

# Participants in Action: The Interplay of Aspectual Meanings and Thematic Relations in the Semantics of Semitic Morphology

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**Abstract.** This work aims to demonstrate that event structure and thematic relations are closely intertwined. Specifically, we show that in Modern Hebrew the choice of a morphological template has profound effects on the event structure of derived verbs. These effects are mediated by the meaning of roots, and complement the thematic account proposed by [Doron(2003)].

## 1 Background

Verbs, nouns, and adjectives in Semitic languages are derived from (tri-)consonantal roots plugged into templates of consonant/vowel skeletons. The lexical items in (1), for example, are all derived from the same root,  $[y][l][d]$ .

- (1) The root  $[y][l][d]$  (birth, child)

<i>Nouns</i>	<i>Verbs</i>	<i>Adjectives</i>
$[y]i[l]o[d]$ beget	$[y]a[l]a[d]$ give birth	$mu[]a[l]a[d]$ innate
$[y]e[l]e[d]$ child	$[y]i[l]e[d]$ deliver a child	
$[y]e[l]i[d]$ native		

In MH, verbs are derived using a set of seven templates termed ‘binyanim’. The MH verbal templates are typically arranged in a two-dimensional grid, as shown in (2) together with their traditional names.

- (2) The Verbal Templates

	<i>Simple Intensive Causative</i>		
<i>Active</i>	Pa'al	Pi'el	Hiph'il
<i>Passive</i>	—	Pu'al	Huph'al
<i>Middle</i>	Niph'al	Hitpa'el	—

Putting a root through different templates results in different lexical items which correspond to different verbs in English, as exemplified in (3).

- (3) The root  $[x][l][k]$  (a part, share, smooth)

	<i>Simple</i>	<i>Intensive</i>	<i>Causative</i>
<i>Active</i>	$[x]a[l]a[k]$ to share	$[x]i[l]e[k]$ to divide	$he[x]e[l]i[k]$ to make smooth
<i>Passive</i>	—	$[x]u[l]a[k]$ to be divided	$hu[x][l]a[k]$ to be smoothed
<i>Middle</i>	$ne[x][l]a[k]$ to differ	$hit[x]a[l]e[k]$ to glide	—

These templates differ significantly from typical ‘grammatical operators’ as they are not fully productive, and equi-root verbs in different templates show surprising idiosyncrasies. For example, the verbs in (4) are all derived from the same root,  $[k][b][l]$ , yet their meanings seem unrelated. Further, putting the same root through the middle template, Niph’al, is ungrammatical, as shown in (5).

- (4) a.  $[k][b][l]$  + Pa’al = *kābal* (complain)  
b.  $[k][b][l]$  + Pi’el = *kibel* (receive)  
c.  $[k][b][l]$  + Hiph’il = *hikbil* (parallel)
- (5) a.  $[k][b][l]$  + Niph’al = \**nikbal*

This led some linguists to conclude that the templates are arbitrary, that root/template combinations are inherent in the lexicon, and that templates are irrelevant for making semantic predictions. [Doron(2003)] was the first to demonstrate that the Semitic templates have systematic semantic contribution, albeit restricted to the thematic domain. Here we propose that the templates contribute aspectual meanings as well. The key idea is that participants are elements in the temporal extension of an event, and therefore marked thematic relations affect the verbs’ aspectual content. Thus, treating events and participants in the same theoretical framework allows us to investigate aspectual meanings in languages that do not grammaticalize aspect, yet mark thematic relations by formal means.

The remainder of this paper is organized as follows. In section 2 we pose our main research question, and elaborate on the theoretical facets required to answer this question. In section 3 we spell out our hypothesis about thematic roles and aspectual meanings, followed by the methodological guidelines we adopt in section 4. Section 5 provides a brief introduction to Event Calculus, an axiomatic system we use to formalize our theoretical findings in section 6, and in section 7 we apply our formal theory to three of the MH templates, the so-called *active* templates, Pa’al, Pi’el and Hiph’il. Then, section 8 describes the experimental setup and preliminary results of an empirical investigation we conducted to support our theoretical findings and in section 9 we summarize and conclude.

## 2 Research Questions

MH has a three-way tense system that grammaticalizes past, present and future, and no aspectual inflectional morphology as it is in Indo-European Languages. For example, the MH verb ‘avad’ (worked) can be interpreted in various ways, as demonstrated in (6).

- (6) a. hu avad maher  
 he worked fast  
 He worked/was working/has worked/had worked fast
- b. hu oved maher  
 he works fast  
 He works/is working fast
- c. hu ya'avod maher  
 he will-work fast  
 He will work/will be working fast

The lack of grammatical aspect in the MH tense system raises the question whether means to denote aspect can be found ‘elsewhere’ in the language. Specifically, we investigate whether the MH morphological templates carry aspectual meanings. We address this question via the following three questions:

- (7) a. Do the templates belong to the syntax or to the lexicon?  
 b. Do the templates systematically contribute to verbs’ meanings?  
 c. Do the templates systematically contribute to aspectual meanings?

