

Marking of verb transitivity by Hebrew-speaking children*

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ABSTRACT

The study examines children's command of transitivity permutations in Hebrew, where a change in verb-argument syntax entails a change in verb-morphology. 30 children aged two, three and eight were required to produce existing and novel Hebrew verbs differing in transitivity. Younger children showed a good grasp of the syntax and semantics, but not the morphological marking of transitivity, three-year-olds did much better, and eight-year-olds produced mainly adultlike responses. Results were higher on existing verbs than on novel forms. Direction of change had little effect with existing verbs, but with novel verbs success was much higher in changing intransitive to transitive forms than the converse. Some alternations proved easier than others, e.g. intransitive activity verbs in the basic *pa'al* verb-pattern yielded more causative *hif'il* forms than intransitive inchoative verbs in the *nif'al* pattern. Findings throw light on the development of derivational morphology, item-based versus class-based learning, and the impact of lexical productivity and language-particular properties on acquisition.

INTRODUCTION

Children's construals of verb-transitivity have been of interest since Bowerman (1974) first analysed her children's marking of causativity in English. The present study examines acquisition of transitivity alternations in Hebrew, where a change in syntactic verb-argument structure involves

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change in verb-morphology. It addresses the issue of rote-learned, item-based knowledge compared with productive rule-application and the effect of directionality in changing from intransitive to transitive compared with from transitive to intransitive predicates.

An earlier review of acquisition of Hebrew verb-pattern alternations (Berman, 1982), revealed that children at the period of early clause-structure rarely use the same verb with more than one transitivity value. Two-year-olds fail to use verb-pattern morphology for any of its systematic functions, such as: to mark syntactic distinctions of transitivity; to express semantic notions such as causativity, inchoativity, or reciprocity; and to apply lexical processes of new-word formation such as denomination. Rather, young children use verbs mainly as unanalysed amalgams, even when they already have command of tense and agreement inflections. These observations are supported by subsequent analyses of Hebrew verb-usage based on cross-sectional speech samples of 27 children aged 1;9 to 2;6 (Kaplan, 1983) and on longitudinal records of 5 Hebrew-speaking children aged between 1;6 and 2;6 (Berman & Weissenborn, 1991). Children use verbs belonging to different morphological patterns even at the one-word stage, but they rarely use the same verb-root in more than one pattern. One aim of the present study was to test this finding for initial lack of verb-pattern alternation in a structured elicitation setting.

Productive knowledge of the Hebrew verb-pattern system is manifested from around age three, *after* children have already mastered basic clause structure. Evidence for command of verb-pattern alternation is provided by creative errors in children's spontaneous usage: innovative verbs outside the established lexicon, which generally accord with the transitivity value canonically associated with specific morphological patterns (Berman, 1980; Berman & Sagi, 1981). Experimental findings support age three to four years as critical for command of verb-pattern usage: A test of verb-pattern alternation on 14 pairs of verbs administered to 60 Hebrew-speaking monolinguals showed marked improvement between age three to four: Three-year-olds (3;0-3;6) made the correct morphological change 61% of the time, while four- and five-year-olds (4;0-4;6 and 5;0-5;6) rated 80% and 85% success respectively (Rabinowitch, 1985). Her test concerned verb-pattern morphology in general, without comparing the shift from transitive to intransitive verb-forms and vice versa. The present study was designed to test specifically for directionality of change.

The 'binyan' system of verb-pattern alternation

In Hebrew, like other Semitic languages, a change in syntactic transitivity requires a change in verb-morphology. This is realized through the set of *binyan* 'conjugation' patterns, as in the contrast between the pairs of sentences in (1) to (3). In these examples, 'Pn' stands for one of the five

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P₁ - PA

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P₃ - PI

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nonpassive *binyan* patterns,¹ and 'OM' stands for the accusative preposition *et* marking direct object NPs.

- (1) a. *Ron shafax* [P₁] *et ha-mits*
 Ron spilled OM the juice
 'Ron spilled the juice'.
 b. *ha-mits nishpax* [P₂]
 the juice spilled
- (2) a. *ha-isha horida* [P₅] *et ha-yeladim (me ha-mita)*
 the woman took-down + FM OM the boys (from the bed)
 'The woman took the boys down off the bed'.
 b. *ha-yeladim yardu* [P₁] (*me ha-mita*)
 the-boys got-down + PL (from the bed)
 'The boys got down off the bed'.
- (3) a. *ha-yalda mesovevet* [P₃] *et ha-xaruzim (al ha-xut)*
 the girl spins + FM OM the beads (on the string)
 'The girl is spinning the beads on the thread'.
 b. *ha-xaruzim mistovevim* [P₄] (*al ha-xut*)
 the beads spin + PL (on the string)
 'The beads are spinning on the thread'.

The five active and middle-voice patterns in these examples display typical values for transitivity. In the present context, [+Transitive] verbs are narrowly defined as occurring in SVO constructions and as governing accusative case, i.e. the object nominal takes *et* as in (1a), (2a) and (3a). By this strict definition, the patterns cluster as follows:

(4)		[- Transitive]		[+ Transitive]
P ₁ - PA'AL [QAL]	<i>caxak</i> ²	laugh		<i>daxaf</i> push
	<i>yashen</i>	sleep		<i>shavar</i> break
P ₂ - NIF'AL:	<i>nishbar</i>	break		
	<i>nivhal</i>	get a fright		
P ₃ - PI'EL:			<i>tiken</i>	fix, mend
			<i>nigev</i>	wipe
P ₄ - HITPA'EL:	<i>hitraxec</i>	wash (oneself)		
	<i>hitbayesh</i>	be ashamed		
P ₅ - HIF'IL:			<i>hidlik</i>	light, ignite
			<i>hirdim</i>	put to sleep

Verbs in P₁, P₃ and P₅ alone can govern accusative case, as illustrated in (1a), (2a) and (3a). Verbs in P₂ and P₄ can be loosely transitive, since they

[1] Characterization of the Hebrew system of *binyan* verb patterns is restricted to a brief outline. Prior studies of this system from different perspectives are reviewed in Junger (1987), and my own current analysis is detailed in Berman (1991).

[2] Verbs are cited in the morphologically simple form of past tense, 3rd person masculine singular, except where otherwise specified.

may require a prepositional object, e.g. P2 *nehena mi-* 'enjoy from' or P4 *histakel be-* 'look at', but they never govern *et*. Also, verbs in P1, P3 and P5 have passive-voice alternants, but those in P2 and P4 do not.

Pairs of patterns manifest productive alternations, illustrated in (5) as symmetrical pairings, with no indication of directionality (e.g. whether P5 is derived from P1 or vice versa).

(5)

a. P1	~	P5	<i>caxak</i>	laugh	~	<i>hicxik</i>	amuse
[-Tr]		[+Tr]	<i>yarad</i>	go down	~	<i>horid</i>	take down
b. P1	~	P2	<i>sagar</i>	shut, close	~	<i>nisgar</i>	get-shut
[+Tr]		[-Tr]	<i>shafax</i>	spill	~	<i>nishpax</i>	get-spilled
c. P2	~	P5	<i>nivhal</i>	get-a-fright	~	<i>hivhil</i>	frighten
[-Tr]		[+Tr]	<i>nirdam</i>	fall asleep	~	<i>hirdim</i>	put to sleep
d. P3	~	P4	<i>nipeax</i>	blow up	~	<i>hitnapeax</i>	swell up
[+Tr]		[-Tr]	<i>nigev</i>	wipe	~	<i>hitnagev</i>	wipe oneself

A change in transitivity, then, entails a change in verb-morphology, by means of *binyan* pattern-assignment. Hebrew lacks a parallel to English verbs like *change*, *move*, *open*, which can be both one-place intransitive or two-place transitive predicates. There are only two minor exceptions to this constraint: high-style, classical forms of deadjectival verbs which are both inchoative and causative (cf. English *redde*) and a few aspectual verbs (akin to English *begin*). Children thus have little or no evidence for assuming that pattern-shifting is optional, and use of an intransitive verb in the context of {S V *et* O} is immediately identifiable as ungrammatical by Hebrew speakers.

