕ	< 0.001	15.62

(d) χ^2 results of ʕ

Table 5.6: Gutturals' co-occurrence with each other in tri-consonantal roots

Aside from not occurring with other gutturals, a few more statistical trends were found. Some classes of consonants tended to occur more frequently with the gutturals in certain positions of the root. These more frequent patterns are summarized here below:

- *h – coronal sonorant-h-C_3*, *C_1-h-labial*, *C_1-h-coronal sonorant*, *C_1-h-coronal fricative*, *C_1-labial-h* and *h-C_2-glide*.
- *ʔ – coronal stop-ʔ-C_3* and *C_1-coronal sonorant-ʔ*.
- *ħ – ħ-coronal fricative-C_3*, *C_1-coronal sonorant-ħ* and *ħ-coronal fricative-C_3*.
- *ʕ – coronal fricative-ʕ-C_3* and *C_1-velar-ʕ*.

As said, similarity avoidance is the factor that blocks gutturals from co-occurring with other gutturals, and permits them to co-occur with dissimilar consonants. Consequently, the patterning of *resh* with other consonants could reveal which consonants *resh* is more similar to. The fact that *resh* not only seems to co-occur with gutturals, but in several cases its co-occurrence is more frequent with them, indicates that *resh* is not similar to the gutturals.

Other phenomena

Apart from the phonological phenomena described above, that are shared (at least partially) with *resh*, the gutturals display a few other phenomena that are specific to them.

First, when a non-low vowel precedes a guttural consonant in word final position, an epenthetic low vowel *a*, called *furtive pataḥ* is inserted between the two sounds, hence מָשׁוּחַ *mɔʃuħ*, 'anointed' becomes מָשׁוּחֲ *mɔʃuaħ* (Blau 2010). The guttural *ʔ* does not trigger the insertion of *furtive pataḥ*, since *ʔ* is deleted in word final position. This phonological process competes with vowel lowering when the preceding non-low vowel is fronted (back vowels are mostly unaffected by the gutturals). In general, there are more cases of *furtive pataḥ* than lowering (322 to 1049) which can be explained by the fact that both back vowels and historically long vowels are usually not lowered. Still, the distribution of the *furtive pataḥ* is not uniform among all the verbs – infinite forms (infinitive and participle) are much more prone to trigger the *furtive pataḥ*'s insertion than finite verbs (past, future and imperative), in which lowering and epenthesis are divided almost evenly. Moreover, *furtive pataḥ* is more

common in pausal forms, i.e. words that occur at the end of units of pronunciation and are usually marked with disjunctive accents (S. Fassberg 2013). Nonetheless, both processes stem from the same phonological constraint: a guttural cannot follow a non-low vowel word-finally, since the articulation of non-low vowels is antagonistic to the gutturals' articulation. This situation is solved either by changing the preceding vowel, or by separating it from the guttural via epenthesis.

Gutturals also display a general prohibition on occurring in coda position word-medially. Usually, when a guttural occurs syllable-finally, an epenthetic vowel (either a *ḥaṭef* or a "full vowel") is inserted after it, so that the guttural becomes the onset of a new syllable (McCarthy 1994), e.g., *jaʕmoð*→*jaʕămoð* יַעֲמֹד, 'he will stand'. This prohibition does not hold for the word- and stem-final positions, where no epenthesis after the guttural takes place. The phenomenon is not restricted to Biblical Hebrew, and we find the same prohibition in other languages, such as Bedouin Arabic (Johnstone 1967). Yet, in Biblical Hebrew the coda avoidance is not absolute: it is possible to find forms such as יַחְמֹד *jaħmoð*, 'he will covet', with a syllable final guttural. DeCaen (2003) suggests that the epenthesis is conditioned by the onset of the following syllable – generally, the more sonorous consonants (such as glides, liquids and nasals) force the insertion of an epenthetic vowel after the guttural, while less sonorous consonants do not (although, as it is possible to see from the previous example, this is not always the case). The reason for this insertion could be the need to enhance the gutturals' perceptibility: the coda position, and even more so when found in a consonant sequence, is considered a "weak" position (Ségéral and Scheer 2008) where consonants tend to disappear both synchronically and diachronically (Campbell 2013; Millar and Trask 2015). Therefore, since the gutturals are themselves "weak" consonants that tend to be deleted (Joüon and Muraoka 2006), the epenthetic vowel would help place them in a stronger position (i.e. an onset), thereby preserving them.

Another phenomenon related to the gutturals could be motivated by the same reason – gutturals that are onsets of syllables having ə as a nucleus tend to replace it with a *ḥaṭef*, for example מְלָכִים *məlɔxim*, 'kings' (with a ə) vs. אֲבָנִים *ʔăvɔnim*, 'stones' (with a *ḥaṭef*). Here too the change enhances the perceptibility of the guttural – ə is a weak vowel, and changing it would improve the overall perceptibility of the syllable, together with the guttural. The exact quality of the *ḥaṭef* that replaces the ə depends on different factors, such as the neighboring vowels and the nature of the original vowel replaced by the ə, but the *ḥaṭef* most often associated with the gutturals is *ă* (Yeivin 1980b).

Finally, the last phenomenon typical of the gutturals is "transguttural vowel harmony", which is a process whereby vowels are identical when flanking a guttural consonant, but not other consonants (McCarthy 1991; Rose 1996). This process is exemplified with the particles *lə-* 'to', *kə-* 'like', *bə-* 'in', and *wə-* 'and', which join the following word as prefixes. When these particles precede a word beginning with a guttural, the *ə* assimilates to the quality of the vowel through the intervening guttural: *bə-* + *ʔĕmɛθ*→*bɛʔĕmɛθ*, 'in truth'. As for other phenomena described earlier, transguttural harmony is found also in other languages, such as Jibbāli, a Modern South Arabian language (K. M. Hayward and R. J. Hayward 1989) and in Iraqw, a Cushitic language (Mous 1993). This assimilation is facilitated by the guttural articulation – since those consonants are articulated in the throat area, and do not involve movements of the tongue's upper surface, the tongue configuration assumes the position of the second vowel for both vowels.

5.1.2 Differences between the gutturals and Resh

After reviewing the gutturals' phonological properties, it is possible to compare them to *resh*'s. First, *resh* does not show any sign of *furtive patah*: unlike the gutturals, *resh* tolerates preceding non-low vowels in word final position, e.g. לִבְלֹעַ *livloaʕ*, 'to swallow' vs. לִזְכֹּר *lizkor*, 'to remember'. *Resh* may trigger the lowering of the previous vowel in this environment, but it never causes the insertion of a buffering low vowel. Moreover, *resh* does not participate in the "transguttural vowel harmony" process – when one of the particles *lə-*, *kə-*, *bə-*, and *wə-* attach to a word beginning with *resh*, they either retain their original vowel, לְרָחֵל *lərɔħel*, 'to Rachel', or go through the reduction *CəCə*→*CiC* already discussed in 5.1.1: לִרְאוֹת *lirʔoθ*←*lə* + *rəʔot*, 'to see'.

Similarly, *resh* occurs freely in coda position (נַעֲשָׂה *naʕăsɔ*, 'was done' vs. נִרְאָה *nirʔɔ*, 'appeared') or as the onset of a syllable with *ə* for nucleus (רָעֵב *rɔʕev*∼רְעֵבִים *rəʕevim*, 'hungry person, hungry people' vs. חֶדֶר *ħɛðɛr*∼חֲדָרִים *ħădɔrim*, 'room, rooms'). This difference between *resh* and the gutturals is illustrated by the Tiberian punctuation: since the *ḥaṭef*s replace *ə* in syllables with a guttural onset, and are inserted after gutturals in coda position, we expect them to be much more frequent with the gutturals than with any other consonant (including *resh*). And indeed, this prediction is borne out after analyzing the Biblical text, as shown by table 5.7.

Table 5.7: Distribution of *ḥaṭef*s among the consonants

Consonant	PMI	Consonant	PMI	Consonant	PMI
$\hbar$	6.11	l	0.074	b	0.026
$ʔ$	5.94	s	0.068	$ʃ$	0.22
$ʕ$	5.81	$s^ʕ$	0.06	n	0.02
h	1.1	m	0.05	t	0.011
q	0.4	$t^ʕ$	0.045	s	0.002
d	0.1	k	0.042	w	0.0006
r	0.1	g	0.036	j	0
z	0.08	p	0.027		

The first s represents ס while the second שׂ.

In this table, in order to show the strength of the co-occurrence of the *ḥaṭef*s and the different consonants, the PMI measure index is used. PMI (Point Mutual Information) is a measure of word association commonly used in natural language processing.[48]

Even the phenomena common both to *resh* and the gutturals actually emphasize the difference between them, after further scrutiny. Both the gutturals and *resh* display some restrictions about co-occurring with certain consonants in roots, but these restrictions are quite different: *resh* cannot co-occur with coronal sonorants, while the gutturals do not co-occur with each other (see 3.3 and 5.1.1). Actually, for several guttural consonants, there is an increased chance to occur next to *resh*. At first sight, it could be argued that *resh*, similarly to the gutturals, lowers non-low vowels in its proximity. Although it is true that there are some cases of lowering in proximity of *resh*, the percentages for *resh* and the gutturals show an important difference between them – *resh* lowers adjacent vowels only between 0.8% and 1.6% of the times, in contrast to the 8% to 38% of the gutturals (3.2 and 5.1.1). Furthermore, while *resh*'s lowering is sporadic, the guttural's is systematic, and tends to happen in specific phonological environments. In addition, the phonological changes that the lowered vowels go through are different between *resh* and the gutturals – a total

[48]Given two words (or phonemes etc.) w_1 and w_2, $PMI(w_1, w_2)$ quantifies to what extent w_1 tends to co-occur with w_2, relative to the null baseline where the occurrences of w_1 and w_2 are independent events. Concretely, it is defined as $PMI(w_1, w_2) = log\frac{P(w_1,w_2)}{P(w_1)P(w_2)}$, where $P(w_1)$ is the occurrence probability of w_1 in the text, w_2 is the occurrence probability of w_2 in the text, and $P(w_1, w_2)$ is the probability of w_1 and w_2 to co-occur in the text. Note that the denominator $P(w_1)P(w_2)$ is the probability of co-occurrence of w_1 and w_2 under the null hypothesis of independence. Thus, $PMI(w_1, w_2) = 0$ if, and only if, their occurrences are independent; positive values suggest some degree of dependence (Church and Hanks 1990).

lowering of *i*→*a* is common among the gutturals, spanning between 75% to 17% of all cases, whereas it is rare for *resh*, occurring only 3% of the times.

