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ABSTRACT

The acquisition of morpheme-structure constraints by children is discussed. The focus is a subset of verbs in modern Hebrew and the language-specific knowledge that children acquire of what constitutes a possible verb in their language, from the point of view of both internal form and of categorical appropriateness for naming a certain semantic content or transitive relation. The application of two complementary processes, root extraction and pattern assignment, by 60 Hebrew-speaking children and 12 adults was studied. Subjects were asked to interpret and produce innovative verbs based on familiar nouns and adjectives. The three main findings include the following: (1) children can perform root extraction from as young as age three, and do better at identifying consonantal roots when they are presented with novel verbs for comprehension than in producing novel verbs by extracting roots from nouns or adjectives they know; (2) when children produce new verbs, their innovations conform closely to the grammatical structure of the standard morphological patterns used for constructing verbs in Hebrew; and (3) all child subjects, aged 3-9, overwhelmingly favor the verb pattern preferred for denominal verb-formation in current Hebrew, even though other patterns are equally available in the established lexicon and in the children's own speech. (MSE)

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CHILDREN'S KNOWLEDGE OF VERB-STRUCTURE: DATA FROM HEBREW

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PREAMBLE

The talk concerns the acquisition of what have been called "morpheme-structure" constraints, in the sense of the wellformedness of word-internal structure. I will deal with a particular subset of verbs in Modern Hebrew. This involves a very language-specific type of knowledge: How children learn what constitutes a possible verb in their language from the point of view both of internal form and of categorial appropriateness for naming a certain semantic content or transitivity relation. I will not consider knowledge of inflectional morphology, (in Hebrew verbs, these involve person, number, gender, and tense), to focus on processes of new-word formation associated with derivational morphology.

DESCRIPTION OF HEBREW

All verbs and most nouns and adjectives in Hebrew (as in other Semitic languages) are constructed out of consonantal roots associated with affixal patterns. The canonic root is triconsonantal, but Modern Hebrew contains a large proportion of quadriliteral roots with four or more consonants (Yannai 1974). There are also many defective roots with glides or low consonants which may not be realized in the surface form of words. Hebrew has seven verb-patterns, three of which are considered here. (Of the other four, two are strictly passive patterns, and are rare in children's usage; and two are typically intransitive, and so not relevant to the elicitation task used in

the study; see Berman 1978, 1982). These possibilities are shown in (1), where examples are given for the three target patterns P1 pa'al. P3 pi'el, and P5 hif'il with two full roots - r-q-d 'dance' and g-d-l 'grow' - and two defective roots - y-c-alef 'go-out' and b-w-alef 'come' - in the infinitive and in 3rd person masculine singular present, past, and future tense for each root.

(1) Examples of full and defective roots in three verb binyan patterns:

	ROOT	GLOSS	INFINITIVE	PRESENT	PAST	FUTURE
P1 pa'al	r-q-d	dance (Intr)	li-rkod	roked	rakad	yi-rkod [1]
	g-d-l	grow (Intr)	li-gdol	@godel [2]	gadal	yi-gdal
	y-c-? [3]	go out	la-tset	yotse	yatsa	ye-tse
	b-w-?	come	la-vo	ba	ba	ya-vo
P3 pi'el	r-q-d	skip	le-raked	me-raked	riked	ye-raked
	g-d-l	raise up	le-gadel	me-gadel	gidel	ye-gadel
	y-c-?	export	le-yatse	me-yatse	yitse	ye-yatse
	b-w-?	import	le-yave	me-yave	@yive	ye-yave
P5 hif'il	r-q-d	make-dance	le-harkid	ma-rkid	hi-rkid	ya-rkid
	g-d-l	make-big,enlarge	le-hagdil	ma-gdil	hi-gdil	ya-gdil
	y-c-?	take out	le-hotsi	mo-tsi	ho-tsi	yo-tsi
	b-w-?	bring	le-havi	me-vi	he-vi	ya-vi

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NOTATION:

[1] ' Stress - is generally word-final, an accent aigu indicates penultimate stress

[2] @ Indicates forms typical of spoken usage, not normatively prescribed.

