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PERSPECTIVES ON ARABIC LINGUISTICS XVII-XVIII

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ROOT FORMATION AND POLYSEMIC ORGANIZATION IN ARABIC LEXICON: A PROBABILISTIC MODEL

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1. Introduction

Describing the organization of the lexicon in natural languages is one of the most challenging tasks in linguistic theory. It is the core of the system where the minimal links are established between sound and meaning. The lexicon is one of the basic components of the grammar in different linguistic theories. Many issues related to the lexicon are dealt with from different theoretical frameworks in linguistics and from many different disciplines in human sciences.

The Arabic lexicon has many peculiarities related to the nature of nonconcatenative morphology in Arabic, in particular, and in Semitic languages in general. Many theoretical claims are proposed in an attempt to describe its phonological and semantic organization. Traditional Arab grammarians and lexicographers established the basic issues within a classical framework. In modern times, there are two main directions in dealing with the lexicon in Arabic and Semitic languages. One is a reconstruction of the paths that the roots in Semitic languages took through their evolution where it is assumed that the root was biconsonantal and became triconsonantal (Ehret 1980, 1989, 1995; Bohas 1991, 1993, 1994). The other is a combinatory account based on the semiotic values of the binary sequences that make the word in Arabic (Barbot 1997, 1998). The prosodic account proposed by

McCarthy (1979, 1981) in nonlinear phonology (Leben 1973, Clements 1976, Goldsmith 1976, etc.) is a convenient framework to handle many aspects of the organization of the lexicon in Arabic

In this paper, we deal with polysemy in the Arabic lexicon, and we argue that the rules governing root formation generate polysemy in an unavoidable way. The first part will focus on a brief review of the most important models dealing with the organization of roots in the Arabic lexicon. In the second part, the probabilistic model will be presented (the principles and rules generating roots in the Arabic lexicon) with a special focus on polysemy, morphology, and the different devices working to minimize the phenomenon of polysemy.

2. Root Formation in Arabic Lexicon

2.1 *The historical perspective*

2.1.1 *The Extensionist Model*

Ehret (1989) deals with the origin of the third consonant in Semitic roots through an internal reconstruction applied to Arabic. The main claim is that trilaterals in Semitic languages are extended forms of once-simpler roots (biliterals). This assumption is built on comparative evidence between Semitic and the other branches of Afroasiatic. The strategy in dealing with the phenomenon in Arabic consists of taking sets of trilateral roots which share similar or related meanings and have in common the first and the second consonants but differ in the third consonant. Then the roots that have the same consonant at the third position are grouped and compared to sort out the possible semantic variation related to the presence of that consonant in them. Ehret claims that third consonants probably originated in pre-Protosemitic as verbal extension suffixes expressing some kind of grammatical meanings. He concluded that all or nearly all of the consonants of Protoafroasiatic had developed the capacity to act as verb extensions, modifying the meaning of simple biconsonantal roots in regularly definable ways. This strategy is based on the fact that verbal morphology requires a trilateral surface that made the biconsonantal roots convert formally into triconsonantals by extension or by gemination of the second consonant. Gemination is a formal operation motivated by trilateral verbal morphology rather than semantics.

Ehret deals with polysemy and observes that it is a common phenomenon in Semitic at both levels: triconsonantal roots and the

underlying reconstructed biconsonantal roots. Polysemy in Semitic roots is the result of many once-distinct Afroasiatic roots falling together in pre-Proto- and Proto-Semitic. The collapsing of many root-shapes into one occurred at both vocalic and consonantal levels.

The Extensionnism Model elaborated by Ehret fails to explain many phenomena related to polysemy in Arabic roots. Although we agree that there is a kind of collapsing at the origin of polysemy, we can not admit easily that the single consonant at the level of the root may have some kind of grammatical meaning modifying the meaning of the biconsonantal root that it extends. All the semantic values attributed to single consonants at the extension position are withdrawn from the semantic features proper to the lexical meaning expressed by the root. Since every third consonant in the root is supposed to bear a grammatical meaning, Ehret's model is challenged when this consonant is geminated because gemination is considered a formal operation. So there may be roots where this consonant has a meaning and has none in others. This fact remains unexplained in the Extensionnism framework:

qaram	<to retain, hold>	*m fortative
qardam	<to take all>	*m fortative *d durative
našam	<to be covered with black and white spots or dots>	*m fortative
hmm	< to melt fat >	none

The Extensionnism Model can not handle polysemy conceived as having many different unrelated meanings. The data presented in Ehret (1989) include many roots, each of which may have different meanings and figures in different subsets. Regardless of the problem of the number of consonants and the reconstructed meaning for the extension consonant, a root like *nšr* (where *r is diffusive) has the following list of meanings as presented in Ehret (1989, 194-195):

nšr	
našar	- to blow
našar	- to spread out, unfold or unroll, exhibit, spread about, make publicly known, communicate, propagate, separate, disperse, be scattered.
našar	- to put forth leaves, grass, to sprout forth, raise the dead, revive, be revived, rise from the dead.
našar	- to cut or carve wood, saw,

našar - to have the mange.

The main aim is to explain how these different meanings are grouped together at the triconsonantal root *nšr* in Arabic or at the level of the biconsonantal reconstructed root corresponding to each subset elaborated by Ehret. The samples given above figure in different subsets having one biconsonantal reconstructed root:

*nš
 to overflow,
 to imbibe, absorb, take in liquid, etc.
 to send away, take away,
 to rise,
 to make a low sound,
 to cut.

Assuming that the reconstructed root with its different unrelated meanings belongs to an early ancient period of Semitic (called pre-Proto-Semitic or Proto-Afroasiatic, etc) goes against the minimal requirements of communication: words must be distinct in phonetic form to insure the distinction between meanings.

2.1.2 *The Epenthesis Model*

Brockelmann claimed that there is a tendency in Arabic to make the correspondence between a group of defined consonants in Arabic roots and a certain semantic value or notion. There are many roots composed of a velar and a dental consonant which are specialized in the meaning of 'cutting'. Following Brockelmann, Bohas (1993) considers that the Arabic lexicon is organized in three levels:

1. The matrix: the combination of two articulatory places: (dental, labial), (velar, dental), etc.
2. The etymon: the combination of two consonants, each belonging to one place of articulation. The order of the two consonants is reversible.
3. The root: the consonantal shape that the etymon takes in morphological forms (triconsonantal or other). This realization may be achieved by spreading (diffusion), epenthesis and reduplication. These operations take place when the biconsonantal etymon is mapped to a triconsonantal template.