Finally, even the most conspicuous phenomenon shared by the gutturals and *resh*, degemination, differs in its details between them. To begin with, as already pointed out in 5.1.1, there are significantly more cases of geminated *resh* than gemination in any of the gutturals (and the few cases of *ʔ* with *dagesh* should not be considered as gemination). In addition, those consonants behave differently with regard to compensatory lengthening: while this process occurs virtually always with *resh* (99.15% of cases display lengthening), it is much more varied with the gutturals, ranging between 82% and 2.3%.

Phenomenon	Gutturals	*Resh*
Degemination	Absolute (no gemination cases)	Almost absolute (few gemination cases)
Compensatory Lengthening	Sometimes lengthen the previous vowel	Always lengthens the previous vowel
Vowel lowering	Common and systematic	Rare and unsystematic
Restriction on roots	Cannot co-occur with each other	Cannot co-occur with *l*, *n* (and can co-occur with gutturals)
Furtive patal̠	Trigger insertion	Does not trigger insertion
Prohibition on coda	Mostly cannot occur in word medial coda position	Can occur in word medial coda position
Ḥaṭef insertion	Trigger ḥaṭef insertion	Does not trigger ḥaṭef insertion
Transguttural harmony	Vowel harmony happens	Vowel harmony does not happen

Table 5.8: Differences between *resh* and the gutturals

As said, the sounds of a language are grouped together in different sets usually referred to as "natural classes". The sounds of such a class tend to pattern together in phonological processes, and can be characterized in terms of shared phonetic and articulatory properties (Flemming 2005). Formally, it can be said that sounds that appear together in phonological rules are grouped in the same class, while sounds that are rarely (or never) found together in the same rules are grouped in different classes (Kenstowicz and Kisseberth 1977). Since all the sounds of a specific natural class share the same articulatory or phonetic properties, they can be referred to as having the same feature specifications, such as [−continuant] for all the stops, or [+nasal] for all nasal segments.

With respect to the gutturals, it is easy to see that they indeed meet all the requirements for being classified as a natural class (McCarthy 1991; McCarthy 1994; Rose 1996): all the gutturals are articulated in a specific area (between the larynx through the oropharynx), share acoustic properties (they all show a relatively high F1) and take part in the same phonological processes (already described in 5.1.1), which can be accounted for by the articulatory and acoustic properties of these sounds. In contrast, there is a noticeable disparity in the behavior of the gutturals and the behavior of *resh* regarding plenty of phenomena, as just discussed. Therefore, there is no justification for including *resh* among the gutturals, and re-

constructing it as ɣ or as ʁ/ʙ.

By the same token, it cannot be argued from the evidence of natural classes that *resh* was a "partially guttural" consonant, i.e. a pharyngealized rhotic such as $r^{ʕ}$ or $ʁ^{ʕ}$. Biblical Hebrew has other pharyngealized consonants, $t^{ʕ}$ and $s^{ʕ}$, which are usually called "emphatic consonants".[49] These consonants do not show the same phonological behavior of *resh*: they do not share the same co-occurrence restrictions, they do not lower adjacent vowel and have no problem being geminated, e.g. רִצַּץ *ris*^{ʕ}*s*^{ʕ}*as*^{ʕ}, 'crushed'; קַטֶּר *qat*^{ʕ}*t*^{ʕ}*er* 'burning incense'.[50]

5.2 Resh as a front rhotic

After having entertained the possibility of reconstructing *resh* as a back rhotic, the notion of a "front" reconstruction of *resh*, either as *r* or ɾ should be contemplated. First, it must be noted that the other Biblical Hebrew coronal sonorants, *l* and *n*, do not show any specific phonological phenomena – unlike *resh*, they can geminate and do not lower adjacent vowels. Nevertheless, as shown in 3.3, *resh* does not co-occur with *l* and *n*, which would point to a similarity between these consonants. Still, although the lack of co-occurrence between the coronal sonorants and *resh* does strengthen the hypothesis of the coronal nature of *resh*, it could be an archaic trait retained from a former stage of the language – *resh* could have been a front rhotic in a putative proto-Hebrew, while having shifted to another kind of rhotic in Biblical Hebrew. Another indication of the affinity between the coronal sonorants and *resh* comes from the fact that there are several instances in the Biblical text where *resh* is swapped with *l*, as in *1Kings 2:8* נִמְרֶצֶת *nimrɛs*^{ʕ}*ɛθ* for נִמְלֶצֶת *nimlɛs*^{ʕ}*ɛθ*, and *Ezek. 19:7* אַלְמְנוֹתָיו *ʔalmənoθɔw* for אַרְמְנוֹתָיו *ʔarmənoθɔw* (Laufer 2008). As shown by various researches, more similar sounds tend to be confused more easily (Johnson 2012; Mielke 2012), and the confusion between *resh* and *l* points to an alveolar articulation of the former.

However, the two more salient properties of *resh*, vowel lowering and degemination, remain unexplained. Nonetheless, these two phenomena can be explained if *resh* is reconstructed as an alveolar tap – ɾ. Taps are characterized by being essentially momentary sounds, since they involve a brief and brisk contact between

[49] Those consonants were possibly ejectives, *s'* and *t'*, in earlier stages of the language.

[50] Pharyngealized rhotics are attested in different Semitic languages, such as modern Arabic dialects and North-Eastern Neo-Aramaic dialects (Mutzafi 2014). As such, it is possible that *resh* was pharyngealized, but this secondary articulation cannot be unequivocally reconstructed from *resh*'s phonological behavior.

the articulators (Catford 1988). The alveolar tap is produced with a single contraction of the muscles so that the tongue makes a very short contact with the alveolar ridge, described by Recasens and Espinosa (2007) as "a fast, ballistic tongue-tip raising movement and a single, short apico-alveolar contact". By their very nature, taps cannot geminate: the contact between the phonatory organs must be fugacious, since the sound is produced by knocking the alveolar ridge with the tip of the tongue. This articulatory modality is quite different from other segments, such as stops, which create their typical sounds by constricting the air flow in a more prolonged way, and hence can be geminated freely. By positing a tap manner for *resh* we can explain its impossibility to geminate.[51]

The reconstruction of *resh* as ɾ also helps explaining why this segment occasionally lowers adjacent vowels. Morrison (2004) proposes that the alveolar trill and alveolar tap may affect the neighboring vowels due to the configuration of the tongue during their articulation: the tip of the tongue is raised while the muscles' contraction lowers the body of the tongue (also called "*dorsum*"). The position of the tongue during the articulation of ɾ is presented in figure 5.1. The picture to the left shows the neutral position of the tongue, while the picture on the right shows the position during the production of ɾ. In the latter picture, the tongue *dorsum* is visibly lowered (the position is highlighted in red).

Figure 5.1: Tongue configuration during ɾ production

[51]The fact that a language has ɾ for rhotic does not preclude the possibility of having *r* as its geminated counterpart on a morpho-phonemic point of view (as is indeed the case with several Northeastern Neo-Aramaic dialects, see 6.2). Nonetheless, the fact that *resh* cannot geminate (apart for a few sporadic cases) is indeed suggestive of its tap realization. As discussed in chapter 6, the original rhotic segment of pre-Biblical Hebrew was *r*. In languages having *r* for rhotic, which also have gemination contrast, usually the geminated rhotic is *r* and the singleton is ɾ (Ladefoged and Maddieson 1996). In Biblical Hebrew, the non-geminated rhotic was generalized as the only rhotic, becoming ɾ. It seems that when languages with *r* lose the faculty to geminate consonants, two scenarios are possible – either the language retains the contrast between *r* and ɾ as two distinct phonemes, or ɾ becomes the only rhotic. The former scenario occurred in Spanish, which contrasts *r* and ɾ, while the latter scenario occurred in Romanian, which only has a phonemic ɾ (Chiţoran 2002; Savu 2012).

This configuration of the tongue, i.e. the lowering and retraction of *dorsum*, is antagonistic with the dorsal articulation of non-low vowels (Bradley 2011), and the conflicting articulatory requirements are responsible for the lowered vowels found adjacently to the segment. Bradley (2011) provides several examples from different Ibero-Romance languages for the lowering effects of *r* (and ɾ): *e* is found to have a lowered allophone, *ɛ* before pre-vocalic and after word-initial trills in Castilian Spanish; in Judeo-Spanish an epenthetic *a* is inserted before before word-initial trills (instead of the usual epenthetic *e* inserted elsewhere in this environment); *e* is lowered to *a* before pre-vocalic trills is Astur-Leonese. As mentioned, the *dorsum* activity is not confined to trills, but it is an articulatory property shared also by other coronal liquids, including ɾ (Proctor 2009). Accordingly, vowels also show lowering when occurring next to ɾ. Nevertheless, the modality (and strength) of lowering is not the same for the two rhotics: the tongue body constriction location is more posterior for the trill than for the tap, making *r* more antagonistic to non-low vowels than ɾ (Bradley 2011). Indeed, Recasens and Pallarès (1999) found that the formant F1 is significantly higher for the trill than for the tap, and that *r* exerted larger and longer effects on the adjacent vowels. Another difference between the two rhotics is the direction of co-articulation effects on the vowels – while the trill shows strong anticipatory effects, affecting mostly preceding vowels, the tap shows also carryover effects, which influence the following vowel (Recasens and Pallarès 1999; Recasens and Rodriguez 2017). All in all, the lowering modality of *resh* makes its reconstruction as ɾ more plausible: not only is the lowering in its proximity sporadic and rare (which is symptomatic to weak antagonistic effects against non-low vowels), *resh* also tends to lower vowels that follow it (between 23% and 5% of all cases, while carryover effects are virtually nil for other lowering consonants, as the gutturals).[52]

Reconstructing *resh* as the alveolar tap, ɾ, enables us to explain all the phonological phenomena related to it: it cannot geminate (because of its articulatory properties), it sporadically lowers adjacent vowels (being antagonistic to them), it cannot co-occur with other coronal sonorants in the Semitic root (being a coronal sonorant itself), and it gets swapped with *l* (due to the articulatory and acoustic similarity between these two segments). The most important facet of this explanation is that it accounts for all the phenomena related to *resh*, and for them only. By providing an explanation for the properties of *resh* independently from its supposed guttural aspect, the disparity of *resh*'s behavior and the behavior of the gutturals is no longer a mystery.