A response to (7a) follows from principles of Distributed Morphology (DM) [Halle and Marantz(1993)]. According to DM, a model for Semitic languages is assumed to have a ‘narrow lexicon’ consisting of the basic units on which the syntax operates. In the case of MH, the ‘narrow lexicon’ contains coarse-grained consonantal roots and the morphemes realized in the templates. Verbs are constructed in the syntax (formally, ‘fusing’) by the same processes that construct phrases and sentences (formally, ‘merging’). These processes are relevant for making semantic predictions, yet they allow for idiosyncrasies relative to context (as it is the case, for instance, with the meanings of idioms).

Using principles of DM, [Doron(2003)] answers the question posed in (7b). Doron argues that the contribution of the templates is not transparent yet systematic, and that it is reflected in the *thematic* domain. In Doron’s account, the templates realize functional heads that alter or modify the thematic relations of the arguments projected/licensed by the root. The contribution is therefore, systematic, however mediated by an underlying thematic classification, and should be examined relative to the lexical material provided by the root.

However, in Doron’s account thematic and aspectual operators are orthogonal, as their presupposed classification systems are disjoint. So our question remains — do the templates make a systematic aspectual contribution?

### 3 The Hypothesis

The term *thematic roles* refers to semantic distinctions between NP complements of verbs, which conceptually represent participants in situations. Linguists traditionally referred to a closed set of roles (e.g. agent, theme, location, goal and source) and uniquely assigned them to surface forms.

[Dowty(1991)] surveyed difficulties with this traditional view and proposed that thematic relations are not discrete, but fall within a continuum ranging from a Proto-agent to a Proto-patient. Further, [Dowty(1991)] established that thematic relations must be selected in accord with the event denoted by the verb at hand.<sup>1</sup> Here we hypothesize that the converse also holds, i.e., that *the event structure of derived verbs changes to accord with altered thematic relations*.

We assume that roots carry basic meanings that induce a preliminary event classification à la [Vendler(1967)]. According to Doron, the templates alter the thematic relations projected by the root. We claim that the event structure of the verb at hand changes to accommodate the altered thematic relations, thus affecting the event structure of derived verbs (henceforth, its *aspectual meaning*) in a predictable way.

## 4 The Methodology

In analyzing aspectual meanings of derived verbs we adopt the following methodological guidelines. First, we assume an underlying *classification* of roots into aspectual classes. Then we contrast relevant *aspectual pairs*. To determine which are relevant aspectual pairs we appeal to theories of markedness, a move inspired by [Smith(1991)].

Markedness is concerned with the relations among members of a closed system. The underlying assumption is that a choice is made between *available* alternatives, and thus the contrast between the alternatives is an inherent part of users' choice. [Comrie(1976)] pointed out that marked aspectual choices are typically morphologically marked. So, we first examine the morphological material the templates attach to roots, as demonstrated in (8).

(8) The verbal patterns:

	<i>Simple</i>	<i>Intensive</i>	<i>Causative</i>	
<i>Active</i>	[C]a[C]a[C]	[C]i[C](C)e[C]	Hi[C][C]i[C]	 u-a i-a(-e)
<i>Passive</i>	—	[C]u[C](C)a[C]	Hu[C][C]a[C]	
<i>Middle</i>	Ni[C][C]a[C]	HiT[C]a[C](C)e[C]	—	
		doubled (C)	prefixed H	

The templates implement two dimensions of morphological marking. The vertical dimension, which is marked consonantly, and the horizontal, which is marked by vocalization. The *Simple-Active* template thus remains morphologically unmarked. The aspectual pairs we consider always consist of the unmarked template (Pa'al) and an opposite template that is morphologically marked with respect to it. We contrast the meanings of such pairs, and examine whether the aspectual meaning of a marked form changes relative to the aspectual meaning of the unmarked form with the same root.

<sup>1</sup> This view is also implicit in Doron's account, as her presupposed thematic classification is relative to the lexical material of the root, and therefore to the event denoted by it.

## 5 Formal Setting

The departure point for our formal investigation is Smith’s two-component theory of aspect [Smith(1991)] in which a speaker chooses a constellation of *lexical* and *grammatical* morphemes to express her aspectual choice of *situation type* and *viewpoint*, respectively.

We formalize our findings using Event Calculus (EC) [van Lambalgen and Hamm(2005)], a formalism based on the notion of ‘planning’ which is designed to fit the way humans construct their conscious experience of time. Formally, EC requires (at least) events ( $e, e'..$ ), time instants ( $t_1, t_2..$ ), and time dependent properties called *fluents* ( $f_1, f_2..$ ). The time is represented by the real numbers ( $\mathbb{R}, <, +, \times, 0, 1$ ), which serve as the raw material from which we construct our experience of time.