The etymon *bx* <subside>, for example, when mapped onto a triconsonantal template, takes four consonantal shapes: the third c-slot is filled by spreading one of the two consonants or by epenthesis of the glides w/y in the median or the final position. If it is mapped onto a quadrilateral template, it will go through reduplication of both consonants as follows:

/bx/			
Spreading	(bxx)	baxxa	<subside after anger>
Epenthesis			
	Middle	(bwx)	baaxa <subside>
	final	(bxw)	baxaa <subside>
Reduplication	(bxbx)	tabaxbaxa	<subside>

The epenthesis operation works on glides (w, y), other sonorants (ħ, ʕ, ʔ, h), following Diakonoff, 1965 and Petracek, 1987 and l, r, m, and n. A biconsonantal root may take the following realizations:

Reduplication :		
CCiCi		reduplication of the second consonant
CCi	CCCi	reduplication of the first consonant
CCiCCi		total reduplication
Epenthesis of a glide or a sonorant (S):		
SCCi		initial epenthesis
CCi	CSCi	median epenthesis
CCiS		final epenthesis

The model proposed by Bohas, though based on statistical evidence from Arabic data and other Semitic languages, leaves many questions unanswered, because it is trapped in the idea of biliterality and root expansion by sonorants. In fact, if the basic principle of biliterality is accepted and the semantic relation is established between the different roots related to different *etymons* and matrices, there are too many aspects which can not be handled by this model.

Looking for a biliteral hypothetical stage which evolved to a trilateral or quadrilateral one is problematic. The principles (articulatory, phonological, semantic, etc.) governing the formation of matrices and *etymons* are not clear.

There are many matrices sharing one common semantic field. This fact is unexplained and the idea of specialized Matrices in semantic values is not strong enough to explain this phenomenon:

dental, labial: bt	btt	batta	< to cut>
dental, velar : qt	qtt	qatta	< to cut>
labial, velar : jb	jbb	jabba	< to cut>

Following the realizations of any etymon, there are roots related to that etymon and bear a different meaning which has no relation to the meaning shared by the other roots belonging to that etymon. The epenthesis model can not explain the polysemy in the Arabic lexicon and how a single root may have many different unrelated meanings.

The epenthesis model claims that basically the sonorants are the unique elements that occur in *etymons* expansion. That is true in part, but if we take any etymon, there are many roots related to that etymon where the third element is neither a glide nor a sonorant and they bear the same semantic value. The matrix (velar, dental) comprise many *etymons*, one of which is the etymon /q ṭ / and / ṭ q/ when reversed. It has many roots related to it that are expanded by consonants and has the same meaning as those expanded by sonorants:

/qṭ / qṭb	qaṭaba	< cut, divide by cutting>
qṭf	qaṭafa	< cull-pluck-gather>

The epenthesis model predicts that every etymon is realized by reduplication or epenthesis. The epenthesized segment is always a single sonorant at one of the three positions in the root. However there are many quadrilateral roots which are related to the trilateral ones by sharing a common semantic value: /qṭ/ → qṣṭ, qṣṭb, qṣṭr, qṣṭl “throw someone to the ground”.

This situation can not be handled by the epenthesis model. It is not clear, for example, whether epenthesis occurs by two sonorants (ṣ and r in qṣṭr, or ṣ and l in qṣṭl), or by a sonorant and a consonant (ṣ and b in qṣṭb). The status of sonorants is not clear. They are conceived as being expansion elements which fill in the third C-slot required by the template. There are many roots with two sonorants (e.g., *hdm* “destroy”), three sonorants (e.g., *mlḥ* “salt”, *ḥlm* “dream”, *lmṣ* “shine”, etc.).

2.2 *The semiotic perspective: the Combinatory Model*

Barbot (1998) refutes the concept of the root, the different ways of root formation (extension, epenthesis, metathesis, etc), the concept of root and template as the basic components of the word. Barbot instead argues that lexical items are organized in a network based on the phonetic and semiotic interconnections called *naħt akbar*. The lexicon is divided into two levels: deep structure and surface structure. At the deep structure, the combinatory system between minimal sequences each corresponding to a minimal isoseme is working to generate the different minimal units that combine freely to form elements making together a semiotic network. At the surface, these combinations are mapped onto the rigid morphological templates and take the shape of a numbered consonantal root (bi-, tri-, quadri-, and quinqueliteral). The root shape is not determined at the combinatory level: combinations are not ordered. Barbot considers the linear representation not valid to show the semiotic and phonetic connections sequence-isoseme and suggests graphs based on a multidirectional and simultaneous representation of the correlations between elements making a semantic field.

Although the semiotic approach is tempting and the concept of network is strong enough to handle the organization of any system, the model of *naħt akbar* fails to answer many questions related to the organization of Arabic lexicon in general and to polysemy, in particular. Connections would explain how different elements are grouped together in a unifying common aspect but can not explain how different elements are grouped together with no common aspect at all. Different roots or words may be grouped together regarding their common meanings but the fact that different meanings are grouped together in one single root or word has to be explained.

Root formation can not be conceived as an independent operation, of any kind, cut away from the morphological shape in which it is licensed. Surface-deep structure dichotomy, as drawn by Barbot, can not be the key to understand polysemy since the distinction between those two levels can be accepted neither in a generativist conception nor in the common linguistic sense.

3. The Probabilistic Model

In Zanned (1998) we tried to describe the organization of Arabic lexicon: the phonological and semantic aspects of root formation related to morphology and syntax. The main focus of this paper is to deal with polysemy as a general phenomenon governing the majority of lexical entries in the Arabic lexicon.

3.1 *Basic principles*

All rules and principles discussed in this section are based on data analysis. Our concern is not to determine the origin of things or their evolution. Our conclusions may agree with some facts suggested in some of the models reviewed above and may disagree with some of them. In both cases, they are based on the description of the data.

We assume that roots in Arabic are triconsonantal, quadriconsonantal and quinqueconsonantal. Roots are structures of ordered consonantal positions. The number of the positions determines the number of the consonantal segments in the root. The order of the consonants determines the identity of the root in both the aspects of phonological shape and semantic aspect.

Consonants are elements of the articulatory space framed between labials and laryngeals. The articulatory space is a continuum of domains and places of articulation. Places of articulation are established in a diffusive way through history in an attempt to explore all the articulatory possibilities required by the distinction between meanings expressed by language. There are 28 consonantal articulatory places in Arabic. Roots are formed by combination of consonants from different articulatory places. Combination of consonants is a chaotic combination between places of articulation within the limits of the articulatory space.

The positional structure of the root is governed by phonological rules such as features, places and so forth.

Root formation in Arabic is governed by the law of the variable and the fixed. This law yields listemes of twenty-eight roots. The fixed element (F) is the consonant which is common to the elements of the same listeme. The variable element (V) is the consonant in which all the elements of the listeme differ. The value of F and V is one of the 28 consonants in Arabic. It is determined in many ways discussed below.

Assuming that the root is triconsonantal, the combination of F and V allows three kinds of structures regarding the number of the Fs and Vs in each one. Fs and Vs are ordered in the root positional structure as follows:

- a. structure operating with three Fs.
- b. structure operating with three Vs.
- c. structure operating with both Fs and Vs.

Structure (a) generates a series of unlimited copies of the same root in language use by different speakers in different times. The values of Fs are determined once in language and make the phonetic shape (identity) of the root as a lexical entry. Suppose that Fs have the values in a root $F1=k$, $F2=t$, $F3=b$, then ktb is the only root generated by this structure:

F1F2F3
 k t b <write>
 k t b
 k t b
 ...