[52]Even after taking into account the uncertain cases of *e*→*a* lowering in *qiṭṭel* and *hitqaṭṭel* (see 3.2), post-guttural lowering is rare (about 1% of all lowering cases).

Chapter 6

Evolution of resh

In chapter 6 I argued that *resh* should be reconstructed as ɾ, based on its phonological behavior. As mentioned in section 4.1, the realization of *resh* was already described in early medieval sources, which points towards a different pronunciation – that of a back rhotic, either ʁ or ɣ. In this chapter, I address this discrepancy, arguing that *resh* went through a diachronic phonological change: while the Tiberian punctuation of Biblical text indicates an older stage of the language, when *resh* was pronounced as ɾ, by the time of the Tiberians, the segment changed into a back rhotic.

This chapter also covers the general diachrony of *resh*: section 6.1 discusses the typology of diachronic changes among the rhotics, in order to establish the likelihood of *resh*'s supposed change. Section 6.2 deals with the comparison of the rhotics among the different Semitic languages. By comparing the languages to each other, it is possible to reconstruct the identity of the original Proto-Semitic rhotic (or at least the rhotic segment that preceded Biblical Hebrew's rhotic). Finally, section 6.3 describes when the phonological evolution of *resh* took place.

6.1 Typological considerations

Rhotics, more so than other segments, are prone to free variation, even in languages that are usually described as having one specific variety of the segment. Lindau (1985) shares that in the languages used in her study, described as having an apical trill, only about half of the speakers produced trills, and not even for every token. Those speakers had taps and approximant allophones in addition to *r*. In a similar vein, Romano (2013) shows that Italian speakers display a surprising variation of

rhotics: although Italian is usually described as having *r* (with an allophonic ɾ in non-stressed syllables) and geminated *rr* (Canepari 1999), several back and non-trilled rhotics are uttered by native Italian speakers, such as ɣ, ʁ, ʁ̞ and even *x* or ɣ̞. These variants are found both regionally and in idioletcs. This variation is not limited to *r* but also occurs with other rhotics – the Romanian rhotic, described as ɾ (Chiţoran 2002), can be produced either as a fricative, approximant or even a trill (Radu 2016), and Modern Hebrew ɣ̞ can surface in some positions as a stop, a fricative, a tap or a trill (Cohen, Laks, and Savu 2019).

This abundance of variation is caused by the articulation of some rhotic segments, which tend to be specially challenging to produce. Specifically, the apical trill *r*, shows great variability in its actual realization (Widdison 1997). Since the seeds of sound change are sown by synchronic variation, it is not surprising that the various allophones of *r* gave rise to changes in the rhotic's identity in several languages, such as dialects of French, German, Danish, Italian, Spanish, Dutch, Norwegian, Portuguese, Swedish, and Provençal (Malmberg 1963).[53] Trills' production depends on several factors such as airflow, impedance, and appropriate apical control that are required to create the needed vibrations of the tongue (McGowan 1992). Apical trills' articulatory gestures are even more complicated, having narrower aerodynamic requirements than other sounds (Solé 1999). Trills are very sensitive to any variation in those conditions, and even small deviations could affect their felicitous production (Ladefoged and Maddieson 1996). Those factors may also affect the acquisition of these sounds by native speakers: Ladefoged and Johnson (1975) state that some people fail to make trills because their tongue blade is too stiff, and the production of a trill involves placing the tongue, very loosely, in exactly the right position so that it will be set in vibration by a current of air.

Apart from the fact that the difficult articulation of *r* creates free variation that pushes towards a diachronic change, the acoustic similarities between the different rhotics may also facilitate such a change (see section 2.2 for a discussion of family resemblance). *r* shares similar pulsing patterns with ʁ, which could explain the changes that occurred historically in French, German Southern Swedish and Danish (Ladefoged and Maddieson 1996)[54]. Acoustic similarity also exists between trills and taps. Although a tap cannot be seen synchronously as a reduced version of a trill (the reduction of the time available for the trill would not turn it into a ballistic tap), from a diachronic point of view there is no reason not to assume that ɾ is derived from *r* (Barry 1997). From a purely acoustic point of view, a trill is not unlike

[53] In those languages, the original front rhotic became a back one. Since those languages are all spoken in Europe, it is possible that this is also a regional trait.

[54] Southern Swedish's rhotic possibly developed under Danish influence

a series of taps, which could lead to an articulatory reinterpretation (Ladefoged and Maddieson 1996). Finally, alveolar trills also exhibit some alternations with fricatives and approximants: frication and trilling may co-occur, since with too little airflow a trill may degenerate into a fricative (Catford 2001). With a further decrease in airflow, the fricative may become an approximant – a change that would be facilitated by the fact that trills may be produced with one or more closures followed by an open phase that is prolonged into an approximant (Ladefoged and Maddieson 1996). Furthermore, other kind of rhotics tend to have some degree of variation, although none as much as *r*. Uvular rhotics often weaken and show free variation between uvular trills, fricatives and approximants (Ladefoged and Maddieson 1996), and in word-initial position, the Modern Hebrew rhotic is fortified because of the higher likelihood of target overshoot (Cohen, Laks, and Savu 2019).

These diachronic changes are not symmetrical: while the change of a front rhotic to a back one is quite common, the other way around is much rarer. Front rhotics can originate through processes of rhotacism – the conversion of a non-rhotic consonant to a rhotic. Several such processes are known throughout the world's languages. Among the Indo-European languages, the change of *s* to a rhotic is quite common, having occurred both in the Germanic and Italic branches (Catford 2001). Another case of rhotacism is the change of *n* to ɾ that occurred in Romanian and Albanian; in Scottish Gaelic, the cluster *knV* develops into *krṼ*. Plosives can also change into rhotics, chiefly ɾ, as shown by the pronunciation of intervocalic *t* and *d* in American English, a phenomenon called "flapping" (Catford 2001). Lastly, sociolinguistic factors may also drive the change of a rhotic segment to another one, like the spreading of ʁ in the Flanders region (Van de Velde, Tops, and Hut 2013).

6.2 Rhotics in Semitic languages

Few sources deal with the identity of the rhotic segment in Proto-Semitic. Those that do, argue for its "dental" nature, without substantiating it (see for example Bergsträsser 1983; Lipiński 2001; Bennett 2008). However, the comparative method lends itself better for exhaustive investigation of this matter (see 2.3). This methodology involves the comparison of corresponding sounds in related languages, leading to the discovery of systematic correspondences. Those, in turn, allow us to find out the identity of a certain segment in the ancestral proto-language (Millar and Trask 2015). Thus, the character of the Proto-Semitic rhotic could be determined by comparing the rhotics found in the different ancient and modern Semitic languages.

The main split among the Semitic languages is between West-Semitic languages and East-Semitic, the latter branch being completely extinct, and comprising Akkadian and Eblaite. The rhotic sounds of Akkadian is reconstructed by Huehnergard and Woods (2004) as ɣ or ʁ, due to the fact that they often patterned with *x*: *i* and *u* were lowered to *e* and *o* when they occurred before the rhotic or *x*. Nonetheless, as discussed in section 2.2 and 5.2, vowel lowering also takes place in the proximity of front rhotics such as *r* and ɾ, and therefore this segment cannot be unambiguously reconstructed as a back rhotic. For Eblaite, Catagnoti (2012) mentions that in several inscription the syllabogram for <r> was swapped with the syllabogram for <l>, pointing to a front realization of the rhotic. A few words recorded by Conti (1990) display a geminated rhotic, making *r* the most adequate reconstruction.

The West-Semitic branch is divided into several sub-branches: Ethio-Semitic languages, Modern South Arabian (*MSA* for short) and Central Semitic (Huehnergard and Pat-El 2019). The first recorded language among the Ethio-Semitic languages is Gəʕəz, the sacred language of the Ethiopian church (Butts 2019). Although this language is now extinct, its pronunciation is partially preserved by the recitation of the holy texts written in it, where the rhotic is pronounced as *r* (Mittwoch 1926). Similarly, Weninger (2010) also reconstructs the segment as the alveolar trill.[55] Other Ethio-Semitic languages, which are spoken nowadays, have front rhotics: Tigrinya's rhotic is *r* (Bulakh 2019), while Tigre and Amharic have ɾ as their rhotics (Leslau 2000; Elias 2019).[56] Similarly, Gumer and Muher (grouped into Gurage sub-branch) have alveolar trills for rhotics (Völlmin 2017; Meyer 2019).[57] Modern South Arabian languages, confined to the southernmost part of the Arabian peninsula, all have *r* as their rhotic segment (Stein 2011; Kogan and Bulakh 2019; A. D. Rubin 2019).[58]

The third branch of the Semitic languages, Central Semitic, contains the languages closest to Biblical Hebrew: Arabic, Aramaic and the Canaanite languages. Classical Arabic was spoken by the Arabic tribes throughout the Arabian Peninsula during the first millenium CE, and was recorded by the grammarian Sībawayh in his book *Al-Kitāb*. Sībawayh categorized the sounds of Classical Arabic by their place of articulation, placing the rhotic among the alveolar consonants (Carter 2004). Sībawayh also gives indications regarding the manner of articulation of the Classical Arabic's rhotic, describing it as *mukarrar*, 'repeated', i.e., trilled (Carter 2004). The same phoneme is found also in several Modern Arabic Dialects, such as Levan-

[55]The rhotic in Gəʕəz also behaves differently from the guttural consonants: while those cannot geminate, the rhotic does not show such a restriction.

[56]Other sources state the rhotic in Amharic is realized as *r* (Edzard 2019).

[57]In general, Gurage languages show an allophonic distribution between *n*, *l*, and *r* (Meyer 2011).

[58]In Mehri, the liquids *r* and *l* seem to diphthongize the following long vowels (A. Rubin 2010).

tine and Egyptian Arabic (Brustad and Zuniga 2019; Leddy-Cecere and Schroepfer 2019). Several dialects, including the Levantine and the Egyptian, have developed a phonemic pharyngealized rhotic, $r^{\text{ʕ}}$, alongside the plain r.

