

Morpho-phonology and the Lexicon-Syntax Interface: Thematic Operations in Standard Arabic, Palestinian Arabic and Hebrew¹

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1. Introduction

This paper sets out to examine the role of morph-phonology and its application with respect to other components of the grammar, the lexicon and the syntax, based on the morpho-phonology of thematic arity operations. Different thematic realizations of the same concept are assumed to be derived from the same basic entry via arity (valence changing) operations. I examine five such operations in the verbal systems of Modern Standard Arabic (hereafter MSA), Palestinian Arabic (hereafter PA) and Hebrew.²

(1) Thematic arity operations (Hebrew)

Type of Operation	Examples	
Passivization	tipel → tupal	'took care of' → 'was taken care of'
Decausativization	higiz → hitragez	'upset' → 'became upset'
Causativization	xatam → hextim	'signed' → 'made X sign'
Reflexivization	serek → histarek	'combed' → 'combed oneself'
Reciprocalization	xibek → hitxabek	'hugged' → 'hugged each other'

I will shed light on three intriguing generalizations observed in the three verbal systems, involving morpho-phonological differences between passivization and other four arity operations.

(2) Generalizations

- i. Passivization shows unidirectional relations between input and output forms, while the other operations demonstrate bidirectionality, with some forms serving both as a base and as a derived form.
- ii. Passivization is performed mainly by changing the vocalic pattern of the verb, unlike other operations, which are manifested by different morpho-phonological processes, such as affixation and gemination.³
- iii. The morphological output of passivization can be easily predicted, in contrast to other operations that have more than one possible output form.

I argue for a correlation between arity operations and their morpho-phonological manifestation. Specifically, I will show that the difference in the component of the grammar

¹ I would like to thank Outi Bat-El and Tal Siloni for their constructive comments and suggestions.

² The analysis of MSA and PA is based on the judgments of native speakers of Arabic as well as on data drawn from Wehr's (1961) Dictionary of Modern Written Arabic and Wright (1889).

³ PA demonstrates a different pattern of passivization. I will address this issue in section 6.1.

where operations take place, lexicon vs. syntax, is what underlies the observed generalizations. This analysis is provided within the framework of the word-based theory (Aronoff 1976) and the theory of the Lexicon-Syntax Parameter (hereafter 'Lex-Syn Parameter') (Reinhart & Siloni 2005). I will argue that the setting of this parameter dictates morpho-phonological properties with regard to the variety of derivations which can take place, the predictability, and the directionality of such operations.

This paper is organized as follows: In §2 I provide the theoretical basis for the analysis. Section 3 outlines the five types of arity operations discussed in this paper. Section 4 deals with the verbal systems of MSA, PA and Hebrew. In §5, I discuss the morpho-phonological processes responsible for deriving one verbal form from another. In §6, I analyze the morpho-phonological differences between syntactic and lexical operations based on the processes which manifest the derivation of new predicates.

2. Theoretical Framework

My analysis is couched within two theoretical frameworks, Aronoff's (1976) word-based model of morphology and the Lexicon-Syntax parameter (Reinhart and Siloni 2005).

2.1. The Word-based Approach

2.1.1 Words vs. Morphemes

The word-based approach, originally proposed in Aronoff (1976), is based on the notion that the lexicon consists of words rather than morphemes or roots. Aronoff's main thesis states that a new word is formed by applying Word Formation Rules (WFRs) to an already existing word. Both the new word and the existing word are members of a major lexical category. Every WFR specifies the following: (i) The properties of the words on which it can operate. (ii) A unique phonological process which is performed on the base. (iii) A syntactic label and subcategorization for the resulting word. (iv) A semantic reading, which is a function of the reading of the base, for the resulting word. Aronoff refers to these rules as once-only rules. These rules do not apply every time the speaker of a language speaks. They serve for producing new words, which may be added to the speaker's lexicon, and redundancy rules defining morphological relations. They are thus different from the rules of syntax and post-lexical phonology, which must apply in the derivation of a sentence.

2.1.2 Stem Modification

There are two main approaches to the relation between a consonantal root and a vocalic template in Semitic languages, such as Arabic and Hebrew. The tradition approach views takes the consonantal root, which consists of 2-4 consonants in a specific order, as carrying the core meaning of the stem, and thus expresses the semantic relations between stems. This view is structurally expressed by the multi-tiered representation proposed by McCarthy (1981), where the vocalic patterns are

represented independently, on the basis of morphological categories. Deriving new forms involves the extraction of a consonantal root from the base form and associating it with a given template (Bat-El 1986). However, this approach invokes both a theoretical and empirical problem, known as the problem of transfer (Bat-El 1994). Recent research has revealed that the information transferred from the base to the derived form is not only the order of the consonants but also which consonants occupy adjacent positions in the base, i.e. whether two or more consonants form a cluster.

Stem Modification is an alternative theoretical model, which can account for generalizations about morpho-phonological alternations as it allows for internal stem adjustments. It was first introduced in Steriade (1988) in the analysis of reduplication and in McCarthy and Prince (1990) in the analysis of the formation of the Arabic broken plurals and diminutives. Arabic broken plurals cannot be derived by root-to-template morphology, as there are structural properties that are drawn from the singular base, which cannot be attributed to either the root or the template. This is attested when vowel length is transferred from the singular stem to the plural (3a) and when derivational morphemes survive derivational processes (3b).

(3) Arabic broken plural

- a. qindiil → qanaadiil 'lamp'
- b. miftaaḥ → mafaatiiḥ 'key'

These examples show that lexical relations in Arabic broken plurals involve more than just the root and are established over words or lexemes.

Bat-El (1994) provides further support for this model within the analysis of the formation of denominative verbs in Modern Hebrew. Bases which contain five or more consonants arranged in clusters yield verbs containing the same clusters.