Structure (b) generates all the trilateral roots in Arabic Lexicon. This structure includes all the roots, since it is the most abstract one. It is the absolute triconsonantal root structure:

V1V2V3
 k t b <write>
 r q d <sleep>
 q r ? <read>
 ...

Structure (c), which operates with Fs and Vs, is of two kinds:

- c. 1) structure operating with two Vs and one F.
- 2) structure operating with two Fs and one V.

Each one of c-1 and c-2 yields three schemes regarding the position of F in c-1 and V in c-2 at the level of the triconsonantal root shape: initial, median, final.

Each one of the three schemes of c-1 generates listemes of roots with a common consonant corresponding to the F position. Structure c-

1 affords the phonetic link between different roots without any obligatory semantic relation between them. The structure c-1 is a source of the consonantal phonetic network providing any kind of arbitrary use or arrangement of the roots in the Arabic lexicon: rhymes in poetry and prose, lexical entries in dictionaries, language games, cross words, scrabbles, etc:

c.1 (V1, V2, F)

V1V2F	V1FV2	FV1V2
k t b <write>	r q d <sleep>	ħ f đ <learn>
r k b <ride>	y q n <be sure>	ħ r q <burn>
- - b	- q -	ħ - -

The schemes of c-2 are productive in root formation in Arabic on the basis of the correspondence between phonetic and semantic forms. The two Fs, regardless of their positions, are the elements common to the listeme and make its phonetic identity and semantic unity: lexical field. The members of each listeme differ in the V element which insures the distinction (opposition) at the phonological aspect corresponding to a semantic distinction between the different roots included in the same listeme. The schemes of c-2 are responsible for the polysemic organization of roots in the Arabic lexicon as we will demonstrate below.

Trilateral root formation in the Arabic lexicon, based on the law of F and V, is governed by the following structures:

C1C2C3	a.	V1V2V3	triconsonantal root
	b.	F1F2F3	root : lexical entry
	c.1	V1V2F	
		V1FV2	phonetic network: resemblance
		FV1V2	at the F element
	c.2	F1F2V	
		F1VF2	root listemes: phonetic and
		VF1F2	semantic correspondences

3.2 Root formation: (F1, F2, V)

The schemes of c -2, above, work to generate trilateral roots. Then any consonant in this kind of root may be at the position of Fs or Vs. In this way, any root, in theory, is generated by the three schemes of c-2,

being the point where they cross or intersect. We call the three copies of the same root which are common to the three listemes, each generated by one scheme, the archiroot. The archiroot is polysemic.

Every listeme is governed by two principles which unite its members in both cases: phonological and semantic. The phonological principle is based on the articulatory continuum at the position of the V element, so the listeme will have 28 roots, in theory, where Vs are consonants from the different articulatory places situated between the labials and the laryngeals. The semantic principle is based on the semantic continuum: the different roots in the listeme bear common semantic features since they belong to one semantic field and may differ in particular semantic features. The semantic distinction corresponds to the phonological distinction.

Consider, for example, the Archiroot *hjr*. The structure which generates *hjr* is c-2 with its three schemes. Every consonant of the root *hjr* may be the value of V or F in the different listemes generated by the schemes. For every scheme, the values of Fs are given, and the value of V is one of the 28 consonants in Arabic. Listemes are given below following the places in the articulatory space:

F1F2V	F1VF2	VF1F2
h j -	h - r	- j r
h j b	h b r	b j r
h j m	h m r	m j r
h j w	h w r	w j r
h j f	h f r	f j r
h j θ	h θ r	θ j r
h j ð	h ð r	ð j r
h j ċ	h ċ r	ċ j r
h j t	h t r	t j r
h j d	h d r	d j r
h j ʈ	h ʈ r	ʈ j r
h j n	h n r	n j r
h j s	h s r	s j r
h j z	h z r	z j r
h j ʃ	h ʃ r	ʃ j r
h j d'	h d' r	d' j r
h j l	h l r	l j r
<u>h j r1</u>	h r r	r j r
h j š	h š r	š j r
h j j	<u>h j r2</u>	j j r

h j y	h y r	y j r
h j k	h k r	k j r
h j q	h q r	q j r
h j x	h x r	x j r
h j γ	h γ r	γ j r
h j Ṣ	h Ṣ r	Ṣ j r
h j ħ	h ħ r	ħ j r
h j h	h h r	<u>h j r</u>3
h j ?	h ? r	? j r

The three listemes have the form *hjr* in common. Every occurrence of *hjr* is a copy of the archiroot, having its meaning through the listeme in which it is included. Since every listeme is a semantic field, then each copy of *hjr* bears a meaning related to the listeme in which it is included, following the semantic principle governing the formation of the listemes. Then, at least, three different unrelated meanings, are grouped together and coincide in one single root: the archiroot. This fact makes of every archiroot a polysemic lexical entry.

Root formation in Arabic is probabilistic. Polysemy is the result of the crossing of many listemes in a common phonetic form (Archiroot). The Archiroot *hjr*, for example, is a hybrid element in both phonetic and semantic aspects.

Lexicographers put all the lexical items related to the phonetic form *hjr* in one lexical entry in the dictionary, grouping together the different meanings and sorting out polysemy. Some of them tried to explain polysemy by establishing some kinds of logical relations between the different meanings in an attempt to handle the variety of uses. Others related polysemy to the variety of uses in the different eras and places in the history of Arabic. These explanations fail to handle polysemy, because there is no relation between the different meanings related to one singular root. The root *hjr*, for example, is in many lexical entries in the mental Lexicon of Arabic speakers, since they make easily the difference between its different uses and meanings.

3.2.1 *The archiroot: the stratified polysemy*

The meanings related to the entry *hjr* are usually presented in the dictionary following the morphological forms. Any verbal or nominal form may have different meanings. This kind of presentation is not convenient for our issue in this paper. The different meanings will be

presented in sets of common semantic features. The sets will be divided into main or principle meanings and secondary meanings. This distinction is based on the frequency of the bearing forms and the ability of the meaning to fit in one set or not.

In this section, we deal with the main meanings in the framework of the Probabilistic Model. For the secondary meanings see 2.2.3.

hjr:

1- main meanings:

- a) to break with, leave, forsake, renounce, emigrate, flee
- b) to be delirious, to dote, talk at random, idle obscene talk, custom, manner, habit, mockery.
- c) to travel in the heat of midday, hottest time of the day, hot midday, bitter dry plant.

The archiroot *hjr* is formed by the crossing of the three listemes generated by the schemes of c-2. Our model predicts that each copy of the root *hjr* in each listeme bears a meaning which fits easily in the semantic field or general notion related to the attested roots in the listeme.