Aramaic comprises several different languages stretching over around 3000 years. Unfortunately, the earliest texts of Aramaic did not incorporate any graphical signs for vowels or reduplication, so the phonological behavior of their rhotic consonant remains obscure (Muraoka and Porten 2015). The first dialect written with graphical signs denoting vowels and doubling is the Biblical Aramaic (found in the books of Daniel and Ezra). This language exhibits several interesting phenomena related to its rhotic (Rosenthal 2006): similarly to Biblical Hebrew, it cannot geminate (a trait also shared by Biblical Aramaic's gutturals): *barrix*→*bɔrix* בָּרִךְ, 'he blessed'. Biblical Aramaic shows a strong tendency to vowel lowering next to the rhotic and the gutturals – in word final position, non-low vowels preceding these segments are consistently lowered to *a*, e.g. *ʔɔmer*→*ʔɔmar* אָמַר, 'saying'. Unlike Biblical Hebrew, the lowering is retained even when the rhotic and the gutturals are found in stem final position, rather than word-finally: *ʃabbeħu*→*ʃabbaħu* שַׁבַּחוּ, 'they praised'. A few other lowering phenomena are peculiar only to the gutturals, which tend to lower the imperfect prefixes' vowels to *a* or *ɛ*, and the infinitive prefix's vowel to *ɛ*: תַּעַבְדוּן *taʕavðun*, 'you (pl.) will do' vs. תִּרְשֻׁם *tirʃum*, 'you (sg.) will write'; מֶעְבַּד *mɛʕbað*, 'to do' vs. מִרְמֵא *mirme*, 'to throw'. Finally, gutturals may also change the *ə* of the template *qəṭal* to *a*, a change that does not take place with the rhotic: עַבְדֵת *ʕavðeθ*, 'I made' vs. רְשַׁם *rəʃam*, 'he wrote'.

The situation in Biblical Aramaic is somewhat complex – the complete lowering of vowels in word final position would be suggestive of the alveolar trill, while the fact that the segment resists gemination would point to an alveolar tap. The same features are also found in the language of the *Targum* Onqelos (the Jewish Aramaic translation of the Pentateuch, dating from the early 2nd century CE). That said, in the Onqelos translation degemination occurs only with the rhotic (with the typical lengthening of the previous vowel), while it is uncertain for the gutturals (Lambdin and Huehnergard 2001). Similarly, in Syriac the rhotic lowers non-low vowels in word final position, and goes through degemination in Eastern Syriac, which retained doubled consonants (Arayathinal 1957; Muraoka 2005). Unlike Biblical and *Targumic* Aramaic, Syriac developed a grammatical tradition, which classified the rhotic among the "lingual" consonants, i.e. *d*, *t*, $t^{\text{ʕ}}$ *l*, *n* (Arayathinal 1957). An analogous affinity to coronal sonorants is found also in Jewish Babylonian Aramaic, where the rhotic is substituted in several words with *l* or *n* (Bar-Asher Siegal 2013). Nonetheless, the Yemenite punctuation tradition of Jewish Babylonian Aramaic

shows several cases of the rhotic's gemination (Morag 1987), which suggests that this dialect had *r* as its rhotic segments.

Modern Aramaic dialects display a varied situation, with the development of different rhotic segments (although all the varieties include a dental rhotic). North-eastern Neo Aramaic dialects (also known as *NENA* dialects), spoken in Iraq and Turkey, all contain more than one rhotic segment. The christian Neo-Aramaic dialect of Diyana-Zariwaw has two rhotics, a plain ɾ, which surfaces as *r* when geminated, and a pharyngealized $r^{\text{ʕ}}$ (Napiorkowska 2015). The same rhotics (with the ɾ∼*r* alternation during gemination) are found in the Jewish Neo-Aramaic dialect of Betanure (Mutzafi 2008) and in the Neo-Aramaic dialect of the Christians of Urmi (Khan 2008a). The Jewish Neo-Aramaic dialect of Amədya also has two rhotic consonants, showing some degrees of allophony (Greenblatt 2011): the un-pharyngealized rhotic is usually realized as an alveolar tap ɾ, but word initially and when geminated, as an alveolar trill *r*; the pharyngealized rhotic is a retroflex approximant $ɻ^{\text{ʕ}}$, sometimes realized as a tap $ɾ^{\text{ʕ}}$. The geminated version of the pharyngealized rhotic is a trill $r^{\text{ʕ}}$. The most complex Neo-Aramaic dialect, having three phonemic rhotic segments, is the Neo-Aramaic dialect of Ṭyare (Mutzafi 2014). This dialect contrasts a retroflex rhotic, usually realized as an approximant ɻ or tap ɽ; an alveolar plain rhotic, normally realized as a tap ɾ, but trilled in word-initial position and when geminated; and an emphatic rhotic, realized as a pharyngealized trill $r^{\text{ʕ}}$ in word-initial position and when geminated, and as a pharyngealized flap $ɾ^{\text{ʕ}}$ elsewhere.

Dialects that are not part of the NENA group are more conservative regarding their rhotic segments. The Neo-Mandaic dialect of Khorramshahr has an alveolar trill, with an alveolar approximant ɹ as allophone in syllable final position (Häberl 2009); the dialect of Ṭuroyo-Mlaḥso and have an alveolar trill (Jastrow 1994), similarly to western Neo-Aramaic (*WNA*) dialects (Arnold 1990).

The data from the Neo-Aramaic dialects point toward an original dental rhotic, either *r* or ɾ, that in several dialects diversified into a retroflex or an approximant. The extinct Aramaic languages, such as Biblical and *Targumic* Aramaic, seem to have had ɾ as their rhotic, due to its impossibility to get geminated, although it retained some traits typical of trills (the total lowering of preceding vowels). This seems to be an areal feature that was also shared with Biblical Hebrew, although not with other Aramaic dialects (such as Jewish Babylonian Aramaic and the Neo-Aramaic dialects).

Finally, the languages closest to Biblical Hebrew are the Canaanite languages, comprising Ammonite, Edomite, Moabite and Phoenician. The Canaanite glosses from the Amarna letters attest to a geminated rhotic (Bergsträsser 1918), pointing to the fact that the ancestor of the Canaanite languages had *r*. Regarding the descendant languages, there is insufficient evidence for Ammonite, Edomite and Moabite, since they are recorded only in a few steles (Gzella 2011), but there is more evidence for Phoenician, due to its prominent role as a trade language in the Mediterranean area. The rhotic in Phoenician (and in its later stage Punic) is usually reconstructed as an alveolar trill *r*. The rhotic does not show any restrictions regarding gemination, as attested by the transcription of Phoenician words in Greek and Latin characters, such as *Μηρρη* and <Merre> for *meʔerreħ*, 'host' (Krahmalkov 2000). The rhotic degemination did not propagate to all Hebrew dialects – Samaritan Hebrew retained the possibility to geminate the rhotic, and even expanded it in several cases, such as *mirreːm* for *merɛħɛm* מֵרֶחֶם, 'from the womb' (Stadel 2017).

As showed, the vast majority of the Semitic languages have a dental segment as their rhotic. In several branches (such as Ethio-Semitic and Canaanite), the daughter languages' rhotic is either an alveolar trill or an alveolar tap. As we have seen in section 6.1, the usual diachronical trajectory is *r*→*ɾ*, while *ɾ*→*r* is much rarer. Therefore, it is safe to conclude that the alveolar trill was the original rhotic of Ethio-Semitic, MSA, and Canaanite. The retroflex segments found in some NENA dialects are unique to those languages, and should be treated as innovations. Similarly, phonemic pharyngealized rhotics are found uniquely in NENA and Modern Arabic dialects, and should not be reconstructed for their Proto-languages. Accordingly, an alveolar trill is posited for Arabic and Aramaic, and consequently for West-Semitic as a whole. The evidence for East-Semitic is less conclusive, but it can safely be said that at least for one of the two major branches of the Semitic languages, the original rhotic was the alveolar trill. The degemination of the rhotic, symptomatic to the *r*→*ɾ* transition, seems to be an areal phonetic innovation of some Canaanite languages (Biblical Hebrew) and Aramaic languages (Biblical Aramaic, *Targumic* Aramaic and Syriac), not traceable to a specific branch of the Semitic languages. Figure 6.1 shows the phylogenetic tree of the Central-Semitic languages (the closest languages to Biblical Hebrew), indicating the rhotic segments of the different languages.[59]

[59]For a phylogenetic tree that includes all the languages mentioned in this section, see appendix D.

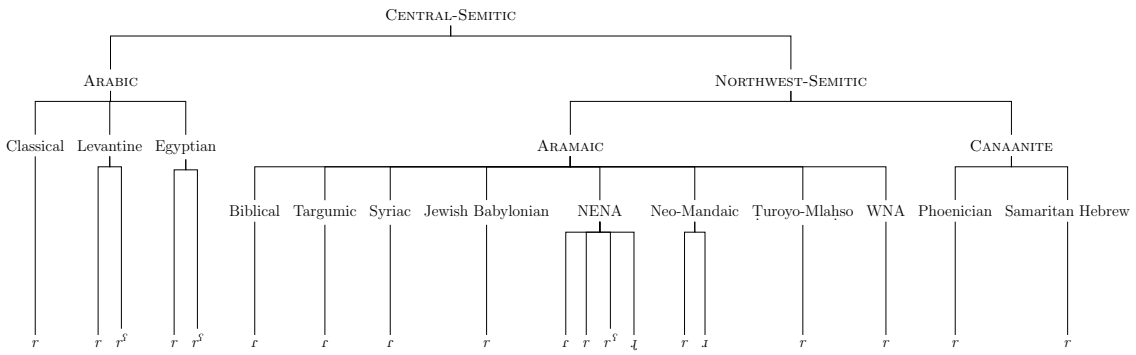

Figure 6.1: Central-Semitic phylogeny with rhotics

6.3 Timeline of change

As shown in section 4.1, by the time of the Masoretes *resh* was usually described as a back rhotic, while its pointing in the Tiberian tradition suggests *resh*'s identification with the alveolar tap. Moreover, in more ancient stages of the language the rhotic was seemingly *r*. It is possible to reconcile these different reconstructions by positing a diachronic change of the ancestral alveolar trill to a back rhotic, with an intermediate *ɾ*. In this section, I also show that it is possible to pinpoint the approximate period when these changes took place. As explained in 2.3, there are several ways to reconstruct the sounds of ancient languages – puns, spelling variants, transcriptions to other languages and the phonological behavior of the sounds themselves. All these methods are used here to trace the different stages of the diachronic trajectory of *resh*.