(4) Transferred Clusters

- praklit 'lawyer' → priklet 'to practice law'
- sandlar 'shoemaker' → sindler 'to make shoes'

Moreover, denominative verbs whose vocalic pattern is the marked *o-e* can be derived only from nouns whose base contains the vowel /*o*/ (4).

- (5) tof 'a drum' → tofef 'played a drum'
 kod 'a code' → koded 'coded'

This provides further support for stem modification motivated by the need to keep the derived verb as faithful as possible to its base when a suitable vocalic pattern exists in a language.

The root extraction approach assumes that the template contains a certain CV order and fails to explain why this structure is different for different verbs of the same template. Moreover, it does not explain why a multi-consonantal root should be arranged as its base, in addition to the order of the consonants. In stem modification, however, the relevant changes are made on the base itself and thus, it is not surprising that some of the base's properties survive in the derived form.

2.2. The Lexicon-Syntax Parameter

2.2.1 Thematic Relations

The theta system is the System enabling the interface between the conceptual and computational systems, the syntax and, indirectly, the semantic interface systems (Reinhart 2000). For each set of systems of the UG, one assumes the existence of some central system that gathers information, which may be legible for sets of systems and enables the interface. The theta system can be viewed as the central system of the system of concepts.

The theta system consists of lexical entries, specified for their theta roles and a set of arity operations on lexical entries, which may generate new entries, or just new options of realization.

2.2.2. The Lexicon-Syntax Parameter

Although predicates such as reflexives and reciprocals are derived by the same kind of operation universally, the considerable crosslinguistic variation they exhibit results from the level in which these operations apply according to a parametric choice. Reinhart & Siloni (2005) suggest that UG arity operations, which affect the syntactic valence of a verb can apply in the lexicon or in the syntax, as formulated in the following parameter.

(6) The Lex-Syn Parameter (Reinhart & Siloni 2005)

UG allows thematic arity operations to apply in the lexicon or in the syntax.

The syntactic component of the grammar is the engine that builds phrases from elements selected from the lexicon. The question arises as to whether the syntactic components can manipulate the thematic information of these elements. It has been suggested that the syntactic machine operates with the selected elements and the lexical-semantic information they bear and cannot change their basic properties (Siloni 2002). Once a theta role is part of the theta grid of a predicate in the structure, it must either be merged as an argument or have a residue in the syntax or at the level of interpretation. This is formulated in the following guideline.

(7) The Lexicon Interface Guideline (TLIG)

The syntactic component cannot manipulate theta grids: Elimination, modification or addition of a theta role are illicit in syntax

While lexical operations apply to basic entries, operations in syntax apply to a syntactic structure, which is already associated with the semantic representation of an event. The Lex-Syn parameter is applicable only if the grammar includes an active lexicon (Siloni 2002), which is more than a mere list of items, and allows the application of derivational operations. The lexicon and the syntactic component are expected to be nonredundant systems, whose constraints and workings are different. The inventory of concepts does not contain a syntactic structure, as this would be superfluous reduplication of the syntactic component. Thus, there is no relation between distinct predicates; only a syntactic structure puts them together.

3. Thematic Arity Operations

3.1 Types of Thematic Arity Operations

In this section I discuss five types of thematic arity operations.

3.1.1 Passivization

Passivization involves an operation labeled saturation, which saturates the external theta role by existential closure (Chierchia 1989/2004, Reinhart & Siloni 2005). The external argument is no longer syntactically accessible, but it is still accessible at the level of interpretation. Passivization can apply to predicates, which bear both an external and an internal theta role.

Horvath and Siloni (2005) provide evidence that this operation is syntactic. Although the Lex-Syn parameter does not directly dictate which processes must take place in syntax, it is theoretically preferable to consider operations as syntactic, as long as the theta grid does not change. The syntax is therefore considered to be the default component for thematic operations.

3.1.2 Decausativization and Causativization

Decausativization derives unaccusative and subject experiencer predicates, by fully eliminating an external theta role. This arity operation is restricted to predicates whose external argument is a cause and their internal argument is a theme or an experiencer⁴. Similarly to passivization, the predicate's valency is reduced and the verb loses its accusative case. However, unlike passivization, the reduced argument is no longer accessible at the level of interpretation. As demonstrated for MSA in (8), it is possible to add a by-phrase in cases of passivization (8a), while it is impossible in cases of decausativization (8b).

- (8) a. kusira ʔal- ʃubbaak ʃala yad zayd-in
 'The window was broken by Zayd'
 b. *ʔinkasara ʔal- ʃubbaak ʃala yad zayd-in
 'The window broke by Zayn'

⁴ When the internal theta role is a theme, this operation derives unaccusative verbs (e.g. *waqaʃ* 'fell'), while it derives subject experiencer verbs when the internal theta role is an experiencer (e.g. *zaʃil* 'was upset').

The operation of causativization adds a theta role to the theta grid of the predicate. This operation applies for predicates whose external theta role is necessarily an agent. According to TLIG (7), both causativization and decausativization are lexical operations, as in both cases, the theta grid is manipulated.

Pesetsky (1995) views the operation of causativization in a much broader range. He derives the transitive alternate of unaccusatives, transitive and unergative verbs from the one place entry by causativization. Reinhart & Siloni challenge this analysis as it raises several problems. First, this operation adds a new role to the basic entry. This role alternates between an agent for transitive and unergative verbs and a cause where unaccusative verbs are concerned. If this is the same operation, why would it be a different role? Second, as opposed to unergative and transitive verbs, causatives and unaccusatives show derivational morphology. This implies that they are both not separate entries in the lexicon but derived by an operation. Third, following Pesetsky's analysis, we would lose the definition of the set of unaccusative and the unergative predicates, as they all undergo the same operation. Finally, languages such as French (Friedman 2000) do not have lexical causativization. There is a lexical alternation between unaccusative and unergative verbs, while there is no such alternation between unergative and causative verbs. How can we explain that a language exhibits only a part of this predication? These lend support to the analysis that a different lexical operation is involved where causative and unaccusative verbs are concerned.