Consider the first scheme of c-2 (F1F2V) where the values are as follows: F1=h, F2=j, V= any C of 28. The general notion common to the listeme is <leave, break> including many related notions like separation, ceasing (activity, state), cutting relations, leaving a place, discordance, etc. Thirteen out of fifteen attested roots bear this general notion. This gives one source of the meanings related to *hjr*:

F1F2V = hj- <leave, break>

hjb - urge, beat, hasten, thrust.

hjm - overthrow, pull down, drive away, expel.

hjl - direct a satire against, lampoon, biting speech, mockery.

hjf - be thrown into disorder (country).

hjn - deem or call one mean, damage one's honor or character.

hjs - repel-prevent, desist, murmur to one's self.

hjl - make a secret communication to.

hjl - let the camels go at large, *haajil*: who travels often.

hjr1 a)- break with, leave, forsake, renounce, emigrate, flee.

hjs - drive slowly, bring about mischief, discord.

hjj - leave one's country, emigrate.

hjs - sleep, subside, cease, appease one's hunger.

hjs - subside, cease, start doing something and interrupt it.

The second scheme of c-2 (F1VF2) where the values are: F1=h, F2=r, V= any C of 28, generates a listeme of roots having in common the general notion of <talk> including many related notions: organs of talk, ways of talk, contents of talk, frequency of talk, etc. Fourteen out of fifteen attested roots bear this general notion:

F1VF2= h-r <talk, dote, insult>

hbr - *habr*: a sudden pause made at the beginning of Koranic verse which is considered very bad reading, to mangle (with the teeth).

hmr - *hammaar*: talkative, garrulous -*hamrat*: growling, snarling.

hwr - surmise-suspect of.

hḍr - talk nonsense, foolishly, delirate, dote, be talkative.

htr - idle frivolous talk, insult, call names, confusion of mind, delirate from old age.

hdr - roar, give utterance, bray, shout.

hṭr - humility of a beggar.

hZR - thrash, ill treat, slander badly.

hrr - whine, yelp, detest, abhor, twang, *haarr*, weak from old age, decrepit, be of a bad character.

hšr - pertness, haughtiness, ingratitude.

hjr2 b)- delirate, dote, talk at random, idle obscene talk, custom, manner, habit, mockery.

hyr -*yahyarr*: dispute, quarrel/hayyir (who engages inconsiderately in...)

hkr - admiration, astonishment.

hṣr - *hayṣarat*: a woman who always shouts and quarrels.

The third scheme of c-2 (VF1F2), where F1=j, F2=r, V= any C of 28, generates a listeme of roots sharing the notions of thirst, liquid (water, wine, blood, etc.) and heat (natural or man-made). Fourteen out of nineteen attested roots bear this general notion:

VF1F2 = -jr < heat, thirst, liquid>

bjr - be full of water or milk without being satiated.

mjr -be thirsty, have the stomach full of water without being satiated, instil milk into someone's mouth.

wjr - instil medicine into a child's mouth.

fjr - drain water by breaking the rock, open a passage, a channel for water, blood, etc., to flow forth.

θjr - mix anything with the fermenting juice of a fruit-VIII:break forth (water, blood) flow over copiously.

djr - be confused in one's speech, drunk, *dayjuur*:dry herbage.

- njr -be seized with violent thirst, to boil water or milk with a hot stone, heat, hot time of the day.
 Sjr - heat the stove, start a fire.
 šjr - to lay clothes on the *mišjar-mišjar*: a tripod made of three pieces of wood used to lay clothes on.
 xjr - *xaajir*: the noise that water makes at the bottom of a mountain.
 ţjr - to become dry on the teeth and stuck (saliva)-V: to cover oneself with *mišjar*, *šjaar*: veil for women, hat (men).
 ħjr - stove of a pipe, brazier of a hookah.
 hjr3 c)- travel in the heat of midday, hottest time of the day, hot midday, bitter dry plant.
 ʔjr - bake bricks by the heat of fire.

The main meanings related to the Archiroot *hjr* may be represented as three layers anchored to one consonantal shape at which three listemes cross, each from a different departure depending on the values of Fs and Vs. Thus, *hjr* is three lexical entries in one as shown in Table1.

Table 1. ARCHIROOT *hjr*

Schemes	F1F2V	F1VF2	VF1F2
Values	h j -	h - r	- j r
Roots	h j r 1	h j r 2	h j r 3
Meanings	break	talk	heat
Listeme notions	break, leave, separate	talk, dote, insult	heat, thirst, liquid

3.2.2 The Archiroot: the network of stratified polysemy

The Probabilistic Model predicts that any root in Arabic lexicon is the crossing point of three listemes, each one generated by one of the schemes in c-2. Any root is an Archiroot. This phenomenon generates a network of relations between different listemes and roots: any listeme crosses with two other listemes in any root. Every root is common to three listemes since it is the point where they cross. Any root, when taken outside the network, is polysemic but it is monosemic when anchored in a determined listeme.

To test this hypothesis, we will follow the network starting at *njr* included in the listeme containing *hjr3* with the common notion <heat,

thirst, liquid>. Another path which consists of the root *hwr*, will be examined later. The main attested meanings of *njr* are the following:

- a) be seized with violent thirst, be seized with violent thirst from eating bitter seeds or drinking sour milk; heat, hot time of the day; to boil water or milk with a hot stone.
- b) cut or plane wood, hew, carve wood.
- c) hasten, beat to make moving fast.

The scheme F1F2V, where F1=n, F2=j, V= any C of 28, generates a listeme of roots with a common general notion related to the <speed, velocity> in movement (any activity, walk, travel, etc.). Fifteen out of eighteen attested roots bear this general notion:

F1F2V = nj- < speed, velocity>

njb - to flee, escape, *najjib*: fleet camel.

njm - to appear suddenly.

njw - run and pass by rapidly (horse, man, etc.), hurry, hasten, flight, speed.

njf - II: to start taking away (wind blowing the dunes).

njθ - to make a scream of distress, shout for help.

njd - start running, *minjadat*: small stick used to hasten the horse, swift and strong, to sweat, prepspire.

njz - complete speedily and successfully.

njl - walk fast, throw away, fling, kick .

njr1 c)- hasten, beat to make moving fast.

njš - hunt up the game, excite, initiate, hasten.

njj - hasten, hurry, *najjuj*: swift, agile.

njx - rapid torrent which digs in the ground, carry off parts of a precipice (torrent, water).

njſ -go after good food, water, good pasture.

njh - *naajih*, *najjih*: fast walk.

njh -come suddenly upon, I, V: drive away, expell someone with insults.

The scheme F1VF2, where F1=n, F2=r, V= any C of 28, generates a listeme of roots with a common general notion related to <piercing, spreading, carving>. Twenty out of twenty-three attested roots bear this general notion:

F1VF2 = n-r < piercing-spreading-carving>

nbr - pierce through and draw the lance quickly back, cattle, fly.

nmr - *namirat*: crooked piece of sharp metal in which a piece of meat is hanged to catch wild animals.

- nwr - brand an animal with a piece of iron heated in fire-tattoo.
- nfr - flee and disperse.
- nθr - scatter, spread, wound so as to make the blood run.
- nǒr - doom to death, place in front in a combat, amulet for wounds.
- ntr - pierce, tear with hands or teeth.
- ndr - be isolated, cut into something so as to drop the cut piece.
- nṯr - II: tear off (Tunisian Arabic).
- nsr - tear off-tear with the beak-wound, II divide into small parts.
- nṣr - water abundantly, conduct water into a river, *naaSir*: canal, channel, gutter.
- nšr - spread, cut or carve wood.
- njr2 b)-cut or plane wood, hew, carve wood.
- nkr - blood, pus etc issuing from the body.
- nqr - pierce through, excavate, carve or engrave in stone, pierce with the beak.
- nxr - be carious, putrid.
- nṣr - make the blood run out abundantly.
- nṣr - making the blood to spurt out with a noise.
- nḥr - slaughter a camel, wound at the collar bone.
- nhr - dig until one meets with water, enlarge the bed of a river.