6.3.1 Pre-Masoretic times (up to 2nd century BCE)

As pointed in 6.2, the rhotic of the proto-Semitic language was probably **r*. The same phoneme can be reconstructed with more certainty for proto West- and Central-Semitic, due to the fact that almost all the languages show a dental trill or tap throughout their different historical stages (and the few non-dental rhotics can be explained as an innovation of some specific languages).

Regarding Northwest-Semitic, and the Canaanite languages specifically, there is also other supporting evidence apart from the recorded languages (such as the different Aramaic languages and the Greek transcriptions of Phoenician). Akkadian was the lingua franca of the Ancient Near East during the 2nd millenium BCE. Because of its central role in international communication, Akkadian was used also by non-native speakers, who tended to incorporate words from their native languages.

This is the situation reflected in the Amarna letters, written in Akkadian to the Egyptian pharaohs Amenophis III and Akhenaton during the 14th century BCE. Many of these letters were sent by rulers of Canaanite cities, and contain several Canaanite loanwords (Izre'el 2003). These words exhibit geminated rhotics, such as <ḫa-ar-ri>, 'mountain' (cf. BH הַר *har*, 'mountain') and <mu-ur-ra>, 'myrrh' (מוֹר *mor*, 'myrrh') (Bergsträsser 1918; Izre'el 1998). Although Akkadian in general, and Canaano-Akkadian in particular, do not use ample overt designation of consonantal doubling, when a VC_1 syllabic sign precedes a $C_1V(C)$ one, it must mean that C_1 is doubled. Therefore, in the 14th century BCE, the Canaanite dialects could still geminate the rhotic, suggesting a $*r$.

Several later cuneiform transcriptions of Hebrew names and toponyms indicate too the gemination of the rhotic. These transcriptions are both from Assyrian sources (*9th–7th* BCE), such as <am-qar-ru-na>, 'Eqron (location)' (עֶקְרוֹן *ʕɛqron*) and from Neo-Babylonian sources (*6th–4th* BCE), such as <za-kar-ri-ya-ma>, 'Zechariah (name)' (זְכַרְיָה *zəxarjɔ*) and <gir-re-e-ma>, 'Geryahu (name)' (גֵּרְיָהוּ *gerjɔhu*) (Millard 2013).

The next source that explicitly shows the gemination of the rhotic is the Septuagint. This translation, dating from the 3rd century BCE, contains several Hebrew names and toponyms transcribed into the Greek script. The Septuagint transcribes rhotics as geminates practically everywhere it could be expected (Murtonen 1988), including examples as Σαρρα *sarra*, 'Sarah (name)' (שָׂרָה *sɔrɔ*), Γομορρα *gomorra*, 'Gomorrah (place)' (עֲמֹרָה *ʕămorɔ*) and Χορρι *xorri*, 'Hori (name)' (חֹרִי *ħori*). This implies that the change or r to $ɾ$ should be dated later than the 3rd-2rd centuries BCE (Bauer and Leander 1922).

6.3.2 Transitional period (first centuries CE)

The transition from r to $ɾ$ is attested in several different sources, both among Greek and Latin transcriptions, and in internal Jewish sources. This period spans throughout the first centuries CE, a period when Hebrew was highly influenced by other languages, such as Aramaic and Greek. It is not sure when Hebrew stopped being a spoken language, but it is thought that in some Palestinian cities colloquial Hebrew was still employed until the end of the 2nd century CE (Sáenz-Badillos 2011). Nonetheless, many Hebrew documents were produced from the 3nd to the 10th century.

The earliest sources that show signs of the degemination of *resh* are found in the

works of Josephus from the 1st century CE. Josephus often shows a single *ρ* when *ρρ* is expected, although Murtonen (1988) suggests that this could be caused by the many revisions and copies that Josephus' works underwent. A safer ground is found in the *Hexapla* of the theologian and scholar Origen, from the first half of the 3rd century CE. This work is the first critical edition of the Hebrew Bible, containing six different versions of the text: the original Hebrew text, its transcription into Greek script, and four Greek translations (Brønno 1943; Yuditsky 2017). The transcriptions in the second column of the *Hexapla* clearly show that *resh* cannot geminate, such as in the words *ηρφου e:rfu*, 'they insulted' (חֵרְפוּ *ħerfu*), *ουβαρεχ u:barex*, 'and bless' (וּבָרֵךְ *uvɔrex*) and *αρισωνιμ ariso:nim*, 'the firsts' (הָרִאשֹׁנִים *hɔrifonim*). Moreover, four examples from the *Hexapla* display the lowering of *e* and *o* to *a* before *resh* (Yuditsky 2017).

Interestingly, Murtonen (1988) states two properties of the Greek transcriptions that strengthen the plausibility of a tap realization of *resh* during the first centuries CE. First, the Greek transcriptions interchange between *δ* (an alveolar stop) and *ρ* in a way "far too common to be attributed to scribal errors". This alternation is also attested in pre-Classical Latin (see 2.3), and is reminiscent of the "flapping" phenomenon in American English (see 6.1).[60] Since the alternation between stops and rhotics occurs with taps, the Greek transcriptions strongly suggest that *resh* was already a tap during these times. Secondly, Murtonen (1988) notes that word initial *ρ* is occasionally provided with a prothetic vowel, "but not in most cases". This could be related to another property of *ɾ*: this segment is uttered with a vocalic element in word-boundary positions, i.e., in word initial and word final position (Savu 2013). The fact that this vocalic element is only rarely transcribed is indicatory of its non-phonemic status.

Apart from the transcriptions into Greek, Latin transcriptions too showed that *resh* could not geminate anymore during that period. Jerome, who lived during the 4th century CE, transcribed several Hebrew words, which he heard from contemporary Jews (Yuditsky 2014). Although his Latin translation of the Bible, the Vulgate, does indicate cases of geminated *resh* (such as <Gomorra>, <Amorrei> and <Sarra>), the transcriptions found in his letters and comments do not show geminated forms (Yuditsky 2013). Seemingly, the Hebrew names found in the Vulgate are based on their equivalents from the Septuagint (that marked *resh* gemination), while the transcriptions that he heard from contemporary Jews reflect the true pronunciation of the rhotic at that time.[61]

[60] Although "flapping" is usually restricted to the spoken variety of English, it did influence the spelling of a few words, such as <porridge>, originally <pottage> (Catford 2001).

[61] Some examples of non-geminated transcriptions are <uaibarcheu> וַיְבָרְכֵהוּ, 'and he blessed

The pronunciation of *resh* as ɾ can also be supported by Jewish sources from the first centuries CE. Howard (2021) lists several sources in which the letter ד, *d* is equated to ר, *resh*: in the Talmudic tractate *Ta'anit* a pun is made between the word דומי, 'Dumi/Domi' and רומי, 'Romi (Rome)'. This story is attributed to R. Meir, who lived in Israel during the 2nd century CE. Another story, from the *Sanhedrin* tractate, attributed to Rebbi (2nd century CE) , seems to use the word דחץ (with a *d*) for רעץ (with *resh*). Naturally, in these cases there is always the possibility that the similar shapes of the letters ד and ר created the confusion between them, but at least some of these sources seem to relate to spoken traditions (Howard 2021). Finally, it is possible to show that *resh* during this period showed an affinity with other coronal sonorants, especially with *l*. Sharvit (2016) gives several examples of words with *resh*∼*l* interchange, both from Greek and Latin origin (such as מרקוליס *marqolis*, from Latin <Mercurius>, 'Mercury (god)') and in native Hebrew words (גלעין *galʕin* for גרעין *garʕin*, 'seed'). Other words show metathesis between *resh* and *l* (ריטלא *ritla* instead of ליטרא *litra*, from Greek $\lambda\iota\tau\rho\alpha$, 'measure of weight') or the dissimilation of a coronal sonorant to *resh* (ארנונא *arnona* for אנונא *annona*, from Latin <annōna>, 'yearly income').[62]

Some other interesting phonological processes seem to be connected to *resh* during this period – several words suggest that *resh* not only lowered vowels but also retracted them. Such words are found both in the Dead Sea Scrolls (3rd BCE to 1st CE), e.g. מוֹר *mor* for מַר *mar*, 'bitter', and in Rabbinical texts, e.g. קוֹרְדֹּם *qordom* for קַרְדֹּם *qardom*, 'hatchet' (Sharvit 2016). The process itself could also be older, since a few transcription is the Septuagint already shows signs of vowel retraction, as *Ιορδαν jordan* for יַרְדֵּן *jarden*, 'Jordan'. Vowel retraction could be influenced by different types of rhotics, since both front rhotics (Recasens and Pallarès 1999) and back rhotics (Howson and Kochetov 2020) can cause it. Therefore, it is difficult to attribute these changes to a specific type of rhotic, and various explanations could be raised.[63] These changes are also found in some Aramaic dialects spoken in the same area (for example, Christian Palestinian Aramaic רובא *robbɔ* for רַבא *rabbɔ*, 'big'), and thus could be accounted as Aramaisms. Another phenomenon typical of the Dead Sea Scroll is the omission of *resh* in writing, mostly in coda position, for example משע *miʃaʕa* for משער *miʃaʕar*, 'from the gate' (Qimron 2018). The deletion of a rhotic segment in coda position occurs mostly with approximant or fricative

him'; <ardidim> הָרְדִּידִים, 'the shawls'; <sarigim> שָׂרִיגִם, 'branches'; <arim> עָרִים, 'cities'. I thank Dr. Alexey Yuditsky for kindly providing the examples.

[62] Although rarely non-sonorants too may dissimilate to *resh*.

[63] Bilabials and *l*, too, can cause the retraction of adjacent vowels. While retractrion in *l* proximity could be explained by dorsum retraction (similarly to *resh*), it is possible that the bilabials labialized the vowels rather than truly retracting them.

rhotics (as is the case in several English and German dialects), which perhaps was the realization of the rhotic of the Dead Sea Scrolls' writers.