3.1.3 Reflexivization and Reciprocalization

Reflexivization and reciprocalization do not eliminate a theta role. Rather, a theta role is not mapped onto a syntactic argument position present in the semantics of such predicates. Reinhart & Siloni (2005) argue that when these operations apply in the lexicon, they take two theta roles and form one complex theta role. They call this operation bundling, a prerequisite of which is to operate on an external theta-role. This operation associates two theta roles with the external argument.

(9) Lexical Reflexivization Bundling

$[\theta_i] [\theta_j] \rightarrow [\theta_i - \theta_j]$, where θ_i is an external theta role.

The reciprocalization operation is similar to that forming reflexives but its semantics are different. While the reflexive denotes a reflexive event, the reciprocal denotes a reciprocal event. When reflexivization and reciprocalization apply in the syntax, the operation is different. Following TLIG (6), manipulation of the theta grid is possible only in the lexicon. Thus, bundling in syntax does not apply to the theta grid of the verb, but to unassigned theta roles. An internal theta role is not mapped onto its canonical

position due to the lack of case. The unassigned role retains the verbal projection until the external theta role is merged. Upon the merging of the external theta-role, the unassigned role is bundled with the external role, resulting in the assignment of two roles to the same syntactic argument.

4. The Verbal Systems

The verbal systems of MSA, PA and Hebrew consist of prosodic shapes called binyanim. The binyan indicates the phonological shape of the verb, i.e. its vowels, its prosodic structure and its affixes (if any). The phonological shape of a verb, unlike that of a noun, is essential for determining the shape of the other forms in the inflectional paradigm (Bat-El 1989, Aronoff 1994). A verb, which does not conform to one of the existing binyanim cannot enter the verbal system. Therefore, every new verb that enters the language must conform to one of the existing vocalic patterns.

(10) MSA Binyanim⁵

Perfect	Imperfect
faʕal	ya-fʕa/i/ul
faʕʕal	yu-faʕʕil
fa:ʕal	yu-fa:ʕil
?afʕal	yu-fʕil
tafaʕʕal	ya-tafaʕʕal
tafa:ʕal	ya-tafa:ʕal
?infaʕal	ya-nfaʕil
?iftaʕal	ya-ftaʕil
?istafʕal	ya-stafʕil

(11) PA Binyanim

Perfect	Imperfect
faʕal	yi-fʕa/i/ul
faʕal	ye-faʕʕil
fa:ʕal	ye-fa:ʕil
afʕal	yu-fʕil
tfaʕʕal	ya-tfaʕʕal
tfa:ʕal	ya-tfa:ʕal
infaʕal	ya-nfaʕil
iftaʕal	ya-ftaʕil
istafʕal	ya-stafʕil

(12) Hebrew Binyanim

Perfect	Imperfect
paʕal	yi-fʕa/ol
nifʕal	yi-paʕel
hifʕil	ya-fʕil
piʕel	ye-faʕel
hitpaʕel	yi-tpaʕel

⁵ This does not include inflectional pronoun suffixes, which are concatenated to the stem for agreement purposes.

Following previous studies, I assume that Passivization is syntactic⁶ (Horvath & Siloni 2005), while all other operations, in languages such as Hebrew (Reinhart & Siloni 2005) MSA and PA (Laks 2004) are lexical. (13) demonstrates the possible lexical operations in MSA with their morphological manifestation.

(13) Lexical operations in MSA

Base	Derived form	
a. Causativization		
raqas'	ʔarqas' raqqas'	'danced'
labis	labbas	'dressed'
b. Decausativization		
kasar	ʔinkasar	'broke'
ʔawqaʔ	waqaʔ	'fell'
c. Reflexivization		
maffat'a	tamaffat'a	'combed'
ʔaslam	ʔistaslam	'gave in'
d. Reciprocalization		
katab	kaatab	'wrote'
qaatal	taqaatal	'fought'

Passivization in MSA can apply for every transitive verb. A passive predicate is formed by changing the vocalic pattern of the transitive verb, regardless of its prosodic structure.

(14) MSA Passivization

Base	Derived form	
a. Perfective		
kasar	kusir	'broke'
saaʔad	suuʔid	'helped'
ʔarsal	ʔursil	'sent'
tanaawal	tunuuwil	'handled'
ʔintaxab	ʔuntuxib	'elected'
ʔistaqbal	ʔustuqbil	'welcomed'
b. Imperfective:		
yaksur	yuksar	'break'
yusaaʔid	yusaaʔad	'help'
yursil	yursal	'send'
yatanaawal	yutanaawal	'handle'
yantaxib	yuntaxab	'elect'
yastaqbil	yustaqbal	'welcome'

All the lexical operation in MSA exist also in PA (15).

(15) Lexical operations in PA

Operation	Base	Derived form	
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⁶ I will address only the verbal system in this paper.

Causativization	mad'a	mad'd'a	'signed'
Reflexivization	xabba	txabba	'hid'
Reciprocalization	qatal	qa:tal	'fought'
Decausativization	farraḥ kasr	firiḥ inkasar	'made happy' 'broke'

There is a difference between PA and MSA is with regard The passive forms exhibited in MSA do not exist in PA. When passivization is used in PA, passive verbs are formed in the *infaʕal* and *tfaʕʕal* binyanim. The base form of *infaʕal* passive verbs are restricted to verbs of *faʕal* (16a), while passive verbs in *tfaʕʕal* are restricted to forms of *faʕʕal* (16b). There is a unification of the morphological shape of passive and other predicates such as unaccusatives, as *infaʕal* and *tfaʕʕal* are also the output form of lexical operations.

(16) PA Passivization

- a. baʕa → inbaʕa 'sold'
- b. s'allaḥ → ts'allaḥ 'fixed'

Hebrew also demonstrates the four lexical operations.