By as young as 2;6, Hebrew children demonstrate knowledge of relevant features of simple-clause structure: (i) SV(O) word-order; (ii) marking of accusative case by the preposition *et*; and (iii) inflectional marking of Subject-Verb agreement in number, gender and person - with acquisition proceeding in that chronological sequence (Berman, 1985, in press). What they still appear to lack is productive command of morphological marking of transitivity values on the verb.

From rote-learning to productive use

Two-year-olds' knowledge of Hebrew verb-transitivity appears non-productive in the sense that it is not generalized across entire classes or categories. Bowerman (1974, 1982) has described early causative-verb usage as based on unanalysed amalgams. MacWhinney (1978) attributes such item-based knowledge to initial reliance on rote-learning in acquiring inflectional morphology. Other researchers have suggested that passives may also initially be learned verb by verb, with only partial reliance on class-based factors of transitivity or actionality (Gordon & Chafetz, 1990). The question

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addressed in this study is how and when non-analysis gives way to productive rule-extraction in Hebrew verb-pattern alternation.

Development of this knowledge, like other facets of language acquisition, depends on the interaction between linguistic universals and the properties of a particular target language, on the one hand, and the clustering of factors pertinent to a particular linguistic domain, on the other. Factors which are proposed to account for acquisition of Hebrew *binyan* transitivity alternations include typological bias, lexical productivity and frequency of use.

'Typological bias' refers to children's sensitivity to what is relevant in the input language (Berman, 1986, 1990; Slobin, 1990). In the present case, children need to recognize that it is non-Hebrew (hence for them, nonlanguage-like) to use the same form of a verb in both the contexts {S V et O} and {S V}, although there is no universal requirement that verb-morphology be enlisted in order to describe a situation as an intransitive event rather than a transitive action.

The notion of 'productivity' refers, as noted, to how knowledge is generalized from individual items to classes of items and to abstract structural categories. Another facet of this notion is how favoured a particular structural option is in current usage (Clark & Berman, 1984; Berman, 1987). Productivity enables children to recognize certain alternations as expressing quite general form-meaning relations in their language. For instance, the interrelations between P₁ transitive activity and P₂ intransitive event verbs (e.g. *li-shpox* ~ *nishpax* 'spill') and between P₁ intransitive activity and P₅ causative verbs (*la-redet* ~ *le-horid* 'get down' versus 'take down') are highly productive in current Hebrew. The argument here is that once typological bias constrains children to adapt verb-patterns to specific verb-argument configurations, they will abandon earlier rote-learning in favour of rule-bound assignment of transitivity values. The developmental order of which alternations are acquired first and which later will be determined by the most actively productive processes in the current lexicon.

Productivity interacts with lexical familiarity and relative frequency of use, as follows. Productivity helps children extract out generalizations, frequency determines to which items these generalizations are first applied. This explains why children soon recognize the commonality of such early verbs as P₁ *yarad* 'go down' and P₅ *lehorid* 'take down', or P₁ *nafal* 'fall' and P₅ *lehapil* 'make-fall, drop'. Only later will they extend this to more specific, less frequent verbs in the same two patterns, e.g. P₁ *avar* 'pass' versus P₅ *leha'avir* 'make-pass', 'transfer'.

Lexical and/or grammatical knowledge

Knowledge of verb-pattern alternation in Hebrew is affected by lexical factors, e.g. the accidental gaps, frozen forms and semi-productive alter-

nations typically associated with the domain of word-formation. This makes it hard to pinpoint the extent to which knowledge of transitivity marking is productively rule-based. A well-established device for distinguishing generalized knowledge of linguistic structures from more limited knowledge of unanalysed strings since Berko's classic (1958) 'wug-test' study is use of nonce-items not attested in the established lexicon. Studies of plural-formation using this paradigm (e.g. Hecht, 1985; Levy, 1987) indicate that children perform better with real-word than with nonce-word items as input owing to the vulnerability of newly-acquired knowledge which precedes the automated procedural performance of fully consolidated, mature representations (Karmiloff-Smith, 1986).

Nonce words lack an established semantics, and so require prior training in the sound-meaning relationship to be elicited, including appropriate discourse contexts, as in the study of passive-constructions by Pinker, Lebeaux & Frost (1987), of causative verbs by Maratsos, Gudeman, Gerard-Ngo & DeHart (1987), and of transitivity alternations by Braine, Brody, Fisch & Weisberger (1990). This problem can be mitigated when derivational morphology is involved, by requiring children to apply rules to items which do exist in the established lexicon, and so have an established semantics, but which happen not to undergo the alternation in question. Such a methodology has proved successful in studies of lexical innovation, where children are required to derive novel nouns from familiar verbs (Clark & Berman, 1984), novel compounds from set paraphrases (Clark & Berman, 1987), or novel verbs from familiar nouns (Berman, 1989; Berman & Clark, 1993). This procedure was extended in the present study to the production of innovative non-occurrent verbs from familiar established input verbs, with the aim of distinguishing rule-based from word-based knowledge.

Direction of change

An important issue in the study of children's verb usage has concerned the question of directionality: Whether children prefer to overextend transitive verbs to intransitive contexts or vice versa. Data from English-speaking children formed the basis for Bowerman's observation that children may turn intransitive verbs into causatives as young as age 2;0 to 2;6, as in 'I'm gonna fall this on her' (1974: 144) similar to my child's 'somebody *fallen* the lamp and it broked' (Berman 1982: 172). Bowerman observed that her daughters produced novel or unconventional transitives more often than the reverse, a finding which she explains in semantic terms, as adding compared with subtracting the element 'cause'. In English, causatives are often produced by zero derivation (e.g. 'He broke the vase' versus 'The vase broke'), so that the higher frequency of intransitive-to-transitive overextension could be due to the relative ease of adding elements compared with subtracting through backformation (Ravid, 1990). In contrast to Bowerman, Lord (1979) found

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that her children made errors in both directions, which she explains in light of a syntactically motivated model of bidirectional transitivity derivation in English. Diary data thus appear to leave unsettled the question of whether there is an asymmetry between intransitive to causative overextensions compared with the reverse.

Several structured elicitation studies address this question in English. Hochberg's (1986) test of three- to five-year olds' judgements of the grammaticality of sentences paired for transitivity revealed better results on judging incorrect intransitives than on incorrect transitives. She attributes this bias to children's preference for describing events in terms of prototypically high-transitivity scenes, from an agentive perspective. Maratsos *et al.* (1987) examined English causatives as semi-productive constructions. Their test of four- and five-year-olds' use of the nonce-word *fud* in different pragmatic and syntactic contexts indicated that favouring of intransitive or transitive extensions may be a matter of individual differences, since some of the children appeared to make productive use of the causative, while others failed to do so. Braine *et al.* (1990) tested verb-argument structure of familiar as well as nonce verbs among two- and four-year-olds, using a careful design which varied both how a verb was first introduced (in a transitive, intransitive, or neutral context) and types of discourse-probes (questions about what an agent versus a patient was doing) to elicit transitive compared with intransitive uses of verbs. Adopting a zero-derivation hypothesis similar to Bowerman's, to the effect that children will tend to overextend intransitive verbs to transitive contexts more than vice versa, they predicted that young children would take a long time to recognize the argument-structure of a novel verb, and that they would tend to use it in both a causative and an intransitive sentence frame. They found that children's responses to the novel nonce verbs resemble their responses on optionally transitive English verbs (e.g. 'roll', 'turn') far more than on verbs with fixed transitivity (e.g. the obligatorily intransitive 'fall' and the obligatorily transitive 'throw'). They suggest that initially verbs are learned in piecemeal fashion and that errors occur once 'children acquire canonical schemas that describe the arrangement of postverbal arguments for verbs that have more than one such argument... (usually) some time after the verb lexical entries have been set' (1990: 341).

Data from both diary and experimental studies on directionality thus indicate some favouring of intransitive to transitive overextensions in English, a language in which causative-formation need have no morphological consequences. One aim of the present study was to consider whether this bias is a function of the language-particular structure of the input language. Naturalistic data from Hebrew indicate that failure to change *binyan* verb-pattern may be in either direction, although there is more overextension of intransitives to transitive contexts than vice versa, in the

ratio of around two-thirds to one-third (Berman, in press). The present study was designed to ascertain the relative difficulty of alternations from plus to minus transitive compared with from minus to plus transitive on the assumption that there would be no clear bias in either direction in Hebrew. Rather, the interrelations between particular pairs of verb-patterns illustrated in (5) would be the deciding factor as to whether children overextend to or from transitive verb forms.