[3] ? Stands for the glottal stop alef, & - for the pharyngeal ayin, both generally pronounced as zero in word-initial and final position, and as a glottal-stop intervocalically.

' Stands for cases where a glottal stop is pronounced.

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THE ACQUISITIONAL TASK

What Hebrew speakers know, and what children need to learn, is how to apply two complementary processes - "root-extraction" and "pattern-assignment". Root-extraction means that they can identify the consonantal skeleton out of which a word is formed; pattern-assignment - that they can associate a suitable affixal pattern with this root so as to produce a word. In order to find out when and how this ability is established for unfamiliar verbs, we tested children on novel verbs innovated from familiar nouns and adjectives - words which do not have a related verb in the established lexicon. The task was designed with Eve Clark of Stanford, and it follows on from earlier work we have done on children's ability to understand and produce novel nouns (Clark & Hecht 1982, Clark & Berman 1984) and compounds in Hebrew (Berman 1987).

60 Hebrew-speaking children and 12 adults were asked to interpret and produce innovative verbs based on familiar nouns and adjectives. Sample items are shown in (2) - with one example from the 10 items used for comprehension and two examples from the 40 used for production. (Thanks are due to Dr. Dorit Ravid of Tel Aviv University for help in constructing and piloting the test items).

(2) COMPREHENSION, Example in P1:
ani roca li-tsmod [P1] et habuba. hine ani tsomed-et et habuba. ani sama la TSAMID. ani tsomed-et ota. = 'I want to-bracelet the doll. Look how I bracelet the doll. I'm putting a BRACELET on her. I'm braceleting her.'

PRODUCTION - LOCATION = PLACE NOUNS, Example in P3:
bo('i) nasim et haxaruzim bexol miney mkomot. kodem tasim(i) otam al ha-SHULXAN. tar'e li ex ata yodea le-shalxen [P3] et haxaruzim. Yofi ex she at(a) me-shalxen-et otam!. ata mamash shilxant(a) nehedar et haxaruzim! = 'Let's put the beads in different places. First put them on the TABLE. Show me how to table the beads. That's great, the way you table them! You tabled the beads just right!'

(2) continued:

PRODUCTION - CAUSATIVE ADJECTIVES, Example in P5:
yesh lanu kan sir im marak, ve hamarak lo ta'im ve gam en lo tseva. tsarix la'asot lo kol miney dvarim, lamarak haze. Lemashal, tsarix la'asot she hamarak yihye SHAKUF. az tsarix le-hashkif [P5] oto. hine ani mashkif-a et hamarak. ani osa oto shakuf. = 'Here's a big pot with soup in it. But the soup has no taste, and it needs some color, too. So we're going to do different things to the soup. Say we want to make the soup CLEAR [=transparent], then we need to clear it. Look how I'm clearing the soup, I'm making it clear.'

RESULTS

The main findings were: First, children can perform root extraction from as young as age three to four; and they do better at identifying consonantal roots when they are presented with novel verbs for comprehension than in producing novel verbs by extracting roots from nouns or adjectives which they know - i.e. comprehension outstrips production. Second, when children produce new verbs, their innovations conform very closely to the grammatical structure of the standard morphological patterns used for constructing verbs in Hebrew. Third, all subjects - from age 3 up through age 9 - overwhelmingly favor the particular verb-pattern which is preferred for denominal verb-formation in current Hebrew (P3 pi'el) - even though the other patterns are equally available in the established lexicon and in the children's own speech. The major difference between the innovations of young children compared with adults is the variability of the novel forms which they produce. Mature speakers extract roots quite uniformly and consistently both across and within items: They agree even more than children aged 7 or 9 years and older children agree more than 3 and 4 year olds on which roots they favor for a given word. In contrast, 3 and 4-year olds tend to be quite idiosyncratic in the forms which they construct.

The rest of the talk focuses on these three areas: Root extraction, Pattern choice, and Convergence of form.