(17) Lexical operations in Hebrew

Base	Derived form	
a. Transitives/unergatives → causatives		
rakad	hirkid	'danced'
xatam	hextim	'signed'
b. Transitives → unaccusatives		
ʕavar	nifbar	'broke'
hirgiz	hitragez	'upset'
hikpi	kafa	'froze'
c. Transitives → reflexives		
raxac	hitraxec	'washed'
sirek	histarek	'combed'
ʕataf	niftaf	'washed'
d. Transitives → reciprocals		
katav	hitkatev	'wrote'
pagaf	nifgaf	'met'

Hebrew passive forms are productive in two prosodic shapes, *pu'al* and *huf'al*.⁷

(18) Hebrew Passivization

- hiflix → huflix 'threw'

⁷ There are also passive verbs in binyan *nifʕal*. I do not address this matter in this paper.

tipel → tupal 'handled'

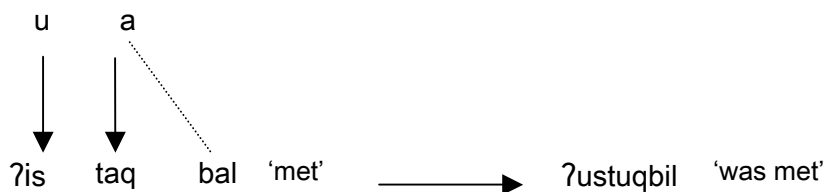
5. A Word-based Analysis of the Data

Based on the stem modification theory, the alternation between the verbal templates is manifested via several processes.

5.1 Melodic Overwriting

The syntactic operation of passivization has a segmental manifestation of melodic overwriting. In MSA, the vocalic pattern of every transitive verb can be overwritten by *u-i* in perfective forms and by *u-a* in imperfective forms. When the verb exceeds the minimal word size (two syllables), one of the vowels of the passive pattern spreads to the rest of the syllables. Melodic overwriting takes place in a different pattern with respect to perfective and imperfective forms. In the perfective form (19), the last vowel of the stem changes to /i/ and the preceding one to /u/. The /u/ spreads to the preceding syllable.

(19) MSA perfective forms: Melodic Overwriting



In the imperfective form (20), the first vowel turns into /u/ and the second one into /a/ which spreads to the rest of the word.

(20) MSA Imperfective forms: Melodic Overwriting



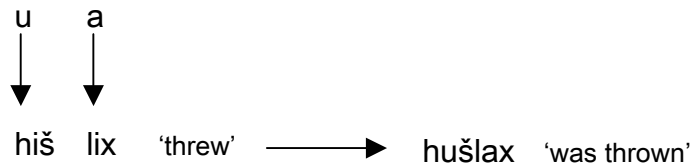
The data in (19) and (20) raise a question with regard to the different direction of spreading in the perfective form and in the imperfective form. I assume it stems from the difference between the imperfective suffixes (e.g. /*ya-*/ in *yustaqbil*) and the syllable added to some of the perfective forms (e.g. /*ʔi-*/ in *ʔustaqbal*). The occurrence of the former is not phonologically conditioned while the occurrence of the latter is (see 5.3), hence they are not considered prefixes. The vocalic pattern of the passive voice associates with the first two inherent syllables of the form, and the rightmost vowel in the pattern spreads to the right when there are more syllables and also to

the left. The epenthetic syllabic is not inherent, and thus the vocalic pattern skips it in association, but then the rightmost vowel of the pattern spreads to the right.

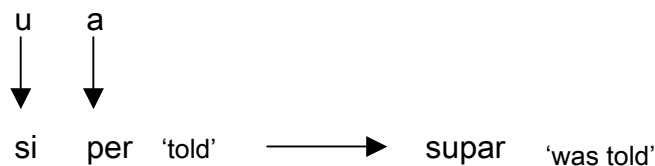
In Hebrew, the vocalic pattern of transitive verbs changes into *u-a* in order to form passive predicates.

(21) Hebrew passivization

a.



b.



The relation between active predicates and their passive counterparts exhibit only melodic overwriting; the prosodic structure in both forms is identical and thus vacuously assigned. Melodic overwriting does not involve reference to the consonantal root (Bat-El 2002) as it operates directly on the stem.

5.2 Prosodic Circumscription

The most challenging morphological processes are those involving alternation in the prosodic structure, which amounts to geminates vs. simple consonants and long vs. short vowels. McCarthy and Prince (1990) suggest an analysis, which gets around the problem of transfer with regard to Arabic broken plurals. To derive the plural from the singular, they posit a rule of positive prosodic circumscription that isolates the leftmost moraic foot of the singular base and maps the circumscribed material onto an iambic foot template. The residue is added to the iambic foot and melodic overwriting follows as well (22).

(22) Derivation of broken plurals in MSA

Singular Form: maktuub 'letter'

Prosodic Circumscription: Base- mak (μμ) Residue- tuub

Mapping: [makμμ]tuub

Melodic Overwriting {a}: makaatib

McCarthy (1993) extends the circumscription analysis to the verbal system. He suggests a rule of negative circumscription. This rule extracts a prosodic unit, which consists of a moraic syllable and adds a mora prefix to the residue (23).

(23)	<u>Derivation of <i>ħammal</i> from <i>ħamal</i></u>	
	Base:	ħamal 'carried'
	Negative Circumscription:	<ħa>mal
	Prefix μ:	<ħa>μ mal
	Spread L:	<ħa> mmal
	Output:	ħammal 'carried-Causative'

The reciprocal is derived in a similar way. Instead of gemination, the first vowel is lengthened and occupies the position of the new mora. The distinction between the derived forms *ħammal* (23) and *qaatal* (24) is attributed to the direction of spreading by which the inserted mora is filled.