A test administered to children aged 2, 3 and 8 years required them to produce responses with converse transitivity to input sentences demanding various morphological alternations, balanced for direction of change across five sets of *binyan* pairings. The test included both 'known' items from the established Hebrew lexicon, and 'novel' items, where the input is an established Hebrew verb and the expected response is a possible but non-occurrent Hebrew verb. We predicted the following results.

Predictions

(1) There will be an age-related development in proportion of correct responses. Young children aged around two years will tend to avoid verb-pattern alternation; by age four, children will generally show that change in syntactic verb-argument structure requires change in verb morphology; and by early school age, knowledge of lexical convention will combine with knowledge of grammatical structure to yield responses which are largely adultlike.

(2) The same results will not emerge across the board for all classes of items. The factor of productivity will cause certain alternations to be acquired earlier, and more completely, than others. Shifts between P₁ *pa'al* and P₅ *hif'il*, between P₁ *pa'al* and P₂ *nif'al*, and between P₃ *pi'el* and P₄ *hitpa'el* should produce better results than the less productive P₂ *nif'al* vs. P₅ *hif'il* alternation and the lexically restricted P₄ *hitpa'el* reflexives.

(3) Children will do better on producing alternations which exist in the established lexicon than in producing novel verb-forms. The factor of familiarity will have less impact with age, once knowledge becomes established as rule-bound.

(4) Given the lack of verbs with optional transitivity in the input language, there should not be any strong overall preference for producing transitive from intransitive forms rather than the reverse, and errors might occur in either direction.

METHOD

Subjects

After detailed piloting with 30 children, 10 at each of three age levels from age 2;6 to 8;7, a test was administered to another 30 children in the same

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age-groups and 10 adults. The pilot test and the present study yielded very similar results, even though the two tests were conducted a year apart, with different children in different neighbourhoods of Central Israel, using slightly different stimulus materials (and the pilot did not include novel items). We thus felt justified in keeping the number of children tested on the final version to ten per age-group, with an equal number of boys and girls in each group divided as follows: two-year-olds - 10 children aged 2;6 to 3;0, mean age 2;9; three-year-olds - 10 children aged 3;0 to 4;0, mean age 3;9; eight-year-olds - 10 second-graders aged 7;6 to 8;7, mean age 8;0. The novel items were also given to five men and five women, native speakers of Hebrew with high school or college-level education.

Materials

The test consisted of 32 items, 20 verbs that have conventional *binyan* variants in the established lexicon with reverse transitivity, and 12 that lack such variants in the established lexicon - termed 'known' and 'novel' respectively. Two pictures pasted on a cardboard sheet and separated by a vertical line accompanied each item (i.e. 64 pictures in all), with an action taking place in relation to a person or object in the one, and being performed by an agent on that same person or object in the other. Half the pairs had the intransitive action on the right side and the transitive action on the left, while for the other half, the pictures were the other way round. For example, in the first half, one righthand picture showed a ball rolling = P4 *mitgalgel*, and the lefthand picture showed a boy rolling the ball = P3 *megalgel*; in the other half, one righthand picture showed a mother washing a child in the bath (P1 *kan ima roxecat et ha-yeled* 'here Mommy washes + Fem OM the-boy' = 'here Mommy is washing the boy') and the lefthand picture showed a child washing himself (P4 reflexive *ha-yeled mitraxec* 'the-boy washes + Refl' = 'the-boy is washing (himself)'). One verb was always given to children, so they did not have to guess which particular verb they were supposed to manipulate. This was meant to avoid other appropriate, but non-target, descriptions.

Choice of items was confined to verbs which are familiar to children as young as age 2;6, and which represent actions that can be unambiguously represented in pictures. The 20 'known' items were divided into five sets of four alternating pairs of verbs. These are illustrated in Table 1, where the label Ch-of-State refers to change-of-state or inchoative predicates.

The 12 novel items in the 'novel' part consisted of 6 transitive and 6 intransitive verbs that lack morphological alternants with reverse transitivity in the established lexicon. Selected largely from recorded instances of children's spontaneous innovations in filling lexical gaps (Berman & Sagi, 1981; Berman, in press), they are illustrated in Table 2.

CHILD LANGUAGE

TABLE 1. *Examples of 20 known test items in five binyan transitivity pairings*

Intransitive	Transitive	
P1 Activity <i>kofec</i> <i>ozel</i>	~ P5 Causative ~ <i>makpic</i> ~ <i>ma'axil</i>	'jump, bounce' 'eat ~ feed'
P2 Ch-of-State <i>nishpax</i> <i>nishbar</i>	~ P1 Activity ~ <i>shofex</i> ~ <i>shover</i>	'spill' 'break'
P2 Ch-of-State <i>nidlak</i> <i>nidbak</i>	~ P5 Causative ~ <i>madlik</i> ~ <i>madbik</i>	'be lit, light' 'stick'
P4 Ch-of-State <i>mistovev</i> <i>mitgalgel</i>	~ P3 Activity ~ <i>mesovev</i> ~ <i>megalgel</i>	'turn, spin' 'roll'
P4 Reflexive <i>mitraxec</i> <i>mitnagev</i>	~ Px Activity ~ <i>roxec</i> ~ <i>menagev</i>	'wash (oneself)' 'dry (oneself)'

TABLE 2. *Examples of 12 input verbs on novel part of test with possible responses, by binyan pattern and transitivity value*

Input verbs	Expected responses
Intr Activity Ch-of-State	Trans Causative
P1 <i>soxe</i> 'swim'	P5 * <i>masxe</i> ~ P3 * <i>mesaxe</i>
P2 <i>nisdak</i> 'crack'	P1 * <i>sodek</i> ~ P5 * <i>masdik</i>
P4 <i>mitgalech</i> 'slide'	P3 * <i>megalech</i> ~ P5 * <i>maglich</i>
Trans Activity	Intr Ch-of-State
P1 <i>shote</i> 'drink'	P2 * <i>nishte</i> ~ P4 * <i>mishtate</i>
P3 <i>megahec</i> 'iron'	P4 * <i>mitgahec</i> ~ P2 * <i>nighac</i>
P5 <i>markiv</i> 'assemble'	P2 * <i>nirkav</i> ~ P4 * <i>mitrakev</i>

Procedure

Children were shown two pictures representing the same activity from different points of view: A person or object doing something or undergoing an action, to elicit intransitive descriptions; and somebody else performing the same action to that person or object, to elicit transitive descriptions. The experimenter described one picture, and the child had to respond to the other. For example, the experimenter would show a child two pictures, point to one and say *kan ha-yeled ozel* 'here the-boy eats'; then she would point to the second picture and say *ve ma ro'im kan* 'and what see-PL here?' = 'and what do we see / what is shown here?'. If the child failed to respond, or

responded inappropriately, a standard PROMPT was given by providing the required subject-noun, e.g. to elicit a response to the picture of feeding, the experimenter would say *kan ha-ima...* 'here the- Mommy...' and wait for the child to complete the sentence. Where this, too, failed to elicit the correct response, the experimenter would tell it to the child, for example by saying *naxon, kan ha-ima ma'axila et ha-yeled* 'right, here the-Mommy eats+ CAUS+FEM the-boy' = 'here the Mommy is feeding the child'.

Children were first given the 20 known items, and then the 12 novel items. Presentation of the first 20 pairs was counterbalanced, so that half the children in each age-group received one set of 10 items (two items for each of the 5 *binyan* alternations to be elicited) in the transitive form in order to provide the intransitive alternant, and the other half received these same 10 items in the intransitive form to provide the transitive alternant. Order of presentation was randomized for transitivity direction, *binyan* alternation, and items. On the novel part, subjects were all given the same 12 input verbs, half intransitive and half transitive, also in random order. Before starting on this part, children were told that they were going to play a game of pretend, where they should *lehamtsi* 'make up, invent' words of their own.

Children were interviewed individually, in a quiet room adjoining their nursery-school or classroom. Each session started with a warm-up period, in which they were asked to talk about an unrelated picture showing children engaged in different activities in a playground.