EC allows us to formalize situation types, using *eventualities*.<sup>2</sup>

**Definition 1.** *An eventuality is a structure  $\langle f_1, f_2, e, f_3 \rangle$  where:*

1.  $f_1$  represents an activity which exerts a force
2.  $f_2$  represents a changing object/state driven by the force of  $f_1$
3.  $e$  represents a canonical goal
4.  $f_3$  represents the state of having achieved the goal

An eventuality in EC is an abbreviation for a fully specified scenario: a sequence of general statements universally quantified with respect to time. Together with the EC axioms, the scenario defines a micro-theory of temporal/causal relations in the event.<sup>3</sup> Using the eventuality quadruples, EC represents different *Aktionarten*, or *situation types*, as follows.

**Definition 2.** *Aktionarten*

1. States (e.g. *love, know*)  $\langle -, -, -, + \rangle$
2. Activities (wide) (e.g. *walk, push*)  $\langle +, +, -, - \rangle$
3. Achievement (e.g. *fall, break*)  $\langle -, -, +, + \rangle$
4. Accomplishments (e.g. *build, create*)  $\langle +, +, +, + \rangle$

EC formalizes *viewpoints* using integrity constraints<sup>4</sup> that define the *reference time* (cf. [Reichenbach(1947)]) for the event. In MH, we use integrity constraints to define *default* viewpoints for the different situation types.

**Definition 3.** *Viewpoints (the reference point is marked with [+].<sup>5</sup>)*

1. States (e.g. *love, know*)  $\langle -, -, -, [+ \rangle$
2. Activities (wide) (e.g. *walk, push*)  $\langle [+ \rangle, +, -, - \rangle$

<sup>2</sup> We drop the term ‘event’, in order not to confuse it with formal event-types/tokens.

<sup>3</sup> For complete technical overview refer to [van Lambalgen and Hamm(2005)].

<sup>4</sup> ‘Integrity constraints’ are adopted from database theory, and their role is to enforce coherence of the stored data by triggering updates in the system.

<sup>5</sup> The full formalization of viewpoints in EC bears the forms  $?HoldsAt(f, R), R \stackrel{\geq}{\leq}$  *now succeeds* and  $?Happens(e, R), R \stackrel{\geq}{\leq}$  *now succeeds*. However, for the purpose of the current exposition the above abbreviations will suffice.

3. Achievement (e.g. *fall, break*)  $\langle -, -, [+], + \rangle$
4. Accomplishments (e.g. *build, create*)  $\langle [+], +, +, + \rangle$

EC allows fluents to be associated with entities in the real world that possess the property they mark. Therefore we can extend the formal description of the fluents in the eventuality quadruple with the participants associated with them. We use Dowty's *Proto-roles* to determine the kind of participant a fluent should be associated with.

**Definition 4.** Thematic Relations

1.  $f_1$  is associated with a Proto-agent
2.  $f_2$  is associated with a Proto-patient (an incremental theme)
3.  $f_3$  is associated with a Proto-agent (an experiencer) or a Proto-patient (a theme), relative to the situation type.

This brief formal exposition serves to show that the extended theory of EC allows us to formalize situation types, viewpoints, and thematic relations in a single framework. This, in turn, enables us to pinpoint precisely how an eventuality structure is affected when a certain thematic relation is modified.

## 6 An Account of Aspect in Modern Hebrew

**Syntax** A model for Semitic languages in DM assumes a ‘narrow lexicon’ that contains the units on which the syntax operates, listed in (9).

- (9) a. Roots:  $R = \{R : R = [C][C][C], [C] \text{ is a consonant}\}$
- b. Templates:  $B = \{Pa'al, Pi'el, Hiph'il, Pu'al, Huph'al, Niph'al, Hitpa'el\}$

The following definitions recapitulate formally the derivation of MH verb forms.

**Definition 5.** Let  $R$  be a consonantal root and let  $T$  be a morphological template. Then  $R + T = V$  is a verbal form in MH.

**Definition 6.** Let  $R$  be a consonantal root,  $T$  a template, and let  $V$  be the result form of  $R + T$ . The verbal form  $V$  is grammatical if it has a listed phonological form in the ‘vocabulary’<sup>6</sup> and ungrammatical otherwise.

**Definition 7.** Let  $V$  be a verbal form in MH,  $R_V$  be its consonantal root, and  $T_V$  be its template. If  $T_V = Pa'al$ , then  $V$  is simple, otherwise it is non-simple.

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<sup>6</sup> A ‘vocabulary’ is a presupposed component of the DM framework [Halle and Marantz(1993)].

**Semantics** In our account, aspectual meanings are derived from the meaning of roots and the morphemes realized in the templates. Roots provide the verb with a preliminary situation type, and the templates mark thematic features. According to [Doron(2003)], the templates mark two dimensions of thematic features, namely agency and voice, as in (10).

- (10) Agency:  $\iota$  (intensive),  $\gamma$  (causative)  
 Voice:  $\pi$  (passive),  $\mu$  (middle)

The morphemes realized in the templates correspond to the two dimensions of morphological marking, as shown in (11).