The scheme VF1F2 generates *njr3* with F1=j, F2=r and V=any C of 28. *njr3* fits in the listeme containing *hjr3* presented above. The Archiroot *njr* is presented Table 2.

Table 2. ARCHIROOT *njr*

Scheme	F1F2V	F1VF2	VF1F2
Values	n j -	n - r	- j r
Roots	n j r 1	n j r 2	n j r 3
Meanings	hasten	carve	heat
Listeme notions	speed, velocity	piercing, spreading, carving	heat, thirst, liquid

The other sample is the Archiroot *hwr*. The attested main meanings of *hwr* are the following:

- a) - cause, incite, rush heading into (danger etc).
- b) - suspect of, surmise.
- c) - turn from, make to roll down.
- d) - be demolished, fall, destroy, pull down, fall from on high.

The scheme F1F2V, where F1=h, F2=w, V=any C of 28 generates the following listeme of roots that share the notion of <rush, incite, excite>. Fifteen out of nineteen attested roots bear this general notion:

F1F2V = hw- < rush, incite, excite>
 hwb - cry to, call to, bid, invite.
 Hwm - mad love, crazied.
 hwf - *huufun*: stupid, idle good for nothing fellow.
 hwð - *hawðal*: be swift, shaken, swing to and fro, trotter.
 hwt - cry out, call to.
 hwd - make someone drunk (a drink), abate.
 hws - II: excite a keen desire, give one pleasure, *-hawas*: folly, passionate desire.
 hwl - frighten, inspire with terror.
 hwr1 a)-cause, incite, rush heading into (danger etc).
 hwš - be excited, agitated, II: confuse, agitate, set dogs against one another, III: quarrel, VI: be set against.
 hwj - *hawija*: be foolish, thoughtless and precipitate, blow violently, precipitation.
 hwy - IV: rush against with something, X: madden with love.
 hwk - *hawika*: be half mad / V-*tahawwaka*: rush into danger.
 hwʕ - be easily excited, be about to attack one another, *hawaʕun*: disorderly desire.
 hw? - *hawa?* : purpose, intend.

The scheme F1VF2 where F1=h, F2=r, V=any C of 28 generates *hwr2* in the listeme including *hjr2* with the notion of <talk-dote-insult>:

F1VF2 = h-r < talk, dote, insult>
 ...
 hwr2 b)- suspect of, surmise, suspicion.
 ...
 hjr2 b)- to be delirious, dote, talk at random, idle obscene talk.

The scheme VF1F2 where F1=w, F2=r, V=any C of 28 generates a listeme of roots sharing notions related to the circular movement <turn-roll> with its ramifications: the direction of the movement, the place, the nature of activity , the object and any aspect which suggests a circular movement. All the attested roots bear this notion:

VF1F2 = -wr < turn-roll>
 bwr - *baaʕir*: hole in the ground to make fire in.
 mwr - oscillate, swing from side to side, roam, rove-, IV: raise dust.

- fwr - boil, babble, throw out foam and froth.
- θwr - stir and rise-rise and spread.
- ðwr - frighten, *ðuurat*: earth, dust.
- twr - flow, roam about, *taarat*: turn, time.
- dwr - move in a circle, revolve, walk around.
- ɸwr - go around anything, *ɸawr*: turn, time.
- nwr - avoid something, walk around respecting a certain distance.
- swr - get into one's head, II surround a place with walls.
- zwr -IX: deviate, go astray, swerve aside.
- ʃwr - bend, incline to one side, turn the face towards.
- dʷwr - V: writhe, roar from hunger.
- ʃwr - exhibit, show (a horse, a slave).
- jwr - astray from, IV: to cause one to turn aside from.
- kwr - wind in a spiral form, roll along, dig in the ground, fall down.
- qwr - surround the pray, make a circular cut or a round hole in any thing.
- xwr - IV: turn, twist, bend.
- ɣwr - make a foray, a raid on a tribe.
- ʕwr - take away, to cause one to turn aside from.
- ħwr - return, come back, *ħaaʕir*: confused, perplexed.
- hwr3 c)- turn from, make to roll down.
- ʕwr- flee and disperse, be in violent anger, have a sexual intercourse with a woman, motion of clouds, north-wind.

The Archiroot hwr is generated as in Table 3.

Table 3. Archiroot *hwr*

Scheme	F1F2V	F1VF2	VF1F2
Values	h w -	h - r	-w r
Roots	hwr1	hwr2	hwr3
Meanings	incite-rush	suspect	turn-roll
Listeme notion	rush, incite, excite	talk, dote, insult	turn, roll

We can imagine a wide operation, following the different archiroots and their consonantal interconnections with their corresponding semantic interconnections, to go through the nebula of Arabic Lexicon. Any root taken for itself has no value. It acquires its value(s) from the network in which it is involved. Any root should be considered at two levels: as a member of a listeme (a root) and as a crossing point between three listemes (archiroot).

The network of the crossing listemes in the different roots studied above shows the way polysemy in Arabic Lexicon works. This network may take the representation illustrated in Table 4:

Table 4. Lexicon

	...	ARCHIROOT	ARCHIROOT	ARCHIROOT	ARCHIROOT	...	
Scheme	F1F2V	F1VF2	VF1F2	F1F2V	F1VF2	F1F2V	VF1F2
Values	n j -	n - r	- j r	h j -	h - r	h w -	-w r
	---	---	---	---	---	---	---
	---	---	---	---	hwr2	hwr1	hwr3
	---	---	---	---	---	---	---
Roots	---	---	hjr3	hjr1	hjr2	---	---
	---	---	---	---	---	---	---
	njr1	njr2	njr3	---	---	---	---
	---	---	---	---	---	---	---
Meanings	hasten	carve	heat	break	suspect	incite	roll

3.2.3 The archiroot: the stratified polysemy in the network of crossing listemes:

The Archiroot is the product of crossing listemes: each listeme charges the root copy with a semantic value making polysemy a current phenomenon. Meanings are assumed to be organized in strata in the Archiroot. The strata are of two kinds, depending on the level of crossing: the main crossing level would give the main meanings to the Archiroot; the secondary crossing level gives secondary meanings.

In this section, secondary meanings of the Archiroot *hjr* are examined. They are considered secondary, because they do not occur in frequent morphological forms related to *hjr*. They are the result of another layer of stratified polysemy related to the crossing between listemes. The Archiroot gets one main meaning from each listeme in which it fits following the scheme that generates it. This meaning is related to the most frequent notion in the listemes. However, being member of the three listemes at the same time enables the Archiroot to bear some other meanings, proper to one or many roots in one listeme or more. The secondary meaning in an Archiroot like *hjr* may be one of the main meanings of the Archiroot which is the source of that meaning, since every root is an Archiroot. Explaining the presence of these secondary meanings at the Archiroot, using the same general

principles elaborated above insures the explanatory adequacy of the Probabilistic Model.