RESULTS

Overall results of both the pilot test (Guata, 1989) and the present study were very similar: two-year-olds reach around 40% success, three-year-olds around 70%, and eight-year-olds (second-graders) over 90% success on both tests. The analysis which follows concerns only the test constructed for the present study. Results are presented first for the known, then for the novel items, and subsequently for direction of change on the test as a whole.

Results on known items

Responses on the first part of the test were rated as 'correct' if children changed the *binyan* pattern of the input verb to produce a verb-form of converse transitivity.

Children seemed to have little difficulty with the task as such. Even two-year-olds required very few prompts (14% out of their total responses), and only one-quarter of these helped to elicit a correct response. That is, children did not substantially change their performance when given a standard prompt by the investigator providing the subject NP, either agent or patient. Second, only 2% of all the two-year-old responses on the known items test were in the form of 'no response' or 'don't know', and 3 of the 4 such responses were given by the same child, Guy aged 2;6. Moreover, the bulk

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of their responses were appropriate to the situation, suggesting that even children as young as 30 months understood what the task demanded.

Responses were divided into two major classes: 'appropriate' or 'inappropriate'. Three types of responses were rated 'appropriate'.

(a) 'Correct' responses involved both the required *binyan* change and appropriate syntax, e.g. P₅ *ha-yeled madlik et ha-ner* 'the boy lights the-candle' is changed to P₂ *ze / ha-ner nidlak* 'it / the-candle is-lit', P₄ *ha-balon mitpocet* 'the-balloon bursts' is changed to P₃ *hu mefocet et ha-balon* 'he bursts the-balloon'.

(b) 'Morphologically acceptable' responses included a well-formed, but lexically unconventional change of *binyan*, e.g. P₁ *ha-ner dolek* 'the candle burns' [Ori 8; 2] or P₅ *hu mafcic et ha-balon* 'he bombs [*sic*] the balloon' [Ido 8; 2]; or the expected change in *binyan* was made together with a (semantically appropriate) change in verb-root, e.g. P₅ *ha-yeled moci et ha-kelev* 'the-boy takes out the-dog' is changed to P₁ *ha-kelev yored* 'the-dog goes-down' [Hila 2; 9] instead of expected P₁ *ha-kelev yoce* 'the-dog goes-out'.

(c) 'Syntactically acceptable' responses reformulated the input sentence for syntactic transitivity without any morphological operation on the input verb. Some such responses rearranged verb-argument relations using the input verb, e.g. given P₁ *ha-ima roxecet et ha-yeled* 'the-mother washes the boy', Benny [3; 9] said *ha-yeled roxec et acmo* 'the-boy washes himself' in place of P₄ reflexive *ha-yeled mitraxec* 'the-boy washes'; other such paraphrase responses included a general purpose verb with the input root in a nonverb form, e.g. given P₄ *ha-xeder hitlaxlex* 'the-room got dirty', Gil [2; 10] said *ose lixlux* 'makes dirt' instead of P₃ *ha-yeled melaxlex et ha-xeder* 'the-boy dirties the room'.

Two types of responses were rated 'inappropriate' (besides 'no answer').

(d) 'Grammatically incorrect' responses contained an overt transitivity error, that is, a transitive verb was used with intransitive syntax or vice versa, e.g. given *ha-yeled megalgel et ha-kadur* 'the-boy rolls the-ball' Yasmin [3; 0] responded with *ha-kadur megalgel* 'the-ball rolls + Trans'; given reflexive *ha-yeled mitraxec* 'the-boy washes (himself)', Hila [2; 9] responded with ungrammatical *hi mitraxecet oto* 'she washes + REFL him + ACC' = 'she washes-herself him'.

(e) 'Irrelevant' responses included repetition of the input verb with no change in syntactic verb-argument structure, e.g. *gam makpic* = P₅ 'also (makes) bounce' when the experimenter had said *po ha-yeled makpic et ha-kadur* 'here the-boy is-bouncing the ball' [Rotem 2; 7]; or *hu yoshen* = P₁ 'he is-sleeping' when the experimenter said 'And here the baby is sleeping' [Nati 3; 11]. Most other 'irrelevant' responses were picture-descriptions semantically and morphologically unrelated to the input verb, e.g. told that the first picture describes a boy *wetting* his hair, Lika [2; 6] gave the word for 'rain'.

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 TABLE 3. *Percentage of different classes of appropriate and inappropriate responses on 20 known items, by age-group (n = 10 per age-group)^a*

Age	Appropriate			Inappropriate		
	Correct	Morph syntax		Ungrammatical	Irrelevant	
		Acceptable	Total			
2 s	37.5	15	11	63.5	8	28.5
3 s	66	18	4	88	2	10
8 s	92.5	6.5	0	99	1	0
Mean	65.3	13.2	5	83.5	3.5	12.5

^a Each percentage is based on 200 forms.

Table 3 presents the percentage of responses in each of these five classes.

There was a significant difference between each of the three age-groups in percentage of correct responses on the known items, based on a one-way analysis of variants using the Tukey procedure ($F(2, 27) = 42.63$, $p < 0.0001$). Slightly over a third of the two-year-old responses (37.5%) were the required 'correct' forms, compared with two-thirds of the three-year-olds and nearly all the schoolchildren. By the less stringent criterion of percentage of 'appropriate' responses, success goes up to nearly two-thirds of the two-year-old responses, and reaches ceiling in the next group. An ANOVA reveals that the difference is significant between the three- and eight-year-olds ($F(2, 27) = 10.81$, $p < 0.0005$), with a non-significant difference between the two younger groups of children. This suggests that knowledge of the difference between transitive and intransitive constructions is acquired early, before use of verb-morphology as an additional means of marking this distinction. This is supported by the fact that the other 'acceptable' two-year-old responses divide up fairly equally between morphological and syntactic changes (15% compared with 11%), whereas nearly all the appropriate responses from age three up involve morphological change.

Few grammatically incorrect responses were recorded across the population. These took the form of transitivity errors with overt incongruence between syntactic context and morphological form, analogous to English 'Mommy, can you *stay* this open' (Bowerman, 1982:14) or 'Corn doesn't crunch, it *eats*' (Lord, 1979:84). Only 8% of the two-year-old responses and almost none of the older children's were ungrammatical in this way (see Appendix I). Most of the responses rated inappropriate were in the 'irrelevant' category, around a quarter (28%) of the two-year-old responses, and 10% among the three-year-olds.

The ability to use verb-morphology to mark transitivity alternations (calculated by combining the first two columns in Table 3) rose sharply between the two younger age-groups, but levelled off after that: 52%, 84% and 99% of the responses for the three age-groups entailed some suitable

morphological operation on the input verb. In contrast, as noted, there is a significant rise in proportion of normatively 'correct' *binyan* changes from age three to four, and then again between age four years and older children. These findings support the prediction that knowledge of grammar, defined as alternation of *binyan* verb-morphology to suit syntactic context, takes precedence over lexical convention, defined as normatively correct output forms.

Results on novel items

Children were also required to derive novel verbs from known verbs which have no variant with reverse transitivity in the established lexicon. The 12 verbs in this section were divided not by *binyan* membership, but by transitivity. This part of the test was administered to 10 adults in addition to the 30 children who had already done the first part of the test. There is no single correct response on this task, since transitivity alternations between pairs of *binyan* patterns are only partially productive. For instance, an intransitive P₂ *nif'al* verb might yield either a P₁ *pa'al* or a P₅ *hif'il* transitive counterpart (see Table 2). A 'correct' response on the novel items thus was rated for any of the *binyan* transitivity pairings functional in current Hebrew, and 'acceptable' responses were other possible, but unexpected morphological changes. Table 4 shows the percentage of correct and other acceptable morphological changes in production of novel verbs compared with results on the first part of the test, with known verbs.

TABLE 4. *Percentage of correct and other acceptable morphological changes on 12 novel and 20 known items, by age (n = 10 per age-group)*

	Class of items									
	Age	Novel ^a			Known ^b			Test total		
		Cor	Acc	Tot	Cor	Acc	Tot	Cor	Acc	Tot
2 s	9	17	26	37	15	52	27	16	43	
3 s	38	21	59	66	18	84	46	26	72	
8 s	69	8	77	92	7	98	84	7	91	
Mean	2-8 s	39	15	54	65	18	84	52	16	68
	Adults	75	15	90						

^a Each percentage in the novel columns is based on 120 forms.