		<i>Simple Intensive Causative</i>				
		Active	[ ]	[+ $\iota$ ]	[+ $\gamma$ ]	
(11)	Passive	—	[+ $\iota$ , + $\pi$ ]	[+ $\gamma$ , + $\pi$ ]		[+ $\pi$ ]
		Middle	[+ $\mu$ ]	[+ $\iota$ , + $\mu$ ]	—	[+ $\mu$ ]
				[+ $\iota$ ]	[+ $\gamma$ ]	

The derivation of aspectual meanings proceeds as follows. The root provides the verb with a preliminary eventuality scenario, which is the eventuality associated with the root put through the unmarked template. The template marks thematic features that define criteria, by means of additional general statements and integrity constraints, that guarantee the existence of the fluents required by the marked participant. The result scenario is thus given by the *sum* of the eventuality and the criteria.<sup>7</sup> The event structure of the resulting verb can then be simply read off from the result scenario. This derivation process is schematically presented in (12), where *PSCEN* is the preliminary scenario,  $C_T$  is the criteria defined by the template, and *RSCEN* is the result scenario<sup>8</sup>.

		Syntax:	R	+	T	=	V
(12)	Semantics:		E	+	( $\iota \gamma + \pi \mu$ )	=	E'
		Aspectual Meaning:	$PSCEN_R$	+	$C_T$	=	$RSCEN_V$

## 7 Applications

### The Simple Template Pa'al

The simple template, Pa'al, is morphologically unmarked and semantically unmodified. Thus, the aspectual meaning of the verb is determined by the lexical material of the root. Pa'al verbs may be of any situation type, as in (13).

- (13) a. States

<sup>7</sup> This sum operation goes beyond mere addition; repeated statements are eliminated (union), unknown parameters identify with existing ones (unification) and remaining parameters are instantiated based on world knowledge or context (instantiation).

<sup>8</sup> For further details refer to [Tsarfaty(2005a)].

1.  $[a][h][\check{b}] + \text{Pa'al} = \text{aha}\check{b}$  (love)
2.  $[y][d][\check{r}] + \text{Pa'al} = \text{yada}$  (know)
- b. Activities
  1.  $[h][l][\check{k}] + \text{Pa'al} = \text{hala}\check{k}$  (walk)
  2.  $[d][x][\check{p}] + \text{Pa'al} = \text{daxa}\check{p}$  (push)
- c. Achievements
  1.  $[\check{s}][\check{b}][r] + \text{Pa'al} = \text{\check{s}a}\check{b}ar$  (break)
  2.  $[n][\check{p}][l] + \text{Pa'al} = \text{na}\check{p}al$  (fall)
- d. Accomplishments
  1.  $[b][n][h] + \text{Pa'al} = \text{bana}$  (build)
  2.  $[y][c][r] + \text{Pa'al} = \text{yacar}$  (create)

### The Intensive Template Pi'el

The intensive template, Pi'el, is morphologically marked with a double middle consonant and semantically marked with the thematic feature  $[+\iota]$ . Representative examples for Pa'al/Pi'el alternations are illustrated in (14).

- (14)
- a.
    1.  $[y][d][\check{r}] + \text{Pa'al} = \text{yada}'$  (know)
    2.  $[y][d][\check{r}] + \text{Pi'el} = \text{yide}'a$  (inform)
  - b.
    1.  $[h][l][\check{k}] + \text{Pa'al} = \text{hala}\check{k}$  (walk)
    2.  $[h][l][\check{k}] + \text{Pi'el} = \text{hile}\check{k}$  (walk intensively, walk around)
  - c.
    1.  $[s][b][r] + \text{Pa'al} = \text{\check{s}a}\check{b}ar$  (break)
    2.  $[s][b][r] + \text{Pi'el} = \text{\check{s}i}\check{b}er$  (actively break, break with force)
  - d.
    1.  $[y][c][r] + \text{Pa'al} = \text{yacar}$  (create)
    2.  $[y][c][r] + \text{Pi'el} = \text{yicer}$  (manufacture)

According to [Doron(2003)], the  $[+\iota]$  feature reclassifies the agent in the situation as an *actor*, where an *actor* is an entity capable of exerting force. In our account, this requires the eventuality quadruple to include (at least) an activity exerting force, and possibly a changing fluent driven by this force. So, the result scenario for intensive verbs must minimally encompass the statements for  $\langle f_1, f_2, -, - \rangle$  (formally defined in EC as a *dynamics*). Further, the marked feature fixes the viewpoint on the actor, i.e.,  $\langle [f_1], f_2, -, - \rangle$ .

To illustrate the effect of this requirement on the derivation of aspectual meanings, consider first intensive verbs with achievement roots. An achievement root plugged into the simple template results in a simple verb denoting an achievement, which presents the preliminary scenario  $\langle -, -, [e], f \rangle$ . The marked thematic feature  $[+\iota]$  requires the eventuality scenario to contain, at least, the following components, with a newly specified viewpoint  $\langle [f_1], f_2, -, - \rangle$ . Summing the scenario and the  $[+\iota]$  criteria statements results in the following result scenario and sets a new viewpoint for the entire scenario. The new situation type and viewpoint of the derived verb can now be read off of the result scenario.

$$\langle -, -, [e], f \rangle + \langle [f_1], f_2, -, - \rangle \rightsquigarrow \langle [f_1], f_2, e, f \rangle$$



More generally, we claim that plugging an achievement root through the intensive template has the effect of adding a preparatory phase, in which an actor exerts a force which brings about the canonical goal. The resulting eventuality structure then mirrors the structure of an accomplishment and the viewpoint is fixed on the ‘preparation’ fluent.<sup>9</sup> This effect is evident in, e.g., (15a–b).