1. Root Extraction

COMPREHENSION: Previous studies (of my own and of other researchers) suggest that children rely on the consonantal skeleton for interpreting and producing unfamiliar words in a Semitic language by around age four (Badry 1983, Berman 1985, Clark & Berman 1984). This is supported by findings from the present study in both comprehension and production. The comprehension task illustrated in (2) above required subjects to identify novel verbs based on established nouns naming different pieces of apparel. Table One shows that children of school-age behaved like the adults, correctly interpreting novel verbs nearly 100% of the time. Preschool children aged 5, 4, and 3 years - did so in over 80% of their responses; even children as young as age three identified at least 4 and on an average 8 items out of 10 novel verbs presented to them.

(3) Table One - Mean percentage of correct responses in comprehension of 10 novel denominated verbs [N = 12 per age-group]

Group	Age Range	Mean	% correct responses	range of errors
Adults	21 - 48	35	95%	0 - 1
9s - 4th-grade	9;3-9;11	9;6	93%	0 - 1
7s - 2nd-grade	7;0-7;11	7;5	95%	0 - 1
5s - kdgarten	5;0-6;0	5;6	88%	0 - 3
4s - nursery	4;0-4;11	4;4	82%	0 - 5
3s - nursery	3;0-3;10	3;5	80%	0 - 6

The figures in Table One provide clear evidence for knowledge of Semitic lexical structure: the ability to apply the process of root-extraction (Bat-El 1989) - i.e. to identify and isolate the "consonantal skeleton" of a word.

With regard to the items on the comprehension task, the 10 novel verbs to be interpreted differed in transparency: They were in different binyan morphological patterns and had more or less defective roots. Yet, as shown in Table Two, all 10 items were accessible to most of the children tested.

(4) TABLE TWO - Number of correct responses given by 60 children (aged 9-3 years) on 10 comprehension items, in descending order of success

	Input Verb Infinitive	Present	Binyan Pattern	Source Noun	Gloss	Root	Total Correct
1.	leham'il	mam'il	P5 hif'il	me'il	coat	m-&-l	59
2.	lehac'if	mac'if	P5 hif'il	ce'if	scarf	c-&-f	58
3.	lish'on	sha'on	P1 pa'al	sha'on	watch	sh-&-n	56
	lemashkef	memashkef	P3 pi'el	mishkafayim	glasses	m-sh-k-f	56
	lesaner	mesaner	P3 pi'el	sinar	apron	s-n-r	56
6.	limgof	mogef	P1 pa'al	magafayim	boots	m-g-f	52
7.	lesakot	mesake	P3 pi'el	sika	brooch	s-k-y	48
8.	lekavea	mekavEa	P3 pi'el	kova	hat	k-v-&	47
9.	lehafjim	mafjim	P5 hif'il	pijama	pyjamas	p-j-m	46
10.	lismol	somel	P1 pa'al	simla	dress	s-m-l	46

Table Two shows that the formal structure of input items had little effect on comprehension. First, as had been assumed, all three binyan patterns - P1 pa'al, P3 pi'el, and P5 hif'il - occur among both the easiest and the hardest of the items (items ranked 1 - 3 which scored well over 90% and items ranked 8-10 which scored around 75% respectively). As for root-structure, medial glides caused no difficulty in comprehension (all of the top three items in fact), nor were words with open final syllables (ranked 7 and 8 in Table Two) the hardest for the children - contrary to what I had expected

(Berman 1981, Ravid 1988). That is, young Hebrew speakers can extract a consonantal skeleton even when this diverges from the full, canonic structure of three obstruent radicals.

PRODUCTION: To do the production task - of coining novel verbs from known nouns or adjectives - children could have relied on several non-Semitic strategies. These include (a) zero derivation - i.e. treating the input noun as a verb (although the input items were never given in the only form which allows a noun or adjective to have the same surface shape as a verb - the participial or present tense (benoni) form (Berman 1978, Gordon 1982); attaching an external affix to the input noun (b) in the form of verb prefixes - e.g. present-tense me- or ma- or infinitival li-, le- or (c) or noun suffixes; or (d) they could produce a verb with completely different consonants than the input noun. Yet children rarely used these routes. Rather, once they chose to innovate, they did so overwhelmingly on the basis of the classical Semitic process of root extraction plus verb-pattern association. Table Three gives the figures for a representative sample of 22 items (selected from the total 30 nouns and 10 adjectives presented in the production task).