(24)	<u>Derivation of <i>qaatal</i> from <i>qatal</i></u>	
	Base:	qatal 'fought'
	Negative Circumscription:	<qa>tal
	Prefix μ:	<qa>μ tal
	Spread R:	<qa> atal
	Output:	qaatal 'fought-Reciprocal'

The circumscription analysis relies directly on the notion of a word and a lexeme (Aronoff 1976). As opposed to the root-and-template analysis, one can identify morpho-phonological elements which express the derivation, e.g. a long vowel for reciprocal and a consonant for the causatives.

5.3 Affixation

MSA *ʔaʃʃal*/template is derived by adding the prefix /ʔa-/ to the *faʃal* form. However, the first vowel of the stem is deleted in order to preserve the prosodic shape of a binary foot, resulting in the *ʔaʃʃal* form. The *tafaʃʃal* and *tafaʃʃal* templates can be derived from *faʃʃal* and *faʃʃal* respectively by adding the prefix /ta-/. In this case, a syllable is added to the stem but its internal prosodic structure does not change. As opposed to the formation of *ʔaʃʃal*, there is no vowel deletion as it would result in a tri-consonantal cluster (**taʃʃal*). The *ʔinfaʃʃal* template is derived from *faʃal* by affixation of /n/. An epenthetic vowel is then inserted in order to prevent a consonant cluster in word initial position and a glottal stop is inserted preventing a vowel initial syllable. The *ʔistaʃʃal* template is derived by affixation of the prefix /sta-/. An epenthetic vowel and a glottal stop are inserted for the same reasons explained with regard to *ʔinfaʃʃal*. The first vowel of the stem is deleted as noted for *ʔaʃʃal*.

5.4 Combination of Morphological Processes

The derivation of one verbal form from another can sometimes involve more than one morpho-phonological process. The reciprocal verb *tanaat'aḥ* 'thrusted each other', for example, is derived from the verb *nat'aḥ* 'thrusted'. In this case, the *faʕal* template, which lacks prefixes and long vowels or consonants, serves as the base for the derivation of the *tafaʕal* template. This derivation is performed both by affixation of /ta-/ and by prosodic circumscription, resulting in the lengthening of the first vowel of the base form. The derivation of the Hebrew binyan *hitpaʕel* involves both affixation of the prefix /hit-/ and changing the first vowel of the stem if the base form is *piʕel* (e.g. *pileg* – *hitpaleg* 'split') and changing both stem vowels when the base is *paʕal* (e.g. *sagar* – *histager* 'closed').

6. The Morpho-phonological Manifestation of Arity Operations

While some operations are universally lexical (e.g. decausativization) or syntactic (e.g. passivization), there are operations such as reflexivization and reciprocalization, which demonstrate cross-linguistic variation. This variation can be explained on the basis of the component of the grammar where the operation takes place. There are languages such as Hebrew, MSA and Hungarian whose parameter is set to "lexicon", while there are languages such as French and Romanian, whose parameter is set to "syntax". There is a cluster of syntactic-semantic features, which is determined by the value of the Lex-Syn Parameter (Reinhart & Siloni 2005). I argue that the Lex-Syn parameter has morpho-phonological consequences as well; once the parameter value is set, a cluster of three morpho-phonological properties follows: intrusiveness of the process, directionality and predictability.

6.1. Intrusiveness of Process

In morpho-phonological terms, lexical and syntactic operations differ in the degree of complexity of their morpho-phonological manifestation. In Laks (2006), I define a hierarchy of intrusiveness for the observed processes.

- (25) a. Hierarchy of Intrusiveness: (i) is more intrusive than (ii)
- i. Prosodic modification: addition or deletion of syllables or moras - circumscription, affixation
 - ii. Segmental modification: melodic overwriting
- b. Intrusiveness evaluation:
- i. The higher the level of word structure manipulated, the greater the degree of Intrusiveness.
 - ii. The more levels manipulated in one operation, the greater the degree of intrusiveness

The hierarchy of Intrusiveness correlates with the structure of the phonological word. The modification of the prosodic structure, including syllables and moras, is more intrusive. I assume the levels in (25a), so that the higher the level manipulated, the more intrusive the operation (25b-i). In other words, I consider processes, which

add or delete moras or syllables as complex processes. The more intrusive the operation, i.e. the more it changes the original base form, the more complex it is. This hierarchy is also perceptually grounded, since the prosodic structure is more perceptually accessible than the segmental structure, and thus an alternation in the prosodic structure is more intrusive. Furthermore, operations that involve more than one operation, for example, affixation and circumscription are also considered complex.

The most prominent morpho-phonological processes that characterize thematic operations in Hebrew and MSA are shown in (26).

(26) Types of morpho-phonological processes in MSA and Hebrew

Operation	Base	Derived form	
a. Prosodic circumscription:			
Arabic Causativization	ħamal	ħammal	'carried'
Arabic Reciprocalization	katab	ka:tab	'wrote'
b. Affixation:			
Arabic Decausativization	kasar	?inkasar	'broke'
Arabic Reciprocalization	qa:tal	taqa:tal	'fought'
c. Affixation and Prosodic Circumscription:			
Arabic Reflexivization	jahil	taja:hal	'was ignorant'
Arabic Reciprocalization	madaħ	tama:daħ	'praised'
d. Affixation and Melodic Overwriting:			
Hebrew reflexivization	sirek/serek	histarek	'combed'
	raxac	hitraxec	'washed'
Hebrew reciprocalization	nijek	hitnafek	'kissed'
Hebrew causativization	xatam	hextim	'signed'
e. Melodic Overwriting			
Arabic Passivization	qaddam	quddim	'handed'
	tana:wal	tunu:wil	'handled'
	?intaxab	?untuxib	'elected'
Hebrew Passivization	hifkid	hufkad	'deposited'
	siper	supar	'told'

The correlation that emerges is that syntactic operations involve lower morpho-phonological intrusiveness than lexical operations. Passivization, which is syntactic, involves mainly melodic overwriting. Note that the change of the vocalic pattern is not affected by the number of syllables or the length of the vowels in the base form (26e). In contrast, the other arity operations, which are lexical, involve the addition of moras or syllables via prosodic circumscription or affixation or both. Moreover, passivization involves only one morpho-phonological process, while lexical operations can involve more than one process (26d).