The different secondary meanings of *hjr* are presented with the forms bearing them and their lexical category (Verb, N=Noun, A=Adjective), followed by their possible sources in the different listemes generated by the schemes:

a) -rope used to tie up the foot of the camel-bridle, halter-chain:[hajar (Verb),hijaar(N),hajr(N)]

F1F2V = h j -

hjj - hujj : yoke.

VF1F2 = - j r

mjr - *mijaar*: a rope used to tie the last articulation of the foot of a camel to its higher part, so that the camel stands only on three feet and can not move.

bjr - *ʔabjar* (pl. bujr): cable, thick rope (of a ship).

sjr - *saajuur*: a piece of wood tied to the neck of a dog.

šjr - *šijaar*: a piece of wood put into the mouth of a small goat to prevent it from milking its mother.

b) -good, excellent, noble, handsome, beautiful-first rate: [*hajar*(Verb), *hajr*(A), *hijr*(A), *haajir*(A), *haajiriyy*(A)]

F1F2V = h j -

hjn -*hijaan*: be from a noble family and well-considered (man, woman), white camel(s) from an excellent race.

VF1F2 = - j r

njr - najr : root- origin, be well-considered, esteemed.

ħjr - *ʔaħjaaru-l-xayl*: horses of pure race chosen to propagate the race.

c)- large cistern,watering-trough - large cup used to drink: [*hajiir* (N)]

F1F2V = hj -

hjm - *hajm/hajam*: large cup used to drink.

VF1F2 = -jr

mjr - *maajuur*: pottery vase.

?jr - *maajuur*: red pottery vase -earthen pot- flower vase.

d) - slight meal, lunch taken at midday: [*hajuuriyy* (N)]

VF1F2 = -jr

Njr - IV: give to someone the food called *najiirat*: milk mixed with butter and flour.

e)- diadem: [hijaar(N)]

VF1F2 = -jr

ʕjr - *ʕijaar*: veil worn over the face or head.

miʕjar: veil for women, turban.

f)- chain put at the neck as an ornament: [*hijaar* (N)]

VF1F2 = -jr

sjr -*saajuur*: chain at the neck (leather, metal).

g)-curdeled milk (coagulated): [*hajiir*(A)]

F1F2V = hj-

hjm - *hajiimatun*: milk put in a new goat skin intended to be drunk.

hjs - *haajisatun*: turned milk in a goat skin.

hjn - *hajiin*: milk that is no longer colostrum but is not yet totally pure.

F1VF2 = h-r

hdr - *haadir*: milk when it starts to curdle by being thicker at the surface and thin below the surface.

VF1F2 = -jr

njr - *najiirat*: milk mixed with flour.

h)- numerous, very great number: [*muhjir*(A)]

F1F2V = hj-

hjm - *hajmat*: herd of camels from forty to one hundred.

hjš - *haajišat*: great number of men which is just formed -new band of men.

F1VF2 = h-r

hwr - *hawr*: considerable great herd of sheep.

hrr - *hurr*: big quantity of water or milk.

hyr - *yahyarr*: great quantity of water.

VF1F2 = -jr

mjr - *majr*: big quantity, numerous army.

fjr - *fajar*: considerable quantity of wealth.

θjr - *θujrat*: a band of men separated from the others.

i) -to be (very) old: [*hajrat*(A)], an old stallion which has no force to cover females: [*hajiir*(A)], who walks heavily, slowly: [*hajir*(A)]

F1F2V = hj-

hjf - *hijaff*: old ostrich.

hjl - *hawjal*: someone who is heavy and walks slowly.

F1VF2 = h-r

hmr - *hamiirat*, *haymarat*: old woman.

hwr - *haar*: weak from old age (man).

hyr - *hayyaar*: weak (man).

hṣr - *hayṣarat*: old woman.

j)- architect: [*haajiriyy* (N)]

VF1F2 = -jr

ħjr - *ħajjaar*: stone builder, sculpter.

?jr - *?aajurr*: bricks.

k)- year, some time [*hajrat*(N), *hajr* (N)]; applying the notion of emigration to time periods (year, some time) may be related to the Islamic calendar based on the Prophet Muhammad's emigration from Mecca to Medina which was the starting year of the Hijriy calendar.

l)- citizen, inhabitant of a town: [*haajiriyy* (A)]; this meaning is related to the main meaning of *hjrI*: <*hijrat*: removal from the desert to a town>.

3.3 Archiroot-morphology interface: polysemy and triliteral verb templates:

In theory, every linguistic unit should be monosemic. However, the formation of the root in Arabic Lexicon makes polysemy unavoidable with the different layers of meanings grouped together at the phonetic shape of the Archiroot within the network of crossing listemes. Nevertheless, there exists in Arabic Morphology a systematic tendency to reduce polysemy. The existence of different verbal forms or nominal forms with a single meaning is limited in Arabic. If that fact is attested, even in a limited amount, then it supports many of our claims. Morphology and consonantal roots interaction needs to be investigated deeply in the framework of the Probabilistic Model. So far we noticed that the same root, *ḥsb*, for example, takes three verbal forms with different vocalic segments expressing three different lexical meanings:

C1aC2aC3	ḥasab	aa	(past)	<count, calculate>
C1aC2iC3	ḥasib	ai	(past)	<opine, surmise, think, consider>
C1aC2uC3	ḥasub	au	(past)	<be esteemed, of a noble family>

The traditional account of this fact bears on the nature of the vocalic segments. Each verbal template corresponds to a kind of lexical meaning (action, thought, process, etc.). Therefore, the distinction between the three meanings is related to the verbal template and the root bears all of them. However, we may posit the problem in an opposite way: how can a single root take three different verbal forms?

We assume that *ḥsb* is an Archiroot made of three copies of *ḥsb*, each one being generated separately by the schemes of c-2. *ḥsb* is the crossing point between three listemes where each copy is a member of a listeme of roots having one unifying semantic field. In verbal derivation the root will take the corresponding form to its meaning. The distinction is at the heart of the system and does not occur after the root generation.

The scheme F1F2V where F1=H, F2=s, V=any C of 28, generates a listeme of roots sharing the notions of <cut, select, separate>. Calculation has to be conceived in its primitive aspect related to the early stages of human evolution: counting with one's fingers is a kind of separation, selection and accumulation. The perfective-active verbal form corresponding to the notions <cut, select, separate> is C1aC2aC3

giving *ḥasab* from *ḥsb1*. This verbal form denotes transitivity. Ten out of eleven attested roots bear this general notion:

F1F2V = ḥs- < cut-select-separate >

ḥsb1 -*ḥasab*: count, calculate, suffice.

ḥsm-cut, cut off, subtract, deduct, *ḥaasim*: destructive.

ḥsw - to drink a little at a time.

ḥsf -shave off the moustache, select, mow, reap.