(5) TABLE THREE - Number of illformed items out of total innovations produced from 22 input nouns and adjectives, by age [N = 12 at each age]

	Innovations			Nonverb =
	%	Number	Illformed	Noun + Suffix
Adults	99%	262	2	-
9s	97%	255	3	-
7s	98%	256	8	1
5s	89%	234	5	-
4s	86%	228	10	10
3s	55%	144	7	2
	Total	1337	35	13

Table Three shows that even the 3- and 4-year olds produced very few items which violate Hebrew verb-structure constraints: Less than 5% of all their innovative responses (17 out of 372 innovations) were illformed as verbs, while only 12 items took the form of nouns with diminutive or other suffixes - e.g. madaf-it 'shelfie' for madaf 'shelf' (and 9 of these were given by one child, Ya'ara, aged 4;11). Deviant forms are illustrated in (6): These violated either the internal vowel patterning or consonant clustering licensed by the verb-patterns P3 and P5 (Bat-El 1989, Bolozky 1978); children only occasionally used the strategy of attaching a verbal prefix to the stem noun - to yield ungrammatical, though transparent, forms like those at the end of (6).

(6) Wrong vowels: garzen 'axe' > *megarzin [Nitsan 4;6] cf. P3 megarzen
muzar 'strange' > *memazrir [Omer 3;10] cf. P3 memazrer
tmuna 'picture' > *matmen [Sima 4;10] = noun pattern
safsal 'bench' > *mafsal [Tomer 4;0] = noun pattern

Inadmissible consonant clusters:
tris 'shutter' > *metrates [Omri 7;1] cf. P3 metatres
sir 'pot' > *mastrir [Nitsan 4;6] cf. P5 masrir

Prefix+Stem: aron 'closet' > *le'aron [Michal 9;3] cf. P3 le'aren
kise 'chair' > *mekise [Tal 7;0] cf. P3 mekase
ta'im 'tasty' > *meta'im [Tally 5;0] cf. P5 mat'im

There were also very few violations on the construction of possible root combinations in Semitic - specifically, on the first two consonants being homotopic (Greenberg 1950, McCarthy 1981). For example, from kise 'chair', children simply did not give me-kakes or mesaser from sir 'pot' (nor did they give me-sasep from sapa 'sofa, couch' - although two each at ages 3, 4, and 5 did so in the form me-papex from pax 'bin, can'; and Modern Hebrew does in fact have some denominal verbs of this kind - e.g. le-mamen 'to finance' from mamon or le-mamesh 'to realize' from mamash 'reality'). What children very

often did was to add consonants to the end rather than to the beginning of the roots they extracted (see examples in (9) below). And in fact adding consonants onto the end of a weak root (particularly by reduplication) is well-attested method of root-formation in Hebrew. As further evidence for the process of root-extraction, note that only 4 of the hundreds of coinages given by children were based on a different root with a related meaning (e.g. from ambatya 'bath' Tomer [4;0] gave P5 marxic 'washes' with the root r-x-c 'wash'; from sakin 'knife' Nitsan [4;6] gave nominal maxtex 'cutter' from the root x-t-x 'cut'; from tris 'shutter' Oded [4;6] gave mepatex [sic] from p-t-x 'open'; and from ta'im 'good-tasting' Aya [7;7] gave P3 meshaked 'crackers' from the noun shaked '(soup)-almond'). That is, across the board children extracted consonants from the source input word in order to coin new verbs.

2. Choice of Morphological Pattern

The second major finding was that children showed marked, and precocious, knowledge of which morphological pattern or binyan fits the process of creating new verbs by denomination. Examples were given to the children in three of the five nonpassive patterns - as illustrated in (1) and (2) above. (For discussion of the form and functioning of these patterns in current Hebrew, see Berman 1978, chapter 3; Bolozky 1982; Bolozky & Saad 1987; Borer & Grodzinksy 1986; Junger 1988; for characterizations of the acquisition of these patterns by Hebrew-speaking children see Berman 1980, 1982, 1986; Walden 1982). P1 pa'al is the pattern with the highest frequency in preschool speech (some three-quarters of all verb-forms analysed from over 100 transcripts of children aged two to five years, Berman & Dromi

1984) as well as in adult usage (around 60% of all verbs in spoken and written Hebrew, Schwarzwald 1981). And P3 pi'el and P5 hif'il are used far more than other patterns for deriving verbs from nouns and adjectives (Berman 1989, Bolozky 1978, Sivan 1963).