PA raises further questions regarding the matter of intrusiveness. PA does not demonstrate melodic overwriting. As stated in § 4, Passive forms in PA are less

common compared to MSA, but the forms that do occur are only in the *infafal* and *tfafsal*/binyanim, derived only from *fafal* and *fafsal* respectively.

(27) PA Passivization

Base	PA Passive Form	MSA Passive Form	
katab	inkatab	kutib	'wrote'
s'allaḥ	ts'allaḥ	s'ullih	'fixed'

The data in (27) raises a question with regard to the intrusiveness of the morpho-phonological process that is involved. According to the hierarchy of intrusiveness (25), affixation is considered complex as it adds a syllable to the stem. Why would passivization demonstrate the same level of complexity as lexical operations such as decausativization? I claim that the line between intrusiveness of lexical verses syntactic operations is not definite. Rather, this is a matter of relativeness of complexity (25a). I argue that there is an internal hierarchy of complexity within the prosodic level. Adding a prefix or a suffix is less intrusive than prosodic circumscription, as the latter is more intrusive to the structure of the stem of the word that undergoes this process. In affixation, the internal structure of the stem remains intact, while in prosodic circumscription it does not. I therefore revise the hierarchy proposed in (28) and split the prosodic modification into two sub-levels of intrusiveness (19).

- (28) a. Hierarchy of Intrusiveness (revised): (i) is more intrusive than (ii)
- i. **Prosodic modification of the stem**: (1) is more intrusive than (2)
 - 1) External modification: addition or deletion of syllables - affixation
 - 2) Internal modification: modification of the internal prosodic structure – prosodic circumscription
 - ii. **Segmental modification of the stem**: melodic overwriting
- b. Intrusiveness evaluation
- i. The higher the level of word structure manipulated, the greater the degree of intrusiveness
 - ii. The more levels manipulated in one operation, the greater the degree of intrusiveness.

As PA does not demonstrate the simple process of melodic overwriting, it uses the least intrusive level of prosodic interference to the base form. Moreover, some lexical operations in PA demonstrate a higher level of complexity where their morpho-phonological manifestation is concerned. Similarly to MSA, causativization is performed via negative circumscription resulting in gemination (29).

(29) Lexical Operations in PA

Lexical Operation	Processes Involved	Examples	
causativization	prosodic circumscription melodic overwriting prosodic circumscription	daras → darras libes → labbas	'studied' → 'taught' 'wear' → 'dress'
reflexivization	affixation affixation, prosodic circumscription	labbas → tlabbas ʕasal → tʕasal	'dressed' 'washed'
reciprocalization	affixation	qa:tal → tqa:tal	'fought'

Further evidence for this difference in complexity is manifested in the productivity of some of the Hebrew binyanim. *Hifʕil*, *piʕel* and *hitpaʕel* are more productive than *paʕal* and *nifʕal*, where productivity here is measured on the basis of new coining (Bolzky 1978). According to Bat-El (2002), in *hifʕil*, *piʕel* and *hitpaʕel* the phonological shape of the perfective form is minimally but still sufficiently different from the imperfective one. The future prefixes, recognized by speakers as limited to imperfective forms, are eliminated in the perfective form. When the perfective form has a prefix, it takes the position of the future prefix (*hifʕil* and *hitpaʕel*), otherwise the future prefix is ignored. The phonological simplicity of the inflectional relations within these binyanim is demonstrated via the absence of alternation in the prosodic structure. Moreover, the lack of prosodic alternation allows the stem consonants to occupy the same syllabic position in both perfective and imperfective forms. Such preservation of prosodic position is not found in *paʕal* and *nifʕal*.

Adopting stem modification rather than root extraction correlates with the Lex-Syn parameter. If we assumed root extraction there would be no reason to assume morpho-phonological differences between lexical and syntactic operations. Root extraction could apply in all operations, mapping the consonantal root to different vocalic templates (which may consist of affixes). However, since I adopt the view that thematic operations apply in different components of the grammar, I also claim that this has morpho-phonological implications.

6.2. Directionality

Passivization is manifested by changing the vocalic pattern of the active verb (14). Passive verbs demonstrate uniformity with regard to the quality of vowels, as they all share the same vocalic pattern. On the assumption that passivization is syntactic, the formation of passive verbs is post-lexical. The outputs of syntactic operations are not listed in the lexicon; hence they are not available as basic entries. Thus, the relationship between the active and passive forms is unidirectional. The active form is the base and the passive one is derived, followed by a regular change of the vocalic pattern.

The picture is different with regard to some lexical operations presented in (30):

(30) MSA Causativization and Decausativization

Lexical Operation	Base	Derived form
a. Causativization	raqas' 'danced'	ʔa-rqas' 'caused X to dance'
b. Decausativization	ʔa-wqaʕ 'made X fall'	waqaʕ 'fell'