6.3.3 Masoretic times (8th-11th centuries ca.)

For the pronunciation of *resh* during the Masoretic times we have several sources, that were discussed in 4.1.1. Thanks to these, it is possible both to pinpoint the period of linguistic change and reconstruct the segment's realization.

The double pronunciation of *resh* described in the different early medieval accounts is certainly a late phenomenon, which is not typical of earlier stages of the Hebrew language. This is strongly suggested from the fact that, unlike for the plosives *b*, *g*, *d*, *k*, *p*, *t*, no Tiberian text marks different values for resh, and the statements on its twofold realization are not only insignificant in number compared to those on the plosives, but are also confused and contradictory: this situation would be quite improbable if *resh*'s realization really was characteristic of the tradition (Revell 1981). Hence, we must limit the double realization of *resh* only to the last centuries of the first millenium. According to Allony (1969), the grammarians describe the double pronunciation of *resh* as current phenomenon from the 9th to the 11th century CE, while later sources talk about it as a remote uncertain phenomenon, indicating that by then *resh* has lost its double realization. Dotan (2017) is of the opinion that the dates should be anticipated a bit – the twofold realization of *resh* was still common during the 8th century, while it had already disappeared during the beginning of the 10th century.

Regarding the actual phonetic values of the two allophones, we have already seen several reconstructions in section 4.1.2. There are only two sources that explicitly group *resh* together with other consonants, making it possible to identify its place of articulation: *Sefer Yeṣira* and *Hidāyat al-Qāri'*. These two sources are conflicting about *resh* classification – *Sefer Yeṣira* claims that *resh* is pronounced "between the teeth and with the tongue" (front rhotic), and *Hidāyat al-Qāri'* states that "g, j, k, r, q are articulated at the middle of the tongue with the breadth of it" (back rhotic). However, several scholars, such as Morag (1960), pointed to the fact that *Sefer Yeṣira* may refer to a different tradition, the Babylonian, rather than to the Tiberian one. Consequently, the apparent clash between these sources disappears, since they refer to two different reading traditions.

Still, the pronunciation of *resh* according to the *Hidāyat al-Qāri'*, "the middle of the tongue" spans through the palatal place of articulation to the uvular one. Fortunately, the same source describes the pronunciation of the fricative allophones of *k*, *g* as being produced "with the third of the tongue nearest the throat", which is suggestive to uvular segments, *χ*, *ʁ*. Therefore, contrasting the "middle of the tongue" to the "third of the tongue nearest the throat", *resh* should be a velar segment. Since velars cannot be trilled, the Masoretic *resh* should be reconstructed as *ɣ*.[64] This pronunciation can be understood as the *resh*'s main pronunciation, in the "elsewhere" environment, since *Hidāyat al-Qāri'* later mentions the fact that the consonants *d*, *t*, *tˤ*, *s*, *sˤ*, *z*, *l*, *n* influence its realization. Since all these consonants are alveolars, its easy to posit an assimilation process that would change *resh* into *r* or *ɾ*.[65] A last point would be the terms *makruːx* and *ɣajr makruːx*. Khan (1995) proposed that *resh makruːx* refers to a pharyngealized rhotic, *rˤ* (see 4.1.2). This could be the case, since such rhotics have arisen in other Semitic languages (such as Arabic and Aramaic): maybe the contiguity with *tˤ*, *sˤ* spread the pharyngealization to the alveolar allophone of *resh*, which then was generalized as a pharyngeal consonant. Nonetheless, Dotan (2017) interprets *makruːx* as meaning "closed by a *shewa naḥ*", i.e., the allophone is not followed by a vowel, it is contiguous to the other consonant.

Finally, Dotan (2017) is the most comprehensive philological analysis of the different sources, and his reconstruction of the phonological environments of the allophony is the most sound – while other reconstructions just take *Hidāyat al-Qāri'* description as the authoritative one, Dotan (2017) convincingly shows that actually this source made several artificial enlargements to the original rule, creating an arbitrary environment for the allophony. Whereas as stated in *Hidāyat al-Qāri'* the allophone of *resh* surfaces either when it is adjacent to, in the same syllable of or even in the same foot as an alveolar consonant, in the environment posited by Dotan (2017), which he based on a comparative examination of older sources, *resh*'s allophone is present only when immediately followed by *l*, *n* or preceded by *d*, *t*, *tˤ*, *s*, *sˤ*, *z*. This latter environment is much more satisfactory from a phonological point

[64]This contrast could have been lost in later stages: there are some cases where ר is replaced with a fricative ג in a few manuscripts, and the 11th-century poet Samuel HaNagid wrote a short poem about a boy who confuses those consonants in speech (Howard 2021).

[65]It is not clear why Dotan (2017) reconstructs the allophony the opposite way: *r* as the elsewhere allophone and *ɣ* in proximity to alveolars, due to a dissimilatory process! Another complication that such account would rise is that sonorants do not tend to dissimilate from obstruents – while an assimilation process could be caused to ease the articulation of two different segments, dissimilation occurs chiefly in order to differentiate two similar sounds. This would not usually happen between sonorants and obstruents, since acoustically they are quite distinct.

of view, since the affected segment appears in direct contact with the consonants affecting it.

To conclude, during the Masoretic times, *resh* should be reconstructed as followed: its main pronunciation was ɣ, while next to the alveolar consonants it was realized as $ɾ^{(ʕ)}$ or $ɾ^{(ʕ)}$.

6.3.4 Post-Masoretic times (from 11th century onwards)

Hebrew had certainly stopped being a spoken language after the Masoretic times, although it was still used as the sacred language of worship and scholarship by the Jews (Sáenz-Badillos 1996). During this period, its pronunciation seems to have been affected chiefly by the local languages spoken by the Jewish population. The back *resh* is not found in any surviving Middle Eastern biblical reading tradition, all of which regularly pronounce the resh as an alveolar (Khan 2013b). Revell (1981) even argues that the alveolar allophone of *resh* could originate from the general spread of Arabic as an everyday language. Similarly, the Italian Jews' biblical reading tradition adopted the alveolar trill, which was the rhotic of most Italian dialects (Artom 1962). A back rhotic survived in Ashkenazi reading traditions, apparently under the influence of Yiddish (Khan 2013b). This rhotic is possibly the source of the modern Hebrew rhotic, usually described as a dorsal approximant, ʁ̞ (see also 4.2 and 6.1).

6.4 Summary

The original pre-Masoretic Hebrew, *r*, seems to have changed to ɾ during the first centuries CE (and possibly before, although it cannot be proven without additional sources). This variety of rhotic (labelled here as "transitional period") was the one written down in the Tiberian tradition, crystallized in the Masoretic Biblical text. During the second half of the first millenium, this rhotic changed again, emerging as ɣ. Although this was apparently the pronunciation of *resh* during the times of the Masoretes, it was not recorded in the Biblical text.

Yet, a problem arises from this description: while *r* can indeed change into ɾ, and frequently does so (Ladefoged and Maddieson 1996), the change from ɾ to ɣ is more problematic, since a momentary sound produced with a ballistic motion would have had to become a prolonged back fricative in order for this

to happen. Although this change is not impossible (see Radu 2016, which describes that Romanian ɾ is sometimes produced as a fricative), it is quite unlikely. This incongruity could be addressed in two possible ways. First, it could be argued that after the r→ɾ transition, that caused the loss of *resh*'s gemination, the segment changed again to r (possibly under the influence of other local languages, such as Greek and Latin), which later became ɣ: unlike the transition ɾ→ɣ, a change from r to ɣ is found among the world's languages and has an articulatory motivation (as explained in 6.1). Another possibility would be to posit different Hebrew dialects: we have already seen that some dialects kept r as their rhotic, together with the possibility of geminating it (such as Samaritan Hebrew). It could be the case that while the Masoretes recorded a certain reading tradition, their own pronunciation was influenced by a different dialect that kept r, which later became ɣ. Indeed, there seems to be a discrepancy between the Tiberian tradition, in which *resh* could not be geminated, and other reading traditions: medieval manuscripts of Rabbinic Hebrew belonging to the eastern tradition of transmission (classified into the "Palestinian" branch) marked *resh* with *dagesh* more frequently than the Tiberian biblical text (Bar-Asher 1987),[66] which was pronounced geminated in Middle Eastern reading traditions of Rabbinic Hebrew (Morag 1960). These facts attest to the existence of dialects that could still geminate *resh*. It should be also remembered that by the times of the *Masoretes* Hebrew was not a spoken language anymore, and that the *Masoretes*' native language certainly had some impact on their pronunciation of Hebrew.

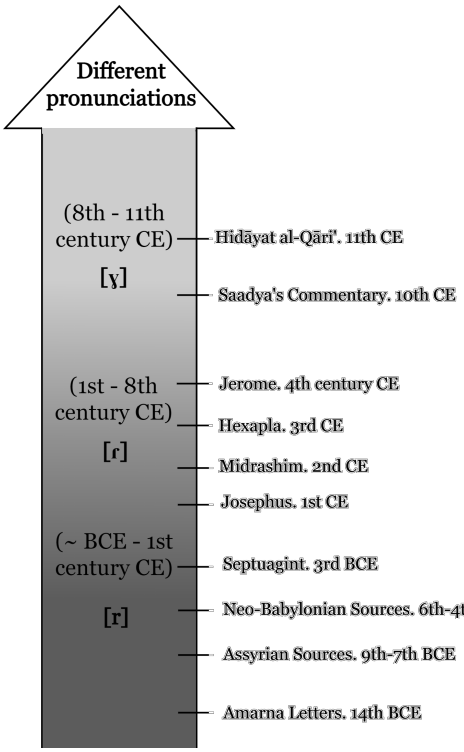

Figure 6.2: Timeline of *resh*'s evolution

[66] The tendency to geminate *resh* is greater in some manuscripts than in others: while some treat *resh* like a normal consonant, others mark the *dagesh* only after the relative particle שֶׁ ʃɛ- and on the medial *resh* of a number of verbal and nominal morphological patterns.