Tables Four and Five below show which morphological patterns speakers selected in coining novel verbs.

(7) TABLE FOUR - Percentage of verbs in three binyan patterns out of total innovations produced by 6 age-groups [N = 12 per group, 40 input items each]

	No. Innovated	P3 = pi'el	P5 = hif'il	P1 = pa'al
Adults	478	70	28	2
9s	463	73	21	5
7s	454	90	4	5
5s	422	90	2	7
4s	411	75	18	-
3s	266	85	4	3

(8) TABLE FIVE - Distribution of patterns in verbs coined by 36 preschoolers

Total Innovations	P3	P5	P1	Other Inappropriate
1099 = [76%]	913 [83%]	91 [8%]	42 [4%]	53

All speakers coin verbs overwhelmingly in the pi'el pattern, P3 - while adults and 9-year olds (as well as the 4s) gave P5 between 20 to 30% of the time. This trend is so marked that it can be taken as a norm. And in fact it closely parallels current preferences in both the established lexicon and in other studies of innovated verbs. There are compelling reasons - a combination of morphophonological, semantic, and syntactic factors - why P3 pi'el is the most favored option for denominal verb-formation (Berman 1989, Bolozky 1978, 1982, Schwarzwald forthcoming, Sivan 1963). The present study

shows that children recognize this from an early age. From Table Five it is clear that 3 to 5-year olds favor P3 pi'el overwhelmingly, and that they hardly ever coin new verbs in P1 pa'al. This is not immediately obvious, since when administering the test, we gave children the same number of examples in all three patterns; besides, the P1 pa'al pattern has far the highest frequency both in the established lexicon and in everyday conversational usage. These findings thus demonstrate that from a very young age, children know what constitutes a possible verb in their language and which pattern is most suited to creating new verbs from nouns in Hebrew.

3. Variability or Convergence of Forms

Young Hebrew learners thus demonstrate considerable knowledge of verb-structure in their language. The last point concerns the major area of difference between young children's coinages compared with those of older speakers (apart from the quantitative lack of innovation among the three-year olds): There is a distinct difference in uniformity of responsem as follows. Adults tended to agree very largely on the forms they produced, whatever the input root-structure. The last set of data - the item-analyses in tables (9-1) through (9-4) below - tabulates responses to two nouns with 3 or 4 consonants - sakin 'knife' and argaz 'box' - compared with two nouns that have defective radicals and open final syllables - kise 'chair' and ambAtya 'bath'.

(9) Responses to 4 items, by output forms and age-group [N = 12 at each age]:

(9-1) SAKIN 'knife' . Instrument, CaCiC = triconsonantal, canonic

			Adults	9s	7s	5s	4s	3s
s-k-n	P3	mesaken	12	7	8	9	8	6
=	P5	maskin		2				
=	P1	soken			1	1		
s-k-n-n	P3	mesaknen		1	1			
s-k-t	P3	mesaket		1				
s-k-s-n	P3	mesaksen			1			
s-k-s-k	P3	mesaksek			1			
RT-CHANGE							1	1
WORD, PHRASE, NO ANSWER							2	3 5

(9-2) ARGAZ 'box, crate': Place, ?CVCVC = quadriconsonantal, alef-initial

			Adults	9s	7s	5s	4s	3s
?-r-g-z	P3	me'argez	12	11	4	9	4	5
=	*	ma'argiz					1	
g-r-g-z	P3	megargez			4		1	
g-z-g-z	P3	megazgez			1			1
g-r-z-z	P3	megarzex				1	1	
g-r-z-n	P3	megarz n			1	1		
g-r-z-r	P3	megarzer				1		
m-r-g-z	P3	memargez			1			
?-r-g-z-z	P3	me'argezez						1
r-g-z	P5	margiz, P1 rogez		1	1		1	
g-r-z	P3	megarez					2	1
NO ANSWER							1	4