Following Reinhart & Siloni (2005), I assume that the unergative-transitive alternation (30a) and the transitive-unaccusative one (30b) are derived by two distinct lexical operations, as each is limited in a particular way (see 3.1.2). In (30a), the causative form is derived from *faʕal*, resulting in *ʔafʕal*, while in (30b) the output is *faʕal* and the input is *ʔafʕal*. Both prosodic templates serve as a base form and as a derived form. This alternation can be explained in terms of paradigm accessibility. Since the Neogrammarians' work on sound change in the nineteenth century, it has been recognized that many exceptions to the regular phonological processes can be explained by proposing that paradigms of morphologically related words influence each other's pronunciation (Dowling, Hall and Raffelsiefen 2005). A paradigm expresses the ways in which linguistic entities may be mutually connected. Languages demonstrate various cases, where a phonologically motivated alternation does not apply in order to achieve paradigm uniformity. For instance, many adjectives in English are formed by adding the suffix *-able* to a verb. In some cases, stress shift is motivated in order to avoid a string of stressless syllables longer than two, e.g. the affixation of *-able* to *discipline* should yield *disciplínable*. However, the prevalent form in actual use is *disciplinable* as it achieves paradigm uniformity with regard to stress. In the paradigm {*discipline, disciplinable*} stress is uniform as it is on the same syllable in both forms (Streiade 2000). The accessibility to other existing forms is a language plays a role in the derivations in (30). I argue that as long as the operation takes place in the lexicon, the morphological system has access to all lexical forms. Consequently, it can derive one form from the other, applying to the basic entry listed in the lexicon, in accordance with the relevant thematic operation. When acquiring a language, the speaker is exposed to the derivation of such paradigms, i.e. simple-to-complex form derivations and vice versa, s/he can implement it on new predicates s/he encounters. This approach intertwines with Aronoff's (1976) view of the lexicon as a system of relations that can be active in the generation of new words. This also supports the claim that there is no one-to-one relation between form and meaning with regard to prosodic templates.

To conclude, lexical operations demonstrate bidirectionality. Although this does not occur with regard to all operations, when it does occur it is restricted to lexical ones. Passivization, in contrast, demonstrates unidirectional relations.

6.3 Predictability

The derived forms of syntactic operations can be easily predicted, as the only change that occurs is the vocalic pattern. In contrast, the morphological output of lexical operations is unpredictable, as most operations have more than one possible input and output binyanim.

(31) MSA possible input/output binyanim

Lexical Operation	Input	Output	Examples
Decausativization	faʕal	ʔinfaʕal	kasar → ʔinkasar 'broke'
	faʕʕal	tafaʕʕal	farrāq → tafarrāq 'separated'
	ʔafʕal	faʕal	ʔawqaʕ → waqaʕ 'fell'
Causativization	faʕal	faʕʕal	ʕarab → ʕarrab 'drank'
		ʔafʕal	raqas' → ʔarqas' 'danced'
Reflexivization	faʕal	ʔiftaʕal	rafaʕ → ʔirtafaʕ 'lifted'
	faʕʕal	tafaʕʕal	jammal → tajammal 'made pretty'
	ʔafʕal	ʔistaʕal	ʔaʕadda → ʔistaʕadda 'prepared'
Reciprocalization	fa:ʕal	tafa:ʕal	s'a:laḥ → tas'a:laḥ 'made peace'
	faʕal	fa:ʕal	qatal → qa:tal 'fought'
	faʕal	tafa:ʕal	madaḥ → tama:daḥ 'praised'

(32) Hebrew possible input/output binyanim

Lexical Operation	Input	Output	Examples
Decausativization	hifʕil	paʕal	hixʔis → kaʔas 'angered'
		nifʕal	hivhil → nivhal 'frightened'
		hitpaʕel	higiz → hitragez 'made X upset'
Causativization	piʕel	paʕal	simeax → samax 'was happy'
		hitpaʕel	rigeʕ → hitrageʕ 'excited'
		nifʕal	haras → neheras 'ruined'
Causativization	paʕal	hifʕil	xatam → hextim 'signed'
		piʕel	lamad → limed 'studied → taught'
Reflexivization	paʕal	hitpaʕel	raxac → hitraxec 'washed'
		nifʕal	ʕataf → niʕtaf 'washed'
	piʕel	hitpaʕel	serek → histarek 'combed'
		hifʕil	nifʕal
Reciprocalization	hifʕil	hitpaʕel	hiʕʔin → niʕʔan 'leaned'
		hitpaʕel	higniv → hitganev 'sneaked'
Reciprocalization	paʕal	hitpaʕel	herim → hitromem 'lifted'
		nifʕal	laxaf → hitlaxef 'whispered'
		hitpaʕel	pagaf → nifgaf 'met'
	piʕel	hitpaʕel	nifek → hitnafek 'kissed'

As demonstrated in (31) and (32), there are several combinations of input and output forms for the same lexical operation. When the base form of decausativization is *hifʕil*, for example, its derived counterpart can be in *paʕal*, *nifʕal* or *hitpaʕel*. There is no phonological or semantic basis to explain why the decausativized counterpart of *higiz* ('made X upset') is *hitragez* and not *nirgaz*, while the one of *hivhil* ('frightened') is *nivhal* and not *hitbahel* (32). It is important to point out that I do not claim the input-output possible forms of lexical operations are totally free. There is a limited set of forms for every operation, e.g. there would be no

reflexive or reciprocal predicate in binyan *ʔinfal* in MSA or in binyan *piʕel* in Hebrew. I do argue that this set of options is much more varied in comparison with the one of syntactic operations.

The low morphological predictability of lexical operations is also attested in the alternating forms of some lexically derived predicates. This alternation is manifested in the occurrence of the same verb in two binyanim. For example, the unaccusative alternate of *hirtiv* ‘made wet’ was originally derived in binyan *nifal* yielding *nirtav* ‘became wet’. However, this derivation is unstable since many speakers use *hitpaʕel* verb *hitratev* which bears the same meaning as *nirtav*. The reflexive verbs *nimrax* ‘smeared oneself’ and *nimtax* ‘stretched oneself’ also alternate with *hitmareax* and *hitmateax* respectively, while there is no change in their reflexive meaning.⁸ Further data can be found in MSA, where verbs can have more than one morphological shape as their derived counterpart. The verb *raqas* ‘(danced)’ has two possible causative alternates: *raqqas*’ and *ʔarqas*’. This does not occur with regard to passivization, as a transitive verb has a single passive counterpart.