- (15) a. 1.  $[x][\check{b}][r] + \text{Pa'al} = x\check{a}b\check{a}r$  (join)  
 2.  $[p][t][x] + \text{Pi'el} = x\check{i}b\check{b}e\check{r}$  (add, connect)  
 b. 1.  $[y][c][a] + \text{Pa'al} = y\check{a}c\check{a}$  (exit)  
 2.  $[y][c][a] + \text{Pi'el} = y\check{i}c\check{c}e$  (export)

Repeating the same procedure for roots from different aspectual classes gives us different predictions. Abbreviated representations of the resulting scenarios are provided in (16).

- (16) a. State .....  $\langle -, -, -, [+]\rangle + \langle [+], +, -, -\rangle \rightsquigarrow \langle [+], +, ?, +\rangle$   
 b. Achievement ....  $\langle -, -, [+], +\rangle + \langle [+], +, -, -\rangle \rightsquigarrow \langle [+], +, +, +\rangle$   
 c. Activity .....  $\langle [+], +, -, -\rangle + \langle [+], +, -, -\rangle \rightsquigarrow \langle [+], +, -, -\rangle$   
 d. Accomplishment  $\langle [+], +, +, +\rangle + \langle [+], +, -, -\rangle \rightsquigarrow \langle [+], +, +, +\rangle$

We exemplify the resulting aspectual shifts on our representative examples in (17). Activities and accomplishments in the intensive form (17a–b) maintain the same event structure as simple ones, since the additional fluents simply unify with existing ones. Achievements and states (17c–d) are extended with a dynamic component which proceeds, and brings about, the (change of) state.

- (17) a. *Activity*  $\langle +, +, -, -\rangle \rightsquigarrow \textit{Activity} \langle +, +, -, -\rangle$   
 i.  $[h][l][\check{k}] + \text{Pa'al} = h\check{a}l\check{a}k$  (walk)  
 ii.  $[h][l][\check{k}] + \text{Pi'el} = h\check{i}l\check{e}k$  (walk around)  
 b. *Achievement*  $\langle -, -, +, +\rangle \rightsquigarrow \textit{Accomplishment} \langle +, +, +, +\rangle$   
 i.  $[s][b][r] + \text{Pa'al} = \check{s}a\check{b}a\check{r}$  (break)  
 ii.  $[s][b][r] + \text{Pi'el} = \check{s}i\check{b}e\check{r}$  (break with force)  
 c. *Accomplishment*  $\langle +, +, +, +\rangle \rightsquigarrow \textit{Accomplishment} \langle +, +, +, +\rangle$   
 i.  $[y][c][r] + \text{Pa'al} = y\check{a}c\check{a}r$  (produce)  
 ii.  $[y][c][r] + \text{Pi'el} = y\check{i}c\check{e}r$  (manufacture)  
 d. *State*  $\langle -, -, -, +\rangle \rightsquigarrow \textit{Accomplishment} \langle +, +, ?, +\rangle$   
 i.  $[y][d][l'] + \text{Pa'al} = y\check{a}d\check{a}'$  (know)  
 ii.  $[y][d][l'] + \text{Pi'el} = y\check{i}d\check{e}'\check{a}$  (inform)

Note that the canonical goal in (17d) is unknown, and remains to be instantiated based on context (most importantly, the direct object). The result state, however, refers to the state of ‘know’, which is provided by the preliminary scenario. Similar behavior is observed for other intensive alternations with stative roots (cf. 21a), e.g., (18a–b).

<sup>9</sup> Similar, but not identical, effects appear when putting English achievement verbs in the progressive, cf. ‘progressive achievements’ in [Rothstein(2004)].

- (18) a. i.  $[y][s][n] + \text{Pa'al} = \textit{yasan}$  (sleep)  $\langle -, -, -, + \rangle$   
 ii.  $[y][s][n] + \text{Pi'el} = \textit{yisen}$  (put to sleep)  $\langle +, +, ?, + \rangle$   
 b. i.  $[s][k][n] + \text{Pa'al} = \textit{sakan}$  (live)  $\langle -, -, -, + \rangle$   
 ii.  $[s][k][n] + \text{Pi'el} = \textit{siken}$  (locate, relocate)  $\langle +, +, ?, + \rangle$

**A note on transitivity alternations** Many intensive verbs, but not all of them, show increased valence.<sup>10</sup> The present proposal allows us to delineate valency increasing alternations as ones in which the additional fluents cannot identify with the ones in the preliminary scenario. As a result, activities and accomplishments maintain the same number of participants in the result scenario, while stative roots show increasing valence that follows from the addition of fluents associated with an acting agent  $f_1$  and an incremental theme  $f_2$ .