^b Each percentage in the known columns is based on 200 forms.

Cor, correct; acc, acceptable; tot, total.

Table 4 reveals a clear age-related increment in proportion of acceptable morphological innovations: around one-quarter of two-year-old responses, nearly 60% from three-year-olds, three-quarters of the eight-year-olds, and 90% of adult responses (the difference being significant only between age two years and all the other groups ($F(3, 36) = 25.77, p < 0.0001$). This

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Age	Acc	Tot
27	16	43
36	26	72
54	7	91
52	16	68

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section of the test proved more difficult for the children as a whole, and for the younger children particularly. The percentage of irrelevant responses on the novel items was consistently higher (though not significantly different) than on the known items (36% of two-year-old responses, compared with 12% of three-year-olds, and 2% of eight-year-olds). Most striking is the relatively low proportion of novel verbs produced by the children which were rated 'correct': 39% across the age-groups, with young children rarely innovating an expected switch in *binyan* of the input verb.

The children's relatively low rate of success in coining novel verbs needs to be evaluated in light of adult performance on this task. Even the adults produced correct responses only three-quarters of the time. Their other appropriate answers (15%) were mostly other, unexpected morphological changes with appropriate transitivity. For example, in response to the P₅ transitive verb *maurish* 'brush', two adults gave P₂ *nivrash* 'be brushed'; in response to P₁ transitive *soreg* 'knit' another adult gave the conventional perfective *sarug* 'knitted', not innovative *nisrag* 'be knitted', even though they were explicitly told to coin novel terms. Sometimes, they innovated a denominal verb-root, e.g. from P₅ transitive *markiv* 'assemble' for pieces of a puzzle, two adults coined *mitpazel* 'puzzles = gets-puzzled' rather than expected P₅ *mitrakev*; or else they coined a new verb-form from a semantically related, different root than the input, e.g. given P₁ *shote* 'drink', one adult coined P₄ *mitgamer* 'finishes + himself', cf. P₁ *gamar* 'finish'. Occasionally, adults resisted any kind of innovation, e.g. in response to P₁ *shote* 'drink', most adults coined either expected P₂ *nishta* or the unexpected passive participle *meshute*, but another three gave impersonal form of the input verb *shatu* 'drank + PL' = 'people have drunk - they've drunk'.

Table 4 also shows a marked difference between performance on known compared with novel items, with children scoring higher on the known than on the novel items across the board. Results on the two parts of the test were submitted to a two-way mixed model analysis of variance, with age (two-year-olds versus three versus eight-year olds) as a between-subject variable and novelty (known versus novel items) as a within-subject variable. A significant effect was found for both age ($F(2, 27) = 31.07, p < 0.0001$) and for novelty ($F(1, 27) = 40.05, p < 0.0001$), with novel verbs rating poorer performance at all ages. Analysis of the interaction of novelty by age indicates that age has more effect on novel verbs than on known verbs ($F(2, 27) = 13.14, p < 0.0001$). As predicted, children did much better on changing the transitivity value of a verb to a target form that exists in the established lexicon. However, with age, there is a consistent decrease in relative advantage of known over novel (37% versus 9% 'correct' responses or around three times the advantage at age two years, compared with around twice the advantage at age three - 66% versus 38% - and around one-third the advantage at age eight - 92% versus 69%).

A clear developmental trend emerges between the two sets of items: The percentage of correct responses on known items at each age-group is similar to the proportion on novel items at the next higher age-group, as shown in Fig. 1.

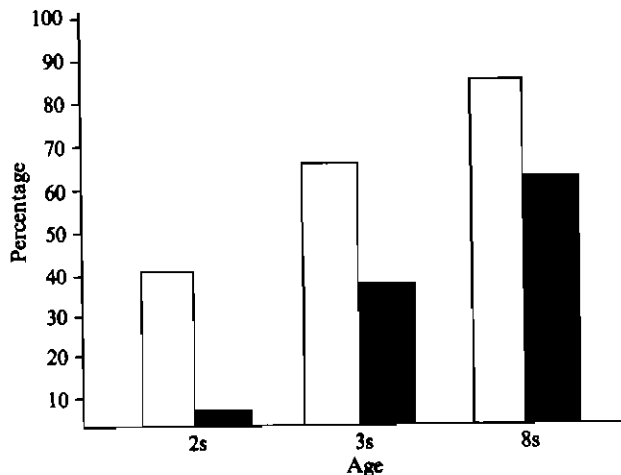


Fig. 1. Percentage of correct response to known (□) compared with novel (■) items in three age-groups.

The ability of children from age three years to innovate wellformed transitivity alternations nearly 40% of the time, and to make some other appropriate morphological permutation in another 20% of their responses, is strong evidence for the acquisition of this system as part of the grammar of their language. The fact that they did so significantly less than on the known items shows that lexical familiarity plays a role at this phase of acquisition. Eight-year-old children, who showed full command of the system with known items, did rather worse than adults on coining novel forms (77% versus 90%).

Despite the markedly better performance on known items, the general developmental pattern which emerges is consistent across both types of items, known and novel. The interaction between the two effects, of subject-age and of item-novelty, is not statistically significant ($F(2, 27) = 1.95, p = 0.17$). Summing across the test as a whole (see the last column of Table 4), the results consistently show that two-year-olds are beginning to use *binyan* verb-morphology for alternating transitivity, three- to four-year-olds have broad knowledge of the system, and early school-age mastery is near-adult. Moreover, as predicted, young children can apply this knowledge more proficiently within the familiar lexicon than when required to fill accidental lexical gaps by application of the same set of morphological alternations.

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HEBREW TRANSITIVITY TEST

Direction of transitivity

A third set of questions concerned whether children would do better at producing transitive verb-forms from their intransitive counterparts, or vice versa. To this end, test items were paired along five different sets of *binyan* alternations for the known items, and for general direction of transitivity for the novel items. Table 5 compares the degree of success, counted as percentage of correct responses, given by children at each age-group on each pair of *binyan* alternations, from intransitive to transitive and from transitive to intransitive. The English equivalents of the four verbs in each pair listed in Table 5 are as follows: P1 ~ P5 *jump, go down, go out, eat*, P2 ~ P1 *break*,

TABLE 5. *Percentage of correct responses given on 20 known items by each age-group, by direction of transitivity and by binyan pairings*

Age ...	2 yr		3 yr		8 yr		Total	
	I > T	T > I	I > T	T > I	I > T	T > I	I > T	T > I
P1 Intr Activ ~ P5 Trans Caus		65		100		95		86
P2 Intr Event ~ P1 Trans Activ	45	50	45	70	100	80	63	67
P4 Intr Event ~ P3 Trans Activ	40	30	70	70	100	85	70	62
P4 Intr Reflex ~ P1, P3, P5 Tr Act	25	30	60	65	95	95	62	65
P2 Intr Event ~ P5 Trans Activ	55	10	75	40	100	80	77	43
Mean	25	37	65	69	95	87	62	
	38		63		98			

spill, open, tear, P4 ~ P3 *dirty, turn, burst, roll*, P4 Reflexive ~ P1, P3, P4 - *dress, wash, comb (hair), dry*, and P2 ~ P5 - *get in, get wet, stick, light = kindle*.

The prediction that difficulties might arise in either direction was supported by the test results. Table 5 shows a similar degree of success on the 20 pairs of known items in production of transitive verbs from intransitives and of intransitive verbs from transitives, at each of the three age groups and across the population as a whole. There was no significant effect for directionality on known items, although interaction between age and directionality approaches significant ($F(2, 27) = 2.81, p = 0.08$).

On the other hand, not all *binyan* alternations do equally well or badly in either direction. Both the highest and lowest scores are in the same direction: From causative P5 *hif'il* to intransitive P1 *pa'al* (86%) and to intransitive P2

nif'al (43%) respectively. The difference in rate of success on the best compared with worst results was far more pronounced among the two-year-olds than among the three-year-olds, but the ranking is the same in both groups. And the same medium-level score of around 60% is achieved in both directions: from intransitive P1 *pa'al* and P2 *nif'al* to transitive P5 *hif'il*, and from intransitive P4 *hitpa'el* to transitive P3 *pi'el*, on the one hand, and from transitive input forms to intransitive P4, on the other. And when OUTPUT forms are compared overall, then P1 (unique in being equally amenable to both transitive and intransitive verbs) does by far the best, yielding nearly 80% correct responses overall. In contrast, both the two typically transitive patterns P3 and P5 and the two typically intransitive patterns P2 and P4 yield the same proportion of around 60% correct responses overall.