Blau (2010) claims that the the compensatory lengthening process could suggest the degemination chronology: if the vowels before a segment that was originally geminated behave as if length were part of the language, the loss of gemination precedes the phonemic length loss of Hebrew. Therefore, segments that consistently show compensatory lengthening would have lost the possibility to degeminate before segments that do not show lengthening. According to the data collected in sections 3.1 and 5.1.1, that order would be (from the first to the last): *resh*, *ʔ*, *ʕ*, *h*, *ħ*. The main problem with this theory is that it assumes that *resh*'s degemination is an ancient phenomenon, and that *resh* was degeminated before the gutturals. In fact, we have seen that the degemination of *resh* is quite recent (dating from the first centuries CE), and that it certainly does not predate the gutturals' degemination: while several Hebrew dialects kept a geminated version of *resh*, none retained geminated gutturals. In consequence, the different percentages of lengthening should be explained otherwise. A possibility would be claiming that the rate of compensatory lengthening does not derive from a different chronology, but rather from the source of the degemination. Both *resh* and the gutturals always display lengthening when degeminating an assimilated consonant (as in the future of the template *niqṭal*), whereas the degemination of a doubled *binyan* only sometimes triggers lengthening. The reason for the consistent lengthening caused by *resh* derives from the fact that it is not merely the degemination of a segment, but rather a phonological change that modifies the identity of the segment.

Finally, a closer look at the cases of geminated *resh* could shed some light regarding their nature. As said in 3.1, among the 17 cases of *resh* marked with a *dagesh*, eight are marked with a *conjunctive dagesh*, which possibly did not mark gemination. The nine cases of true gemination, can be divided into two groups:

- Etymological *dagesh* – שָׁרֵךְ *ʃɔrrex*, 'your navel' (twice); מָרַת *mɔrraθ*, 'bitterness'; שֶׁרֹּאשִׁי *ʃɛroʃi*, 'that my head'.
- Non-etymological *dagesh* – הַרְעִמָה *harrəʕimɔh*, 'to irritate her'; הַרְאִתֶם *harrəʔiθɛm*, 'have you seen?' (thrice); כָּרַת, *xɔrraθ* 'was cut'.

Let us look first at the 'non-etymological' cases. In all these words, it seems that the gemination of *resh* was phonologically motivated to preserve some "weak" segments that would have been otherwise deleted. In the cases of הַרְעִמָה *harrəʕimɔh* and הַרְאִתֶם *harrəʔiθɛm*, the non-geminated version contained the sequence *CGV* (consonant-guttural-vowel, *-rʕi* and *-rʔi-* respectively). In this phonological environment, there is a tendency to delete the guttural consonant. Thus, the gemination

of the following consonant, together with the insertion of the ə, breaks this sequence and helps retain the guttural consonant (Ariel 2020). In a similar way, the gemination in כָּרַת *xorraθ* is used to retain the etymologically short *o*, that tended to be deleted in open, non-stressed syllables (Blau 2010).[67] These forms show that *resh*'s gemination was retained in a few forms when it had a phonological (rather than morphological) motivation. Regarding the words with an 'etymological' *dagesh*, שֶׁרֵךְ *ʃɔrrex* and מָרַת *mɔrraθ*, these should be seen as retentions, while שֶׁרְאֹשִׁי *ʃɛrroʃi* could be interpreted as an influence from Rabbinic Hebrew (since many *Mishnaic* manuscripts show the tendency to mark *resh* with a *dagesh* after the particle שֶׁ *ʃɛ-*).

[67]The templatic pattern of כָּרַת *xorraθ* is not *quṭṭal*, but the rare passive form of *qal*.

Chapter 7

Discussion and conclusions

Throughout this research, I argued that the rhotic segment reflected in the Tiberian tradition is the alveolar tap, *ɾ*. There are several phonological processes related to *resh* (chapter 3): it cannot geminate, it sometimes causes the lowering of adjacent vowels and it cannot co-occur in the Semitic roots with *l* and *n*. Since another group of segments, the gutturals, seems to have similar phonological behavior (i.e., they cannot geminate and tend to lower vowels), I explored the possibility of including *resh* among them (section 5.1), by reconstructing it as a back rhotic segment (either velar or uvular). The inclusion of *resh* among the gutturals was further reinforced by the fact that several medieval grammarian described the Tiberian rhotic as being some kind of back rhotic (see 4.1). Nevertheless, this hypothesis was discarded after a closer examination of the gutturals' properties. These segments display many phonological phenomena that are unique to them (*furtive patah*, prohibition on occurring in coda position, *ḥaṭef* insertion and transguttural harmony), which are not shared with *resh*. Moreover, even the phenomena that would seem common to *resh* and the gutturals, are in fact different in details – *resh*'s degemination always triggers compensatory lengthening (while it is less systematic with gutturals), and *resh* rarely lowers adjacent vowels (whereas gutturals do so much more frequently). The restriction patterns in the Semitic roots are different too: *resh* cannot co-occur with coronal sonorants, and the gutturals cannot co-occur with each other. All these differences make the inclusion of *resh* in the natural class of the gutturals very unlikely, since natural classes consist of sounds that pattern together in phonological processes, and share phonetic and articulatory properties.

After rejecting the reconstruction of *resh* as a back rhotic, I considered the possibility of its identification as a front one. First, the fact that *resh* does not co-occur with *l*, *n* in Semitic roots would suggest an alveolar realization, since these

two sounds are coronal sonorants. The affinity with *l* is further testified by the fact that *resh* is swapped with it in a few instances in the Biblical text. By narrowing the identification of *resh* as a tap, it is possible to explain its phonology without resorting to its classification among the guttural consonants (section 5.2). Taps are essentially momentary sounds, involving a brief contact between the articulators, which by their very nature cannot geminate. This fact would explain *resh*'s impossibility to geminate. Furthermore, the reconstruction of *resh* as a tap also clarifies the vowel lowering associated with this segment: the alveolar tap can affect neighboring vowels due to the lowering of the body of the tongue needed for its articulation. This configuration of the tongue is antagonistic with the dorsal articulation of non-low vowels, causing the lowering process. Interestingly, compared to the alveolar trill, the strength of lowering generated by the alveolar tap is weaker, which indeed suits the fact that *resh* only rarely lowers adjacent vowels. The reconstruction of *resh* as ɾ is also supported by Greek transcriptions, that sometimes transcribe it as *δ* (an alveolar stop). Importantly, this explanation accounts for all the phenomena related to *resh*, and for them only, also shedding light on the disparity of *resh*'s behavior and the behavior of the gutturals.

In conclusion, the analysis presented here explains satisfactorily all the phonological properties of *resh*, and reconciles them with the descriptions made by the medieval grammarians. The various analyses made by researchers were based on different time periods, and therefore do not contradict the reconstruction of *resh* as ɾ. Still, the comparative research of the rhotics in the Semitic languages is still in an embryonic state, and will be hopefully addressed in future research.

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Appendix A

Hebrew consonant letters

Name	Grapheme	Phonetic value	Romanization
aleph	א	*ʔ*	’
beth	בּ	*b*	b
beth	ב	*v*	v
gimel	גּ	*g*	g
gimel	ג	*ɣ*	g
daleth	דּ	*d*	d
daleth	ד	*ð*	d
heh	ה	*h*	h
waw	ו	*w*	w
zayin	ז	*z*	z
ḥet	ח	*ħ*	ḥ
ṭet	ט	$t^{ʕ}$	ṭ
yodh	י	*j*	y
kaph	כּ	*k*	k
kaph	כ, ך	*x*	ch
lamedh	ל	*l*	l
mem	מ, ם	*m*	m
nun	נ, ן	*n*	n
samekh	ס	*s*	s
ayin	ע	*ʕ*	‘
peh	פּ, ף	*p*	p
ṣadheh	צ, ץ	$s^{ʕ}$	ṣ
qoph	ק	*q*	q
resh	ר	*ɾ*	r
śin	שׂ	*s*	s
shin	שׁ	*ʃ*	sh
taw	תּ	*t*	t
taw	ת	*θ*	th

Appendix B

Hebrew vowel punctuation signs

Name	Grapheme	Phonetic value	Romanization
ḥireq	◌ִ	*i*	i
ṣere	◌ֵ	*e*	e
seghol	◌ֶ	*ɛ*	e
pataḥ	◌ַ	*a*	a
qameṣ	◌ָ	*ɔ*	a
qameṣ qaṭan	◌ָ	*o*	o
ḥolem	◌ֹ, וֹ	*o*	o
qibbuṣ	◌ֻ	*u*	u
shureq	וּ	*u*	u
ḥaṭef pataḥ	◌ֲ	*ă*	a
ḥaṭef seghol	◌ֱ	*ɛ̆*	e
ḥaṭef qameṣ	◌ֳ	*ɔ̆*	o
shewa naḥ	◌ְ	∅	∅
shewa naʕ	◌ְ	*ə*	e

Appendix C

Cases of resh with dagesh

1Sam. 1:6 וְכִעֲסַתָּהּ צָרָתָהּ גַּם־כַּעַס בַּעֲבוּר הַרְּעִמָהּ כִּי־סָגַר יְהוָה בְּעַד רַחְמָהּ׃

And her rival used to provoke her grievously to irritate her, because the LORD had closed her womb.[68]

1Sam. 10:24 וַיֹּאמֶר שְׁמוּאֵל אֶל־כָּל־הָעָם הַרְּאִתֶם אֲשֶׁר בָּחַר־בּוֹ יְהוָה כִּי אֵין כָּמֹהוּ בְּכָל־הָעָם
וַיָּרִעוּ כָל־הָעָם וַיֹּאמְרוּ יְחִי הַמֶּלֶךְ׃

And Samuel said to all the people, "Do you see him whom the LORD has chosen? There is none like him among all the people." And all the people shouted, "Long live the king!"

1Sam. 17:25 וַיֹּאמֶר אִישׁ יִשְׂרָאֵל הַרְּאִתֶם הָאִישׁ הָעֹלֶה הַזֶּה כִּי לְחָרֵף אֶת־יִשְׂרָאֵל וְהָיָה הָאִישׁ
אֲשֶׁר־יַכֶּנּוּ יַעְשְׁרֶנּוּ הַמֶּלֶךְ עֹשֶׁר גָּדוֹל וְאֶת־בִּתּוֹ יִתֶּן־לוֹ וְאֶת בֵּית אָבִיו יַעֲשֶׂה חׇפְשִׁי בְּיִשְׂרָאֵל׃

And the men of Israel said, "Have you seen this man who has come up? Surely he has come up to udefy Israel. And the king will enrich the man who kills him with great riches vand will give him his daughter and make his father's house free in Israel."