**A note on denominal Pi'els** Not all intensive verbs have a simple verb counterpart. Some intensive verbs are derived from so-called *denominal* roots. The meaning of denominal roots can be approximated by the noun denoted by it. This noun predicate can then be identified with the object fluent in the quadruple ( $f_2$ , the incremental theme). Thus, the preliminary scenario specifies the following quadruple  $\langle -, f_2, -, - \rangle$ . The contribution of the intensive template thus fills in the activity slot, giving rise to a wide variety of denominal intensive verbs already identified by [Doron(2003)], e.g., (19).

- (19)  $\langle -, +, -, - \rangle + \langle +, +, -, - \rangle \rightsquigarrow \langle +, +, ?, ? \rangle$   
 a. 1.  $[s][m][n] + \textit{noun} = \textit{\check{s}emen}$  (oil)  
 2.  $[s][m][n] + \text{Pi'el} = \textit{\check{s}immen}$  (put oil)  
 b. 1.  $[a][b][k] + \textit{noun} = \textit{abak}$  (dust)  
 2.  $[a][b][k] + \text{Pi'el} = \textit{ibbek}$  (remove dust)

It is to note that the contribution of the intensive template remains neutral with respect to telicity. In many cases, a telic point may be provided by context. Such effect is also available with similar verbs in English in which the quantity/measure of the incremental theme remains underspecified (contrast (19b), for instance, with the activity ‘dust’ and the accomplishment ‘dust the table’).

### The Causative Template Hiph'il

Morphological causatives in MH are derived by fusing consonantal roots with the so-called causative template Hiph'il. The causative template Hiph'il is morphologically marked with a prefixed H and semantically marked with the  $[+\gamma]$  thematic feature. Morphological causatives in MH give rise to a wide range of meanings that does not necessarily coincide with causation in its strict sense. For example, it is debatable whether the meaning of feed is ‘cause to eat’ (20d).

<sup>10</sup> In fact, [Creason(1995)] classifies Pi'el verbs as the transitive counterpart of the Pa'al, and accounts for intransitive Pi'els by stipulating additional sub-categorization of intensive verbs.

- (20) a. 1.  $[p][x][d]$  + Pa'al = *paʔad* (fear)  
 2.  $[p][x][d]$  + Hiph'il = *hiʔxid* (frighten)  
 b. 1.  $[r][k][d]$  + Pa'al = *rakad* (dance)  
 2.  $[r][k][d]$  + Hiph'il = *hirkid* (made dance, cause to dance)  
 c. 1.  $[n][\check{p}][l]$  + Pa'al = *naʔal* (fall)  
 2.  $[n][\check{p}][l]$  + Hiph'il = *hipil* (fell, made fall, cause to fall)  
 d. 1.  $[a][\check{k}][l]$  + Pa'al = *aʔal* (eat)  
 2.  $[a][\check{k}][l]$  + Hiph'il = *he'eʔil* (feed)

As of yet, research into lexical semantics has not shown a systematic correlation between causative constructions and aspectual meanings. In particular, [Levin(2000)] shows that causatives cannot be reduced to any one kind of Aktionsart. However, causatives are valency increasing operations, thereby encoding speakers' choice to incorporate an additional element (a cause) into the event description. According to our hypothesis, this would make them aspectually marked as well.

In [Tsarfaty(2005b)] we set out to make the desired link between causative constructions and aspectual meanings using a revised version of Smith's causal chain [Smith(1991)]. The crucial observation is that causative constructions contribute a 'cause' element which is distinct from elements already existing in the representation of a given situation. Since not all situations map onto the same span of the causal chain, the addition of a preceding 'cause' element gives rise to new event interpretations. Further, marking an explicit 'cause' focuses the linguistic description on the forces behind the initiation and development of the event, thus altering its aspectual viewpoint.

This is in accord with the thematic account proposed by [Doron(2003)]. Doron shows that the causative template contributes an external participant that serves as the cause to the event at hand. We claim that the addition of an external participant alters the eventuality structure by filling in the immediately preceding slots. The new viewpoint is focused on this newly added element(s). (21) illustrates schematically the effect of this process on different roots.

- (21) a. State .....  $\langle -, -, -, [+]\rangle + [+ \gamma] \rightsquigarrow \langle -, -, [+], +\rangle$   
 b. Achievement ....  $\langle -, -, [+], +\rangle + [+ \gamma] \rightsquigarrow \langle [+], +, +, +\rangle$   
 c. Activity .....  $\langle [+], +, -, -\rangle + [+ \gamma] \rightsquigarrow \langle [+], +, [+], +, -, -\rangle$   
 d. Accomplishment  $\langle [+], +, +, +\rangle + [+ \gamma] \rightsquigarrow \langle [+], +, [+], +, +, +\rangle$

The resulting scenarios are illustrated in (22a-d).