I regard the possibility of alternating forms of the predicate as a unique feature of predicates derived in lexical operations. There is no such alternation in the morphological shape of passive forms, which are derived in syntax. This also correlates with the notion that as long as a predicate is in the lexicon, it is exposed to different changes. I regard alternation as one of them, in addition to nominalization, semantic drift and idiom formation (Horvath and Siloni 2005).

4.4. Summary: Two types of morpho-phonology

The following table summarizes the differences between the two kinds of operations, as discussed above.

(33) Morpho-phonological properties of syntactic and lexical operations

Property	Syntactic operations	Lexical Operations
Intrusiveness	Limited to less intrusive processes	All degrees of intrusiveness
Directionality	Unidirectionality	Bidirectionality, no regular template for a specific operation
Predictability	Predictable	Unpredictable, variation of forms

The analysis proposed raises questions with regard to the role of morpho-phonology and its location and application with respect to other components of the grammar. The observed differences between passivization and the other thematic

⁸ Note that these verbs are derived from the *paʕal* transitive verbs *matax* and *marax* respectively.

operations challenges the theory of Distributed Morphology (hereafter DM). The framework of DM (Halle & Marantz 1993) postulates a theory of the grammar without lexicalist assumptions (Contra to Chomsky 1970). DM includes a number of distributed, non-computational lists as Lexicon replacements; the structure of grammar without a unified Lexicon contains three lists. The first list, termed as the “narrow lexicon,” contains the atomic roots of the language and the atomic bundles of grammatical features. The sets of grammatical features are determined by UG and perhaps by language-particular (but language-wide) principles. This list most directly replaces the Lexicon as it provides the units that the syntax operates with. The second list is called “Vocabulary,” provides the phonological forms for the terminal nodes from the syntax. The Vocabulary includes the connections between sets of grammatical features and phonological features, and thus determines the connections between terminal nodes from the syntax and their phonological realization. The Vocabulary is non-generative but expandable. The Vocabulary items are underspecified with respect to the features of the terminal nodes from the syntax; they compete for insertion at the terminal nodes, with the most highly specified item that does not conflict in features with the terminal node winning the competition. The third list, called “Encyclopedia” is the list of special meanings. The Encyclopedia lists the special meanings of particular roots, relative to the syntactic context of the roots, within local domains. As with the Vocabulary, the Encyclopedia is non-generative but expandable. DM is widely correlated with the notion of Late Insertion (Marantz 1993). Late Insertion is the hypothesis that the phonological expression of syntactic terminals is provided only during the mapping of elements to Phonological Form (PF). Syntactic categories are considered purely abstract, having no phonological content. Phonological expressions, i.e. Vocabulary Items, are inserted only after syntax in a process called Spell-Out. This process involves the association of phonological pieces (Vocabulary items) with abstract morphemes.

This approach stands in contradiction with the analysis presented in this section. Thematic operations different morph-phonological behaviour. Assuming that thematic arity operations can apply in a different components, every different locus shows relatively different (though partially overlapping) morpho-phonological manifestation. Adopting late insertion would fail to explain these differences in form, as it predicts that the phonological material is always inserted after syntax, regardless of the component where arity operations take place. Aronoff (1976) shows that the domain of derivational morphology is governed by distinct principles that are essentially unrelated to those governing syntactic structures, by assigning derivational processes to the lexicon. From the point of view of syntax, the structures produced in the lexicon are opaque. These structures may have internal structure, but it is not subject to manipulation by the rules of syntax. The latter treats lexical items as integral atomic units. This notion is parallel to the distinction between the two types of

arity operations. As the syntactic component cannot manipulate theta grids, it has a different kind of access to the structure of words, i.e. it can alter their structure applying different mechanisms than the lexicon. This provides partial support to the Lexicalist Hypothesis (Chomsky 1970), whose basic premise is the independence of syntax and word-structure. While there is evidence that the elements of morphological structure and of sentence structure can overlap (Anderson 1992), the content of the lexicalist hypothesis is represented by the separation of the syntactic and the lexical components. Morpho-phonology seems to be active in both parts of the grammar, the lexicon and the syntax. The manner in which it applies is different in every component with regard to the manipulation of word structure. The analysis intertwines with the notion of parallel morphology (Borer 1991). It supports the existence of an autonomous morphological component that interacts with both the lexicon and the syntax, to which it is not reducible. This observation points out to the location of morphology with respect to other components of the grammar. Morphology can be found in more than one place; some of it is in the lexicon while another portion of it is in the syntax.

7. Conclusions

In this paper, I have shown the correlation between morpho-phonology and the theta system. I began by exhibiting the morpho-phonological processes, which verbs undergo when deriving new predicates from existing entries in the lexicon. After dividing the thematic operations into lexical and syntactic ones, I demonstrated that these two kinds of operations exhibit relatively different patterns of morpho-phonological processes. The Lex-Syn parameter turns out to be responsible for crosslinguistic variation exhibited by reflexives (Reinhart & Siloni 2005), reciprocals (Siloni 2005), and middles (Marelj 2004). Moreover, it seems that languages are consistent regarding the setting of the parameter. This facilitates parameter setting during acquisition, since evidence from various sources (operations) converges to set the choice. The morpho-phonological properties observed in this paper reveal another aspect of this parameter and strengthen this claim. Lexical operations are characterized by bidirectionality, low predictability and a wide range of intrusive morpho-phonological processes. In contrast, syntactic operations are predicatable, apply in one direction and are limited to relatively less intrusive morphological processes.

The analysis reveals the interaction between arity operations and morpho-phonological processes, thereby supporting the existence of a lexicon-morphology interface as well as a syntax-morphology interface. The analysis also supports the word-based approach (Aronoff 1976). Specifically, it demonstrates the superiority of stem modification over root extraction, which does not discriminate between lexical and syntactic operations, making it virtually impossible to account for the observed generalizations.

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