ḥsd -envy, grudge, punish (God).

ḥss -burn, make vanish, kill, VII: be extracted, fall out, decay (teeth).

ḥsl -select and separate the worst part

ḥsr -peel the skin of the tree, pare, shell, destroy with a forceful movement.

ḥsy -dig for water in saturated ground, to drink a little at a time.

ḥsk - *ḥskl*: slughter a young camel.

The scheme F1VF2 where F1=H,F2=b,V=any C of 28, generates a listeme of roots sharing the notion of <think, feel, attitude>. The perfective verbal form corresponding to the notions <think, feel, attitude> is C1aC2iC3 giving *ḥasib* from *ḥsb2*. Ten out of fourteen attested roots bear this general notion:

F1VF2 = ḥ-b < think, feel, attitude >

ḥbb - love, desire, wish.

ḥwb-sin, transgress,V-be sorrowful, grieved, *ḥawb*:love of a mother.

ḥdb - be devoted, benevolent, kind, compassionate.

ḥṭb - help, calumniate, *?aḥṭabu*: miserable.

ḥnb - feel pity for someone.

ḥsb2 *ḥasib*: opine, surmise, think, consider.

ḥzb - cause anxiety, *ḥaazib*: difficult, grave, serious.

ḥrb - be ceased with anger, have a fit of rage.

ḥšb - be ceased with anger, irritate.

ḥjb - *ḥjaab*: modesty.

The scheme VF1F2 where F1=s, F2=b, V=any C of 28, generates a listeme of roots sharing the notions related to a well- considered social position or personal moral qualities inherited or acquired: <family-esteem-nobleness>. The perfective verbal form corresponding to the notions <family-esteem-nobleness> is C1aC2uC3 giving *ḥasub* from *ḥsb3*. Seven out of seven attested roots bear this notion:

VF1F2 = -sb < family, esteem, nobleness>

nsb -origin, genealogy, pedigree, family, *ḥasab wa nasab*:descent and personal merit.

lsb - bite, wip.

rsb - *raasib*: gentle, mild, meek, fit in.

ksb - gather riches, knowledge, *kaasib*: executor.

qsb - be hard.

ʕsb - cover (stallion), *ʕasuub*: chief of a tribe, descendance.

ḥsb3 - ḥasub: be esteemed, be of a noble family.

The Archiroot *ḥsb* is represented in the following Table 5 below.

Table 5. *ḥsb* Archiroot

Scheme	F1F2V	F1VF2	VF1F2
Values	ḥ s -	ḥ - b	- s b
Roots	ḥsb1	ḥsb2	ḥsb3
Meanings	count	opine	be noble
Listeme notions	cut, select	think, feel	family, esteem
Verbal forms	C1aC2aC3	C1aC2iC3	C1aC2uC3
Action/state	transitive	temporary	permanent

3.4 Reduplication in the Probabilistic framework

Reduplication (gemination) in Arabic roots is of two kinds: partial and total. Partial reduplication applies to the second C of the trilateral root. Total reduplication applies to two consonantal roots giving quadriconsonantal ones. Bohas assumes reduplication as a particular way of root realization. His argument is based on the semantic relation (strong or weak) between different roots having in common the two consonants of the etymon. The argument is sound but reduplication itself is not founded. It is conceived as a phenomenon apart, unrelated to other rules of the root formation. Ehret (1989) considers reduplication a formal operation applying to biliteral roots to meet the triconsonantal shape required by the verbal form.

In the Probabilistic Model, not only polysemy is taken into account, but also the root formation rules, including reduplication, are established considering semantic and phonological articulatory aspects. Reduplication is part of the principles governing root formation. A reduplicated root is part of the listeme generated by the different schemes of the structure c-2: F1F2V, F1VF2, and VF1F2.

Starting from the canonical schemes, reduplication occurs when the value of V is the same as the immediate preceding or following F. This device generates the following forms of reduplication:

F1F2V	where F2=V	C1C2C2	(productive)
F1VF2	where F1=V	*C1C1C2	(non productive)
VF1F2	where V=F1	*C1C1C2	(non productive)

Forms (b) and (c) are ruled out by a general principle governing root formation in Arabic Lexicon which stipulates that C1 and C2 of the trilateral roots must be distinct. However exceptions are attested but they are very limited (*bbr: babr* “tiger”). Form (a) where C2 is identical to C3 is productive. The listemes generated by the schemes of C-2 including the Archiroot *hjr* are presented briefly showing how reduplication works while ruling out the unattested roots:

Schemes	F1F2V	F1VF2	VF1F2
Values of F	h j -	h - r	- j r
Root listemes
	h j r1	h r r	*r j r

	h j j	h j r2	*j j r

	*h j h	*h h r	h j r3

Some pairs of corresponding roots (the non-reduplicated and the reduplicated) are presented (from the data analyzed above) as follows:

F1F2V = hj-

hjr1 - break with, leave, forsake, renounce, emigrate, flee.

hjj - leave one's country, emigrate.

F1VF2 = h-r

hjr2 - deliriate, dote, talk at random, idle obscene talk, custom, manner, habit, mockery.

Hrr - whine, yelp, detest, abhor, twang, decrepit, be of a bad character.

F1F2V = nj-

njr1 – hasten, beat to make moving fast.

njj - hasten, hurry, *najuuj*: swift, agile.

F1F2V = ħs-

ħsb1 - *ħasab*: count, calculate, suffice.

ħss – burn, make vanish, kill, VII, be extracted, fall out, decay (teeth).

F1VF2 = ħ-b

ħsb2 - *ħasib*: opine, surmise, think, consider.

ħbb - love, desire, wish.

The phenomena of reduplication represents an entry to a huge network between archiroots in Arabic Lexicon. Following the principles established in the Probabilistic framework, *hjj* is an Archiroot and therefore polysemic, since it includes three copies (roots) each generated separately by one scheme of the structure c-2 as follows:

F1F2V where F1=h, F2=j, V=any C of 28 → *hjj*1

F1VF2 where F1=h, F2=j, V=any C of 28 → *hjj*2

VF1F2 where F1=j, F2=j, V=any C of 28 → *hjj*3

The archiroot *hjj* has the following principle meanings:

hjj :

a)- leave one's country, emigrate.

b)- X: stimulate, hasten (for ex. voyagers so they walk fast), *hajaaj*: fast walk.

c)- pull down, be deep set or sunk (eye).

hajijj: deep valley-long beach through which voyagers always go to their destinations, to descend into a valley.

The scheme F1F2V with the values hj- generates a listeme dominated by the notion of < break> (as we have seen above) as follows:

F1F2V = hj- <leave, break>

....

*hjr*1 - break with, leave, forsake, renounce, emigrate, flee.

....

*hjj*1 a)-leave one's country-emigrate.

....