- (22) a. *State*  $\langle -, -, -, [+]\rangle \rightsquigarrow$  *Inchoative state*  $\langle -, -, [+], +\rangle$   
 1.  $[d][a][g]$  + Pa'al = *da'ag* (be worried)  
 2.  $[d][a][g]$  + Hiph'il = *hid'id* (make worry)  
 b. *Achievement*  $\langle -, -, [+], +\rangle \rightsquigarrow$  *Progressive achievement*  $\langle [+], +, +, +\rangle$   
 1.  $[n][\check{p}][l]$  + Pa'al = *naʔal* (fall)  
 2.  $[n][\check{p}][l]$  + Hiph'il = *hipil* (fell, made fall, cause to fall)

- c. *Activity*  $\langle [+], +, -, - \rangle \rightsquigarrow$  *Ingressive activity*  $\langle [+], +, [+], +, -, - \rangle$
1.  $[r][k][d] + \text{Pa'al} = \text{rakad}$  (dance)
  2.  $[r][k][d] + \text{Hiph'il} = \text{hirkid}$  (cause to dance, made dance)
- d. *Accomplish.*  $\langle [+], +, +, + \rangle \rightsquigarrow$  *Ingressive accomplish.*  $\langle [+], +, [+], +, +, + \rangle$
1.  $[a][\check{k}][l] + \text{Pa'al} = \text{akal}$  (eat)
  2.  $[a][\check{k}][l] + \text{Hiph'il} = \text{he'ekil}$  (feed)

In (22a), the state of ‘being worried’ comes about due to a certain cause, which gives the event an inchoative interpretation. In (22b), the event ‘fall’ is extended to include a preparatory phase that precedes and causes it, giving it the interpretation of a progressive achievement (which mirrors an accomplishment). In (22c) and (22d), the durative events are extended to include a preceding and parallel cause that continuously stimulates the ‘caused’ event, which provides it with an ingressive interpretation.

**Denominal Hiph’ils** The same proposal accounts for the aspectual meanings of *denominal* causatives, i.e. causative verbs that are derived from nouns. We identify the object denoted by the noun with  $f_2$ , the template fills in  $f_1$  with the essential ‘cause’, and the result gives rise to a variety of wide activities, including the emission verbs mentioned in [Doron(2003)], e.g., (23).

- (23) *noun*  $\langle -, [f_2], -, - \rangle \rightsquigarrow$  *activity*  $\langle [f_1], f_2, -, - \rangle$
- a. 1.  $[r][l][\check{s}] + \text{noun} = \text{ra'aš}$  (noise)
  2.  $[r][l][\check{s}] + \text{Hiph'il} = \text{hir'iš}$  (emit noise)
  - b. 1.  $[y][z][l] + \text{noun} = \text{ze'a}$  (sweat)
  2.  $[y][z][l] + \text{Hiph'il} = \text{hi'zi'a}$  (to sweat)

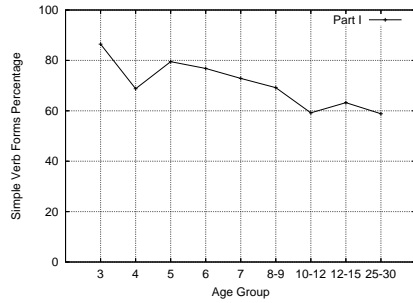
The analysis of denominal verbs in MH serves to demonstrate the two core components of our theory. First, that the addition of a new participant adds also the aspectual context in which it operates, and second, that Semitic derivational morphology has an indispensable aspectual contribution.

## 8 Empirical Investigation

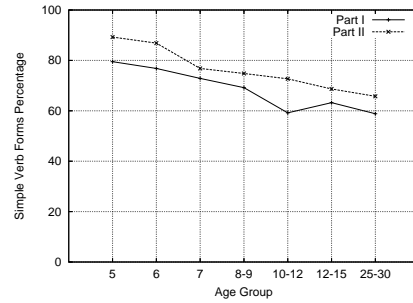
**Experimental Setup** To support our theoretical findings we set out to find empirical evidence for aspectual choice in MH and for developmental trends in the usage of different verbal forms with age. To this end, we used an experimental setup inspired by [Berman and Slobin(1994)]. We asked 22 native MH speakers (ages 3–30) to narrate a story based on a wordless picture book from two different viewpoints. Once while walking through the pictures (‘Part I’), and once in retrospect, after the successful resolution of the plot (‘Part II’).<sup>11</sup>

We expect native MH speakers to compensate for the lack of aspectual inflectional morphology using other means. In the current study we are specifically

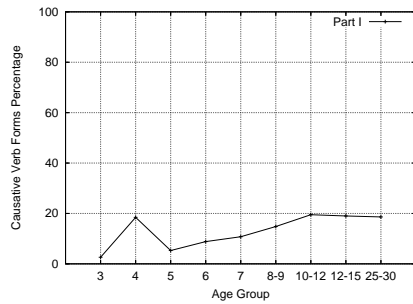
<sup>11</sup> For 3–4 years old children the task was limited to Part I only.