These findings reveal four rather different patterns for the five classes of alternations set out in Table 5. (i) Children produced the highly familiar forms of P1 intransitives far more than their causative P5 counterparts, e.g. compare P1 *axal* 'eat' ~ P5 *he'exil* 'feed', P1 *kafac* 'jump' ~ P5 *hikpic* 'make-jump' = 'bounce (a ball)'. These P1 activity verbs figure in the basic verb-stock of Hebrew-speaking two-year-olds, typically preceding their semantically more complex causative counterparts. (ii) Children did equally well going from change-of-state achievement verbs in both P2 and P4 to their transitive activity counterparts and vice versa. That is, P2 intransitive *nishbar* and P1 transitive *shavar* 'break', and also P4 intransitive *mistovev* and P3 transitive *mesovev* 'turn' appear equally familiar to children by the latter part of the third year. This reflects the high productivity of these two alternations, and suggests that both uses may be equally basic for children. (iii) The least consistent set of responses across age-groups (as in the pilot test) emerges in the alternation between P4 reflexive verbs and their transitive counterparts P1 *roxec* 'wash', P3 *menagev* 'dry', or P5 *malbish* dress. This could be due to the low productivity, and hence the incidental learning involved by this set of alternations: A small subset of verbs of grooming and bodily care have lexicalized reflexives, and children learn the familiar ones early on by rote. These reflexive verbs also have a productive syntactic counterpart with the equivalent of coreferential *self* forms – an option selected by several of the children on both tests. (iv) The alternation which proved hardest across age-groups was from P5 causatives to P2 intransitives, e.g. *hidlik* 'light (a candle)' to *nidlak* 'be lit'. Children tended to use some other form for the intransitive version, e.g. perfective participle *daluk* 'lit up' or *davuk* 'stuck' or the adjective *davik* 'sticky' for P2 *nidbak*. This could be due to the restricted productivity of the P2 ~ P5 alternation; it applies to a largish group of several dozen verbs (e.g. *nish'ar* ~ *hish'ir* 'stay' ~ 'leave', *nish'an* ~ *hish'in* 'lean (on)' ~ 'support'), but these constitute a closed class, and the alternation is not accessible to innovation in current Hebrew.

In contrast to performance on the known items, results on the novel items

were strong and item forms varied in percentage group.

TABLE 5

^a Each percentage score in A
^b Each percentage score in B

On the whole, the transitive counterparts are more consistent than the intransitive counterparts.

This could be due to the known items, the change of state, the novelty of the items, $p < 0.0001$ in part. It is an occurrence of the resultative passive pattern rather than the active pattern (e.g. *shidmitgahec* 'stuck') reasons for the innovative use.

DISCUSSION
Results of the introductory normative study on *binyan* patterns

HEBREW TRANSITIVITY TEST

were strongly biased in favour of one direction of change: Across children and items, the switch from known intransitive input verbs to novel transitive forms yielded better results than in the other direction. Table 6 compares percentage of transitive versus intransitive novel verbs produced by each age-group.

TABLE 6. *Percentage of correct responses on novel items at four age-groups, by direction of transitivity change*

Direction	Age-group ^a				Total ^b	
	2s	3s	8s	Ads	Range	Mean
Intrans > Trans	18	60	93	90	50-78	65
Trans > Intrans	0	17	42	60	10-45	30

^a Each percentage for each age-group is based on 60 forms.

^b Each percentage for range is based on 40 forms per item and for mean on 240 items (see raw scores in Appendix II).

On the novel part of the test, there was a clear advantage in the direction of transitivization, significant at each age-group and across the population as a whole. Even adults did better on using *binyan* morphology to innovate transitive rather than intransitive verbs. Moreover, this pattern holds consistently across all the items in each set (see Appendix II).

This contrasts significantly with the lack of directionality bias found for the known items on the test (Table 5). A 3-way ANOVA with direction of change and novelty as within-subject variables and age as a between-subject variable revealed a significant effect for age ($F(2, 27) = 35.44, p < 0.0001$), novelty ($F(1, 27) = 16.13, p < 0.0005$) and direction ($F(1, 27) = 49.41, p < 0.0001$). The difference with the novel items may have been procedural in part. It was difficult to depict change-of-state situations suited to the non-occurrent intransitive verbs, and around 20% of these elicited stative or resultative forms, not change-of-state inchoatives, mainly in the form of passive participles, e.g. established *sarug* 'knitted' (as in 'knitted clothing') rather than innovative P2 *nisrag* 'got-knitted', established *meguhac* 'ironed' (e.g. shirts which are pressed, not crushed) rather than innovative P4 *mitgahec* 'get-ironed'. In the discussion to follow, however, more principled reasons are proposed to account for the contrast in directionality-bias in the innovative compared with the established lexicon.

DISCUSSION

Results of the test largely confirmed the first three predictions presented in the introduction. There was a clear age-related development in proportion of normatively correct *binyan* alternations; certain alternations between pairs of *binyan* patterns yielded better results than others; and children did better on

the known than novel part of the test. On the other hand, contrary to the null hypothesis prediction about favoured direction of change, subjects did better at producing novel transitives from intransitive verbs than vice versa. These findings are interpreted below in relation to general developmental processes and the issues of productivity and directionality.

Developmental trends

Earlier studies on the acquisition of Hebrew demonstrate that simple-clause word order and case-marking are established before inflectional morphology, which in turn precedes derivational morphology. Results of the test support this claim. The high proportion of appropriate responses given by the two-year-olds reveals them to have a good knowledge of the semantics and syntax of one-place intransitive compared with two-place transitive verb-argument relations. This leads to the conclusion that acquisition of the system of *binyan* verb-pattern alternation to express distinctions in syntactic transitivity relies on PRIOR knowledge of the syntax of transitivity, as expressed in Hebrew through SV(O) linear ordering combined with case-marking of object NPs by accusative *et* or verb-governed prepositions, and by inflectional subject-verb agreement for number, gender and person.

Another striking result from the test was the low rate of ungrammaticalities taking the form of 'transitivity errors', where an intransitive verb is misused in an {S V *et* O} context, or a transitive verb is used without any object NP (Appendix I). This accords with data from naturalistic speech output of Hebrew-acquiring children. Of around 50 such errors of 'neutralization' recorded from diary reports and longitudinal samplings for a dozen different children, only two or three such errors were generally reported for any one child, the bulk before age three (Berman, in press). Even these few errors are surprising, since there is no positive evidence available in the input to suggest that the same verb-form can be used in both transitive and intransitive environments. Besides, young children could avoid the problem of transitivity marking altogether, by adhering to the prototypical or favoured verb-argument configurations for any given verb. For example, they use the P₁ verb *yoshev* 'sit' a lot, but need have no occasion to use a transitive counterpart, either P₃ *yishev* 'settle' or P₅ causative *moshiv* 'seat'.

Two lines of argument can be proposed to explain such errors, relating to language-particular facts of current Hebrew usage. First, the P₁ *pa'al* pattern is equally open to verbs which are both transitive and intransitive (compare the sentences in (1a) and (2b), both with P₁ verbs: transitive *Ron shafax et ha-mits* 'Ron spilt OM the-juice' versus intransitive *ha-yeladim yardu* 'the children got-down'); and this is the pattern which includes most of the verbs used in everyday conversation, and which occurs with much the highest type and token frequency in the language of children and of adults. As a result, children might extrapolate from these verbs to hypothesize that in general

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there is no need for a specific form of the verb in one syntactic configuration but not another. Second, as noted, morphological *binyan* changes are often redundant, since Hebrew has a rich array of syntactic cues to distinguish subject from object NPs. Compare, for instance, the Hebrew transitive versus intransitive pair of sentences in (3a) and (3b) with their English counterparts: 'The girl spins the beads' versus 'The beads spin'.