The other scheme F1VF2 where the values are h-j generates a listeme dominated by the notion of <agitation-rapid move> including some related meanings like violence in speech or behavior, confusion, excitement, etc. Ten out of ten attested roots share this notion:

F1VF2 = h-j <agitation, rapid move>

hbj - beat repeatedly, *habjat*: blow .

hmj -dispatch (well or badly), IV: strain the nerves in running, *haamij*: violent.

hwj -blow violently, be foolish, thoughtless and precipitate, tempest, hurricane.

hdj - walk with a tremble, trotter, V: tremble.

hnj - V- come to life and move (foetus).

hzj - quiver (tremble, to shake tremulously).

hlj - *hulj*: confused dreams.

hrj - excitement, agitation, tumult, great confusion.

hjj2 -X: stimulate, excite, hasten (voyagers so they walk fast), *hajaaj*: fast walk.

hyj - be agitated, be moved with a violent passion, rush against and attack.

The third scheme VF1F2 with the values -jj generates a listeme of roots sharing the notions of <deep, sunk, liquid>. The relation may not be obvious. It has to be built through the elementary features making the image of an eye (shape, color, brightness, physiological liquid (tears) etc., being deep or sunk (far in the distance) into the head with both salient brows. This image fits into the general notion shared by the roots in the listeme that is built up by the depth (pull down, cut, the movement of the liquid (bleed, flow, drink, water, blood, etc.), the movement in the liquid (sink, plunge) and the extraction of the liquid. Sixteen out of nineteen attested roots bear this general notion as follows:

VF1F2 = -jj <deep, sunk, liquid>

bjj - prick open (a tumour), pierce.

mjj - spit out.

fjj - cut in two, split into several pieces, open wide, interval, an opening between two mountains, a wide road between two mountains, *?ifjiij*: narrow and deep valley.

sjj - drink, be just returning from a journey.

θjj - flow abundantly, *θajj*: blood pouring out from a victim.

đjj - call for assistance in a battle.

njj - bleed, suppurate.

zjj - pierce with the point of a lance.

d'jj - drop, drip (rain, tent), to be armed to the teeth.

ljj - be deep, deeply furrowed, plunge to the deep, *lujj*: enormous quantity, immense mass of water.

šjj -plough the sea, mix the wine with water, cleave or break the head, be wounded or scarred, *šujjat*: broken skull, wound in the head.

xjj -to descend into the valley, *xajxaj*: hide his feeling deep in the heart.

ʕjj - to descend into the valley.

- ħjj - to probe, to sound (a wound), extraction of sequestrum, incision (of a wound, a head wound), *ħjjat*: hole (in the ear lobe).
 hjj3 - be deep set or sunk (eye), *hajijj*: far-stretching deep valley, far, stretching beach through which voyagers are always going to their destinations.
 ?jj - *?ajaaj*: bitter, salt.

3.5 *The Continuum: phonology-semantic interface*

One of the basic principles of root formation established in the Probabilistic Model consists of the correspondence between the phonological and semantic aspects. The listeme generated by the schemes of c-2 is supposed to be governed by the articulatory continuum which corresponds to a semantic continuum. The two Fs are common to the whole members of the listeme and make its phonetic identity. All the roots sharing the same Fs bear a common general notion which makes the semantic unity of the listeme.

The consonants representing the values of Vs are the distinctive segments between roots in the same listeme. This distinction corresponds to a semantic distinction between different meanings proper to any root from the listeme. This distinction is not systematic because of the synonymy relation between roots in the listeme due to use or to lexicographer's definitions.

The correspondence is established between phonological features and semantic features. It may be of three levels as follows:

- a) The two Fs in the listeme bear the semantic field.
- b) The phonological features which are common to a group of Vs in the listeme correspond to semantic features common to a subfield of the general semantic field.
- c) The particular phonological feature of a variable consonant corresponds to a particular semantic feature born by the particular root in the listeme.

To demonstrate the continuity in root formation based on the principles established in the Probabilistic Model, the listeme generated by the scheme (F1VF2=n-r) is represented here (Table 6). The two Fs <n> and <r> make the phonetic identity of the listeme to which corresponds the semantic field (general notion) of <piercing, spreading, carving>. The segments corresponding to Vs in the listeme are in bold

letters summarizing the phonological features. The following semantic features (thematic roles) are entries to the classification of the different meanings related to each root in the listeme: Action, Agent, Object, Manner, Place, Instrument, and Goal. The space between lines glossing the meanings indicates the distribution of roots corresponding to the semantic differences between subsets of the semantic field (___) or differences between peculiar meanings in the same subset (_):

Table 6. Representation of a listeme generated by the scheme F1VF2 = n-r
< piercing, spreading, carving >

Action	Agent	Object	Manner	Place	Instrument	Goal	
nbr pierce	human	flesh	quickly	into+out	lance	kill and withdraw	
nmr pierce	_	mouth	0	_	metal	catch _	
nwr burn	-	skin	heated	surface	-	mark__	
nfr disperse	0	0	all directions	surface	0	flee	
nθr spread	0	0	circular	surface	0	0	
	wound	0	flesh	through	into	0	run blood
nđr stand	human	0	0	front	0	0	combat
	amulet	-	wound	0	0	0	heel__
ndr cut	-	0	drop	into	0	0	0
ntr tear	-	0	0	0	hands-teeth	0	0
nṭr tear	-	0	off	surface	0	0	0_
nsr tear	bird	flesh	0	into	beak	0	0
	divide	0	0	small parts	0	0	0__
nṣr dig	human	earth	long	into	0	0	conduct water_
nšr spread	human	0	all directions	0	0	0	0
	cut	-	wood	0	into	0	0
	carve	-	-	0	surface	0	polish-design
njr2 cut	-	-	0	into	0	0	0
	carve	-	-	0	surface	0	polish-design
nqr carve	-	stone	0	- / into	0	0	0
	pierce	0/bird	0	0	through	0/beak	0
nxr carious	0	bone	round	inside	0	0	0__
nkr run	liquid	body	0	out	0	0	0
nṡr run	blood	vein	abundance	-	0	0	0
nṣr spurt	blood	vein	noise	-	0	0	0
nḥr wound	human	vein	0	collar bone	0	0	for food_
nhr dig	-	earth	deep	into	0	0	for water

4. Conclusion:

In this paper we tried to present an account of the organization of the lexicon in Classical Arabic in both phonological and semantic aspects. Three main issues were discussed: the root formation, the relation between the root component and Morphology and the phenomena of gemination. We argued that the formation of the roots is probabilistic, governed by schemes working with two kinds of elements: fixed and variable. Each scheme generates a listeme of roots having a general notion in common. It happens that three schemes, thus three listemes, cross at one particular root and the result is a polysemic form bearing, at least three meanings. We called this form Archiroot which comprises at least three identical consonantal copies, each one bearing its own meaning inherited from its own listeme. This fact makes polysemy unavoidable. Morphology works to minimize polysemy by establishing some kind of correspondence between the lexical meaning related to one particular copy in a particular archiroot and a particular morphological verbal or nominal template. These correspondences make each copy in an archiroot have its own derivational network. This aspect needs to be dealt with further. This will be the focus of the next step in elaborating the probabilistic model in future work. We also demonstrated that gemination is not a formal arbitrary device. Instead it is an integral part of the probabilistic functioning of root formation in Arabic lexicon. Any geminated root is an archiroot like any other regular root.

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