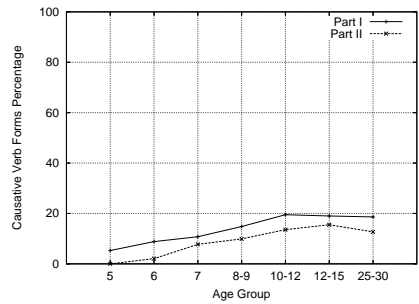
**Fig. 1.** Percentage of simple verb forms used in the first story (average per age group)



**Fig. 2.** Percentage of simple verb forms used in each of the stories (avg. per age group)



**Fig. 3.** Percentage of causative verb forms used in the first story (average per age group)



**Fig. 4.** Percentage of causative verb forms used in each of the stories (avg. per age group)

interested in examining whether templates' alternation is employed for marking aspectual distinctions. Grounding the different narratives in the same pictures allows us to examine how different speakers describe the same situation. The twofold structure of the experiment allows us to compare different descriptions of the same situation by a single speaker, from different temporal viewpoints.

**Results** Figures 1–2 summarize the use of simple verb forms in the narratives. Figure 1 shows decreasing use of simple verb forms with age, thus a respective increase in the use of non-simple forms. This indicates that adult-like use of the morphological templates requires a longer acquisition phase than, e.g., mastering the grammatical tenses<sup>12</sup> (already achieved by the age of 3, [Berman and Slobin(1994)]). Figure 2 shows for all age groups, a persistent increase in simple verb forms in 'Part II' relative to 'Part I'. This shows a prefer-

<sup>12</sup> Note that tense marking is obligatory while marked choices of the kind discussed here are voluntary.

ence for simple verbs when describing complete/completed events in retrospect to drive the story time-line forward.

The distribution of causative verb forms, demonstrated in figures 3–4, shows the exact opposite trend. Figure 3 shows an increasing use of causative verb forms with age, whereas figure 4 shows a consistent decrease in the use of causative verb forms, for all ages, in ‘Part II’ relative to ‘Part I’. This indicates a clear preference for causative verbs when describing incomplete events as they happen.

As of yet we have not found a consistent trend in the usage of intensive verbs per age or a consistent difference between viewpoints. This is possibly due to the fact that many intensive verbs used in the narratives lack a simple verb counterpart (e.g. *xippes* (searched, looked for), *nissah* (tried)). Yet, a qualitative analysis of equi-root templates shows that middle/intensive alternations in the same root demonstrate similar behavior to that of simple/causative alternations, i.e., when the intensive form is used in ‘Part I’, the respective middle form is used in ‘Part II’, e.g. *’ibbed* (lose.intensive) vs. *ne’ebad* (get lost.middle), *yibbeš* (dry.intensive) vs. *hitaybeš* (dried.middle).

We conjecture here that middle verbs, which focus the description on the experiencer of a resulting state, are more appropriate for describing complete and completed events, more so than intensive verbs. However, the analysis of such alternations will only be complete when accompanied with a formal account of the middle templates’ contribution, which is beyond the scope of this paper.

## 9 Conclusion

We present a two-dimensional theory of aspect for MH, in which both lexical and grammatical morphemes are taken into account. The lexical morphemes are roots which are classified to preliminary aspectual classes, and the grammatical morphemes are the morphemes realized in the templates, which mark thematic features that affect the eventuality structure in a principled fashion. Dowty [Dowty(1991)] has already shown that a proper treatment of thematic roles cannot be complete without taking event structure into account. The Semitic templates, formerly associated with phenomena of the thematic domain (voice and agency, transitivity alternations [Doron(2003)]) provided us with an example in the opposite direction: a formal treatment of the event structure cannot be complete without considering the thematic classification of participants.

Treating aspectual content and thematic classification within the same theoretical framework allows one to make precise predictions concerning subtle aspectual distinctions in languages that mark the kind of participants involved (e.g., Persian) rather than strictly aspectual notions such as perfectivity (e.g., Russian) or the progressive (e.g., English). In the future we hope to treat voice alternations within the same theoretical and empirical framework, by means of which we hope to provide further evidence for the interplay between aspectual content of events and thematic description of their participants, thereby establishing further the indispensable aspectual contribution of Semitic derivational morphology.

## Acknowledgments

I am grateful to Prof. Michiel van Lambalgen for supervising this work and to Darrin Hindsill for much discussion throughout. I thank Prof. Susan Rothstein for discussion and comments on earlier notes. Parts of this work were presented at the tenth Batumi symposium, the fifteenth Amsterdam colloquium and at the linguistics seminar of the Hebrew University of Jerusalem. I'd like to thank the audience of these meetings, in particular Barbara Partee, Nissim Francez, Edit Doron, Malka Rappaport Hovav and Anita Mittwoch, for comments and feedback. As of 2005 my work at the ILLC is supported by the Netherlands Organization for Scientific Research (NWO), grant number 017.001.271.

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