Nonetheless, our test reveals that children do quite rapidly, and with relatively little error, learn to redundantly mark verb-argument relations by *binyan* morphology in addition to syntactic marking by word order, subject-verb agreement, and accusative or oblique case-marking. An analogy can be drawn from agreement marking. English has only a single marker of agreement in such sentences as 'the green bead spins and the green block rolls' versus 'the green beads spin and the green blocks roll', and in the past tense, even that would be lacking. Hebrew number and gender agreement, obligatory from subject nouns to verbs in all three tenses as well as from head nouns to adjectives, is thus semantically redundant, nor is it necessary for communicative purposes. Yet these additional markings of grammatical categories are essential to and pervasive across the grammar of Hebrew, and hence they are acquired early by children. The argument here is that, analogously to agreement-marking, so too marking of verb-transitivity is part of the grammar which children must attend to. After an initial period of rote-use of verbs as individual items, followed by some lexical learning of pairs of isolated alternations, children's verb-usage becomes typologically driven to attend to the Hebrew-particular fact of how transitivity affects the morphological shape of verbs. Typological biases thus generate rule-learning in the most general sense of recognizing that a particular linguistic category – such as verb-argument transitivity relations – requires a specific kind of formal marking – verb-pattern morphology. Overall productivity of inflectional compared with derivational processes of morphological marking can explain why Hebrew children establish alternations in number and gender on nouns, verbs, and adjectives before they master alternations in *binyan* verb-patterns.

The finding that ability to use verb-morphology to mark transitivity alternations rose sharply between age three and four years, but levelled off after that accords with results of other studies on Hebrew derivational morphology. It is from around age three years that children show productive ability to use word-formational devices for deriving nouns from verbs (Clark & Berman, 1984), verbs from nouns (Berman, 1989), and stative resultatives from activity verbs (in work currently in progress). Moreover, verb-transitivity marking precedes acquisition of other facets of Hebrew lexical morphology, also expressed through the system of *binyan* verb-patterns tested here. Specifically it contrasts with the relatively late acquisition of compound-noun constructions, of derived nominals and of syntactic passives.

These three constructions have periphrastic options (prepositional phrases with the genitive particle *shel* 'of', subordinate 'that' clauses, and middle-voice or impersonal constructions respectively), whereas the more productive transitivity alternations lack such everyday expressive options.

In examining children's performance on producing transitivity alternations, this study took no account of comprehension. A study with a similar design to ours, with both novel and known items, might systematically contrast comprehension of verb-pattern alternation with production of the appropriate forms. The assumption would be that in this, as in related tasks (see Clark & Berman, 1987), children would manifest understanding of transitivity distinctions before they can produce them. But it is not obvious whether the same developmental patterns as reported here for relative difficulty of *binyan* pairings will emerge in comprehension, too. For instance, studies examining the strength of various types of cues in interpreting Hebrew sentences yield unequivocal results from the point of view of the questions at issue here. Frankel & Arbel (1982) found that the dominant cue for children is accusative *et*, whereas Guri-Herling (1988) found this to be the case only where the surface position of *et* fails to conflict with the even stronger cue of SVO ordering. Sokolov's (1988) study went beyond these to take account of verb-pattern alternation, with children being required to process novel denominal verbs in the P3 *pi'el* and P4 *hitpa'el* patterns in different syntactic contexts, some of which were ungrammatical (e.g. a P4 reflexive verb in an {S V *et* O} construction). His youngest subjects (aged 4;0-4;6) performed around chance, while even the five-year-olds did not appear to have established a clear separation between transitive and reflexive cues. This supports the general developmental finding for precedence of sentence- and phrase-level syntactic cues over word-internal morphological factors in acquisition.

Analysis of longitudinal corpora is needed to test relevant predictions concerning the ontogenesis of the relevant knowledge and its progression across time. It is likely, for instance, that just prior to acquisition of the system, children might for a short period demonstrate some overextensions of intransitive verbs to transitive contexts and vice versa. This might then be followed by a burst in pattern-alternation activity analogous to what has been noted for the period of consolidation in acquisition of quite different domains of linguistic knowledge across children and languages.

Productivity

Two related facets of productivity are considered here: the ability to apply rules and processes beyond the level of item-based knowledge; and reliance on those processes which are currently most functional in the language, compared with more restricted or closed-class sets of alternations. The difference in success on some alternations compared with others suggests that

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children proceed first from item-based learning to class-based knowledge of inter-relations between particular pairs of forms, and only subsequently to an integrated construal of morphological transitivity as a whole. From the second point of view, the system examined here is only semi-productive, manifesting the gaps and inconsistencies of form-meaning relations typically associated with the others. The most productive processes currently favoured by contemporary speakers of the target language in the domain in question include P₅ *hif'il* as the causative version of intransitive activity verbs in the basic P₁ *pa'al*; P₃ *pi'el* for deriving new transitive verbs from nouns; and P₄ *hitpa'el* rather than classical P₅ as the inchoative counterpart of P₃ activity verbs and adjectives. Least productive are occasional or incidental alternations no longer operative in the language (analogous to English causatives such as *rise/raise* and *sit/seat*), which need to be learned by rote as item-based instances. Midway between the two lie alternations which affect large groups of items in the established lexicon, but which are no longer favoured or active as contemporary new-word formation options (e.g. Hebrew adjective-related verbs which are both inchoative and causative, or the alternation between P₂ *nif'al* intransitives and P₅ *hif'il* causatives tested here). The test findings support the prediction that young children will rely on the more productive options in producing verb-pattern alternations. The more restricted sets of items involve a particular kind of class-based learning, which may emerge only at school age. Relatively late learning of this kind has been demonstrated for subclasses of noun plurals in Hebrew as well as for English past tense forms (Bybee & Slobin, 1982), and has important implications for possible directions of language change.

Relative lexical productivity interacts with other factors to determine which alternations children will favour. One such factor is semantic complexity, which could explain why success was higher in producing basic P₁ *pa'al* intransitives compared with their causative P₅ counterparts. Availability of productive syntactic alternatives may also play a role (e.g. *niyha meluxlax* 'became dirty' for P₄ *hillaxlex* [Ram 3;7]) and *menagevet et acma* 'dries + Fem OM herself' for P₄ *mitlaxlexet* [Natali 3;10]). Another factor is the degree to which a given verb-form is favoured in actual usage, in the speech input and output of young children. The high frequency of the P₁ pattern, which accounts for around three-quarters of all early verb usage and for over half of the verbs used in adult Hebrew discourse, explains the relative success children had in deriving P₁ output forms compared with all the other patterns, both transitive P₃ and P₅ and intransitive P₂ and P₄. Traditionally, P₁ was considered primitive, the source for deriving verbs in other patterns; in contemporary Hebrew, the most common everyday verbs are predominantly in P₁. Moreover, P₁ verbs are uniquely neutral or unmarked, in that they may be semantically either stative or active, and syntactically transitive or intransitive to the same degree.

Yet another factor is the relative familiarity of individual lexical items. For instance, to refer to 'spilling', two- and three-year-olds gave the right response over twice as often going from transitive P1 *shofex* to intransitive P2 *nishpax* than vice versa, but they gave the same amount of correct responses in both directions for the verb 'open', both transitive P1 *poteax* and intransitive P2 *niftax*. That is, children treated the same formal alternation differently on different test-items. This could be because negatively-oriented predicates like those meaning *spill*, *tear*, *break* are often used with a patient perspective to refer to highly salient change-of-state events, marked by the intransitive inchoative form in Hebrew child language; in contrast, a more neutral verb like *open* attracts a transitive agent perspective. Familiarity and frequency of use may depend not so much on particular verbs, but more generally on the perspectives typically selected for talking about different types of scenes to and by children.

Elicitation of novel verbs tested productivity of generalized rule-application, while neutralizing the factors of lexical familiarity and frequency. As predicted, children did better on producing verbs which occur in the established lexicon than on coining possible but non-occurrent forms. The fact that the gap between known and novel items decreased with age shows that once knowledge of the system is established, children rely less on contextual clues and lexical familiarity, at the point where knowledge has become fully productive. Preliminary findings on a test of transitivity alternations using nonce verbs in different *binyan* patterns both as input cues and as output forms (in a Hebrew version of the English test reported in Braine *et al.*, 1990) indicate that even four-year-olds find this task extremely difficult. Sokolov's (1988) study using nonce verbs derived from existing nouns also reflected poor results with children aged four and over. In contrast, the novel part of our test yielded suitable morphological alternations in as high as 60% of three-year-old responses. This discrepancy between our results and these other studies can be attributed to the fact that our methodology provides 'strong clues as to the intended semantics of the word' (Levy, 1987:73). Extreme decontextualization, in which both input and output terms lack established semantic content and lexical associations, places a heavy burden on children who are still in the process of consolidating their knowledge in a given linguistic domain.