[68] All the translations are taken from the Bible's English Standard Version.

2Kings 6:32 וֶאֱלִישָׁע יֹשֵׁב בְּבֵיתוֹ וְהַזְּקֵנִים יֹשְׁבִים אִתּוֹ וַיִּשְׁלַח אִישׁ מִלְּפָנָיו בְּטֶרֶם יָבֹא הַמַּלְאָךְ אֵלָיו וְהוּא אָמַר אֶל־הַזְּקֵנִם הַרְאִתֶם כִּי־שָׁלַח בֶּן־הַמְרַצֵּחַ הַזֶּה לְהָסִיר אֶת־רֹאשִׁי רְאוּ כְּבֹא הַמַּלְאָךְ סִגְרוּ הַדֶּלֶת וּלְחַצְתֶּם אֹתוֹ בַּדֶּלֶת הֲלוֹא קוֹל רַגְלֵי אֲדֹנָיו אַחֲרָיו׃

Elisha was sitting in his house, and the elders were sitting with him. Now the king had dispatched a man from his presence, but before the messenger arrived Elisha said to the elders, "Do you see how this murderer has sent to take off my head? Look, when the messenger comes, shut the door and hold the door fast against him. Is not the sound of his master's feet behind him?"

Jer. 39:12 קָחֵנוּ וְעֵינֶיךָ שִׂים עָלָיו וְאַל־תַּעַשׂ לוֹ מְאוּמָה רָע כִּי אִם כַּאֲשֶׁר יְדַבֶּר אֵלֶיךָ כֵּן עֲשֵׂה עִמּוֹ׃

"Take him, look after him well, and do him no harm, but deal with him as he tells you."

Ezek. 16:4 וּמוֹלְדוֹתַיִךְ בְּיוֹם הִוָּלֶדֶת אֹתָךְ לֹא־כָרַת שָׁרֵךְ וּבַמַּיִם לֹא־רֻחַצְתְּ לְמִשְׁעִי וְהָמְלֵחַ לֹא הָמְלַחַתְּ וְהָחְתֵּל לֹא חֻתָּלְתְּ׃

And as for your birth, on the day you were born your cord was not cut, nor were you washed with water to cleanse you, nor rubbed with salt, nor wrapped in swaddling cloths.

Hab. 3:13 יָצָאתָ לְיֵשַׁע עַמֶּךָ לְיֵשַׁע אֶת־מְשִׁיחֶךָ מָחַצְתָּ רֹאשׁ מִבֵּית רָשָׁע עָרוֹת יְסוֹד עַד־צַוָּאר סֶלָה׃

You went out for the salvation of your people, for the salvation of your anointed.

Psa. 52:5 אָהַבְתָּ רָע מִטּוֹב שֶׁקֶר מִדַּבֵּר צֶדֶק סֶלָה׃

You love evil more than good, and lying more than speaking what is right. Selah

Prov. 3:8 רִפְאוּת תְּהִי לְשָׁרֶךָ וְשִׁקּוּי לְעַצְמוֹתֶיךָ׃

It will be healing to your flesh and refreshment to your bones.

Prov. 11:21 יָד לְיָד לֹא־יִנָּקֶה רָע וְזֶרַע צַדִּיקִים נִמְלָט׃

Be assured, an evil person will not go unpunished, but the offspring of the righteous will be delivered.

Prov. 14:10 לֵב יוֹדֵעַ מָרַת נַפְשׁוֹ וּבְשִׂמְחָתוֹ לֹא־יִתְעָרַב זָר׃

The heart knows its own bitterness, and no stranger shares its joy.

Prov. 15:1 מַעֲנֶה־רַךְ יָשִׁיב חֵמָה וּדְבַר־עֶצֶב יַעֲלֶה־אָף׃

A soft answer turns away wrath, but a harsh word stirs up anger.

Job 39:9 הֲיֹאבֶה רֵים עָבְדֶךָ אִם־יָלִין עַל־אֲבוּסֶךָ׃

Is the wild ox willing to serve you? Will he spend the night at your manger?

Song 5:2 אֲנִי יְשֵׁנָה וְלִבִּי עֵר קוֹל דוֹדִי דוֹפֵק פִּתְחִי־לִי אֲחֹתִי רַעְיָתִי יוֹנָתִי תַמָּתִי שֶׁרֹּאשִׁי נִמְלָא־טָל קְוֻצּוֹתַי רְסִיסֵי לָיְלָה׃

I slept, but my heart was awake. A sound! My beloved is knocking. “Open to me, my nsister, my love, my dove, my perfect one, for my head is wet with dew, my locks with the drops of the night.”

Ezra 9:6 וָאֹמְרָה אֱלֹהַי בֹּשְׁתִּי וְנִכְלַמְתִּי לְהָרִים אֱלֹהַי פָּנַי אֵלֶיךָ כִּי עֲוֹנֹתֵינוּ רָבוּ לְמַעְלָה רֹּאשׁ וְאַשְׁמָתֵנוּ גָּדְלָה עַד לַשָּׁמָיִם׃

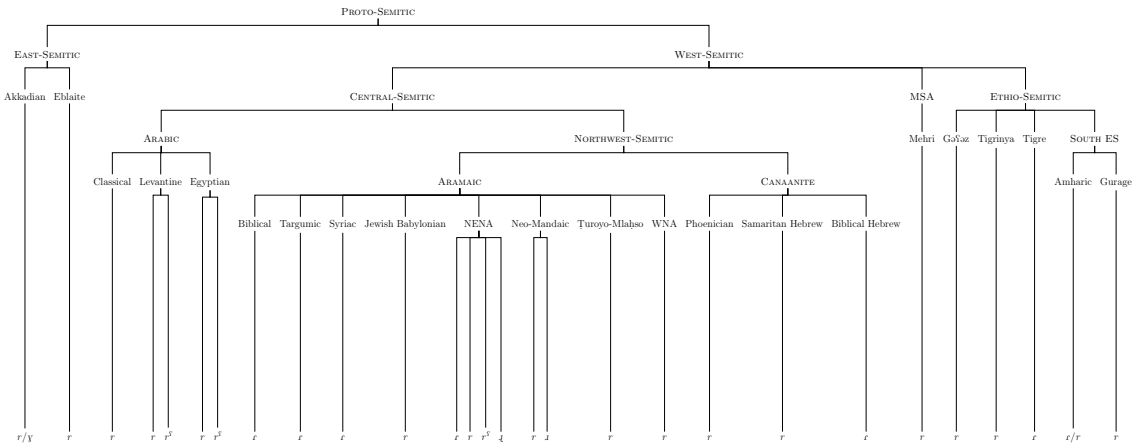
O my God, I am ashamed and blush to lift my face to you, my God, for our iniquities have risen higher than our heads, and our guilt has mounted up to the heavens.

2Chr. 26:10 וַיִּבֶן מִגְדָּלִים בַּמִּדְבָּר וַיַּחְצֹב בֹּרוֹת רַבִּים כִּי מִקְנֶה־רַב הָיָה לוֹ וּבַשְּׁפֵלָה וּבַמִּישׁוֹר אִכָּרִים וְכֹרְמִים בֶּהָרִים וּבַכַּרְמֶל כִּי־אֹהֵב אֲדָמָה הָיָה׃

And he built towers in the wilderness and cut out many cisterns, for he had large herds, both in the Shephelah and in the plain, and he had farmers and vinedressers in the hills and in the fertile lands, for he loved the soil.

Appendix D

Phylogenetic tree of the Semitic languages



חידת הרי"ש

זיהוי עיצור הרי"ש בעברית מקראית

קרלו מלוני

תקציר

בעבודה זו אשחזר את עיצור הרי"ש בעברית המקראית, ואבסס את הניתוח על התנהגותו הפונולוגית. במהלך מחקרי, אבצע בדיקה כמותית של התופעות הפונולוגיות הקשורות לרי"ש, ואטען שהשחזור ההולם ביותר עבורו הוא המוקש המכתשי.

עיצורים רוטיים קיימים ברוב שפות העולם, וכוללים מספר סגמנטים מגוון. קבוצה זו מכילה עיצורים עם מקומות ואופני חיתוך שונים, ולכן לא ניתן להגדירה על סמך מאפיינים חיתוכיים או האקוסטיים בלבד. בשל שונותם הרבה של העיצורים הרוטיים, זיהויים הפונטי בשפות מתות, כגון עברית מקראית, עשוי להיות מאתגר למדיי. לפי מספר חוקרים, יש לסווג את הרי"ש המקראי כעיצור אחורי, בעוד שחוקרים אחרים סבורים שהוא נהגה כעיצור קדמי. חוקרים נוספים, בהסתמך על מדקדקי ימי הביניים, הסיקו שלרי"ש הייתה הגייה כפולה, התלויה בסביבה הפונולוגית. אף אחד מהשחזורים האלו לא התבסס על בדיקה שיטתית של התופעות הפונולוגיות הקשורות לרי"ש, המעידות על השתייכותו לקבוצה הטבעית של העיצורים המכתשיים.

על מנת ליישב בין השחזור שלי לבין תיאורי מדקדקי ימי הביניים, אני מציע תהליך של שינוי דיאכרוני, אשר במהלכו עיצור רוטט מכתשי ראשוני השתנה למוקש מכתשי, שבתורו הפך לעיצור האחורי המתואר במקורות מימי הביניים. ניתוח זה יסתמך על המאפיינים הטיפולוגיים של העיצורים הרוטיים, ועל התנהגותם של העיצורים האלו בשפות השמיות השונות. נוסף על כך, אבסס את תהליך השינוי בעזרת מקורות מגוונים, כגון תעתיקי העברית לכתב יתדות ולאלפבית היווני, אשר יאפשרו לתארך את שלביו השונים.

אוניברסיטת תל אביב
הפקולטה למדעי־הרוח ע"ש לסטר וסאלי אנטין
החוג לבלשנות

חידת הרי"ש: זיהוי עיצור הרי"ש בעברית מקראית

עבודת־גמר לתואר מוסמך

מאת:
קרלו מלוני

בהנחייתם של:
ד"ר אוון־גרי כהן
פרופ' חזי מוצפי

שבט תשפ"א