(9-3) KISE 'chair': Place, CVCV = biconsonantal, open final syllable

			Adults	9s	7s	5s	4s	3s
k-s-y	P3	mekase	7	5	2	1	4	1
=	P5	makse	1	1				
k-s-?	P5	maksi		1				
=	*	mekise			1			
k-s-'	P3	mekasEa	3		2			
=	P5	maksIa	1					
k-s-t	P3	mekaset		5		1		
=	P1	koset				1		
k-s-n	P3	mekasen			2	1		1
k-s-s	P3	mekases			2	0	1	1
k-s-k-s	P3	mekaskes			3		1	1
X-k-s	P3	makis					1	
+ r	P3	mekarsen					1	
	*	mekarse						1
Noun + Sfx		kisani					1	
WORD, PHRASE, NO ANSWER							3	3 7

(9-4) AMBATYA 'bathtub': Object, VCVCya = bi-tri-quadricons, initial alef, final open

		Adults	9s	7s	5s	4s	3s
?-m=b-t	P3 me'ambet	10	11	2	4	2	4
	* me'ambit	1					
m-b-t	P5 mambit	1		1			
?-b-t	P5 ma'abit		1			1	
?-b-m	P1 obem				1		
b-b-t	P3 mebabet				1		
b-y-t	P3 mebayet			1			
b-y-n	P3 mebayen				1		
b-t-n	P3 mebaten			1	1	1	
b-t-t	P5 mabtit			1			
X-b-t	P5 mebit			1			
b-t-b-t	P3 mebatbet			2			
m-b-y-t	* membayet			1			
b-n-y-n	P3 mebanyen				1		
?-n-b-n	P3 me'anben					1	
?-n-y-n	P3 me'anyen				1		
b-l-t-n	P3 mebalten					1	
?-m-b-y-n	P3					1	
RT-CHANGE	P5 marxic						1
Noun + Sfx	* me'ambat-et ~ yot ~ iyen			1	1		1
	* marbanta					1	
WORD, PHRASE, NO ANSWER				1	1	3	7

Across the test, the 12 adults extracted a small set of roots for any given item - s-k-n from sakin in (9-1), ?-r-g-z from argaz in (9-2), k-s and a final alef, ayin, or glide for kise in (9-3), and ?-m-b-t from the loan-noun ambatya in (9-4). In contrast, children varied their responses in a more idiosyncratic way; they added to and subtracted from the consonants of the source nouns quite divergently - e.g. from ambatya they gave P5 ma'abit, P1 obem, as well as P3 mebabet, mebayet, mebayen, mebaten -even though the output forms which resulted, as noted, remain very largely within the grammar of Hebrew verb-formation. I attribute this lack of uniformity to two factors: The older speakers have more conscious knowledge of the system - due to the combined impact of literacy, hence familiarity with the consonantal orthography, and of formal schooling in root extraction and pattern

association. They also have greater command of the established lexicon and hence are more constrained by lexical convention (Clark 1981). Younger children know the general principles governing root-extraction and affixal pattern formation - as was demonstrated by our earlier findings. But preschoolers still need to develop an agreed lexicon which shares the same potential as well as the same actual or occurrent stock of verb forms as is available to the standard adult speaker.

SUMMARY

To conclude: Children have been shown to acquire highly language-specific knowledge of lexical structure as early as age three. This demonstrates early sensitivity to both the general typology of the native tongue - Semitic reliance on a consonantal base - and language-particular structure - the grammar of Hebrew verb-pattern morphophonology. But it also supports a claim I have made for other areas of language development - in extended discourse, the lexicon, and morpho-syntax - as argued in a paper I gave at BU in 1985 (see Berman 1986): Early, quite precocious knowledge of grammatical structgure needs to be incorporated within the broader frame of constraints on language use. In the area considered here, children must eventually move on to a more consistently uniform construal so that they recognize not only what constitutes a possible verb in their language, but also what speakers agree would be a most favored or a likely one.

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