Directionality

The apparently contradictory findings for directionality between known and novel items can be explained in terms of LANGUAGE-PARTICULAR factors relating to the specifics of Hebrew verb-pattern morphology and acquisition of the *binyan* system. Lack of any general directionality bias in the established lexicon suggests that neither direction of change has a universally privileged

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status in linguistic theory, nor hence in child language. Crosslinguistically, the causative transitivizing process may be interpreted as constituting additional semantic complexity by adding a feature, as proposed by Bowerman (1982) and Braine *et al.* (1990). Yet in Hebrew this process is very productive in the switch from P1 to P5, but frozen in the switch from P2 to P5. And there are other DETRANSITIVIZING processes which are equally productive in current Hebrew, particularly inchoative-formation through the P1-P2 and P3-P4 alternations. For children learning a language like Hebrew there is thus no *a priori* reason to find it easier or harder to make necessary morphological adjustments in transitive compared with intransitive contexts or vice versa. Rather, they need to grasp the more productive alternations characterizing the system of *binyan* verb-patterns as a whole, both in relation to processes of causativization and denomination, which entail at least two arguments, and to inchoativity or reflexivity, which entail one-place intransitives.

Hebrew children also need to learn which patterns are typically associated with the former, hence with transitive syntactic contexts, and which with the latter. The low rate of error noted in this study confirms earlier findings to the effect that children recognize the typical transitivity values of different *binyan* forms early in their acquisition of the system (Berman, 1980; Berman & Sagi, 1981). Where they do err, there appears to be a slight favouring of overextension of intransitives to transitive syntactic contexts rather than the converse, as evidenced by the fact that the bulk of the (few) transitivity errors in this study, as well as around two-thirds of those recorded from naturalistic speech data are in this direction. This could be due to the asymmetry between the two types of transitivity violations in Hebrew. {S V_{intr} et O} constructions are totally ungrammatical, and children have no evidence in the input for verbs in P2 *nif'al* or P4 *hitpa'el* in this environment (although it can include verbs in the basic P1 *pa'al* conjugation). On the other hand, a surface string of {S V_{trans}} is often quite acceptable, even where the verb is in highly transitive P3 *pi'el* or P5 *hif'il*. The reason is that Hebrew allows (thematic) object ellipsis where reference is recoverable, e.g. the Hebrew equivalent of 'What's with dinner?' - 'I still haven't made NULL'; 'What happened to your ball?' - 'My brother took NULL from me'.

This surface identity of transitive and intransitive SV strings could mean that in observing children's language, ungrammatical use of a transitive verb is less striking, and less unequivocal, than ungrammatical use of an intransitive. For instance, an item on our test showed a mother towelling a boy dry, the input being P3 *ha'ima* [= *hi*] *menagev-et et ha-yeled* [= *oto*] 'the-mother [= she] is-drying + Fem the-boy [= him]' = 'the mother is drying the boy' compared with the same boy towelling himself P4 *ha-yeled* [= *hu*] *mitnagev* 'the-boy [= he] is-drying-Reflex' = 'the boy is drying himself'. When Guy, aged 2;6, responded to the latter with transitive P3 *menagev*

levad 'dries + Masc alone = 'dries by himself', it does not sound as totally unacceptable as the response of Ram, aged 3;0, with intransitive P4 *mitnagev oto* 'dries + Reflex him + Accus' = 'dries himself him'. The researcher may thus be more sensitive to use of intransitive verbs with transitive syntax rather than the reverse, or one may be more confident of counting Ram's response rather than Guy's as an outright error. In our test, object omissions were *not* counted as errors in transitivity, if subject reference was clearly to a thematic agent, and the verb-form was changed to a transitive pattern. For example, given as input *ha-yeled oxel* 'the-boy eats', Li [3;6] responded by P5 feminine *ma'axila* '(she) feeds', without specifying *ha-yeled* 'the-boy' or *oto* 'him' as object; but the child was credited with a correct answer, since she changed both the transitivity and the (subject-controlled) gender of the verb, as was Alon [7;9] who in response to P1 *ha-kadur kofec* 'the-ball bounces' simply gave P5 *ha-yeled makfic* without mentioning the ball as object.

Finally, directionality did have a distinct effect in coining novel verb-forms. Deriving causative-type verbs in transitive P5 *hif'il* and in P3 *pi'el* proved more accessible to all respondents than deriving novel intransitive inchoative or reflexive predicates. This can be explained in terms of the options available to speakers for the purpose of filling lexical gaps, and the relative productivity in current usage of either derivational morphology or periphrastic syntactic options for expressing different types of verb-argument relations. Modern Hebrew has two major morphological devices for new-verb formation: causativization of active and stative verbs, as well as adjectives, on the one hand, and denomination, on the other, assigned very largely to the two TRANSITIVE patterns, P5 *hif'il* and P3 *pi'el* respectively. Speakers readily use P5 *hif'il* causatives to fill lexical gaps, and children do so quite commonly in their spontaneous usage (Berman & Sagi, 1981). Use of syntactic paraphrase with a verb such as *la'asot*, corresponding to French *faire*, or to English *make* causatives, is rare in early child speech, and reflects the general lack of reliance on such constructions in spoken Hebrew. The other major means of creating new verbs in Hebrew is use of P3 *pi'el* to coin transitive activity verbs from established nouns. This is a highly productive process in adult Hebrew, and it is readily available to children as young as age three years (Berman, 1989).

In marked contrast to P5 causatives and P3 novel denominals which are NOT readily paraphrasable by nonlexicalized devices, different classes of intransitive predicates do have productive SYNTACTIC alternatives in Hebrew. These include the use of the SELF pronouns with both accusative and prepositional objects for reflexivization of activity and stative verbs; use of auxiliary verbs meaning 'become', 'get', or 'turn (into)' for expressing inchoativity; and of pronouns meaning *one another*, *each other* for reciprocity. In intransitive contexts like these, where speakers have other, more

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analytical expressive options in their language, use of verb-morphology may be circumvented by older speakers, and so will be harder for young children to acquire. This language-particular facet of productivity explains why in filling lexical gaps, Hebrew children as well as adults rely on *binyan* morphology for new-verb formation in transitivizing functions more than in the context of single-argument intransitive constructions.

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APPENDIX I. *Transitivity errors by binyan pairing on novel vs. known items*

P1 Intransitive for P5: [for = in place of]		
1. <i>aba soxe oto</i> 'Daddy swims him'	[Guy 2;6]	novel
2. <i>soxe oto</i> 'awims him'	[Moran 2;7]	novel
3. <i>soxe et hayam</i> 'swims OM the sea'	[Rotem 2;7]	novel
4. <i>aba coel oto</i> 'Daddy dives him'	[Guy 2;6]	novel
5. <i>aba coel oto</i> 'Daddy dives him'	[Yasmin 3;0]	novel
6. <i>aba coel oto</i> 'Daddy dives him'	[Lital 3;7]	novel
7. <i>coel et hayeled</i> 'dives OM the boy'	[Liat 7;9]	novel

HEBREW TRANSITIVITY TEST

8. <i>zoxelet oto</i>	[Rotem 2;7]	novel
'crawls + Fem him'		
9. <i>zoxelet et hayeled</i>	[Liat 7;9]	novel
'crawls OM the boy'		
10. <i>yoshenet et hatinok</i>	[Liat 7;9]	novel
'sleeps OM the baby'		
P4 Intransitive for P3		
11. <i>mistovev oto</i>	[Hila 2;9]	
'turns-itself him'		
12. <i>mitraxecet oto</i>	[Hila 2;9]	
'washes + herself him'		
13. <i>mitraxecet oto</i>	[Matan 3;0]	
'washes + herself him'		
14. <i>mitpocec et habalon</i>	[Matan 3;0]	
'bursts-Intr OM the balloon'		
15. <i>aba mitgalech et hayeled</i>	[Lika 2;6]	novel
'Daddy slides-Intr OM the boy'		
P2 Intransitive for P1		
16. <i>nishbar et ha'ec</i>	[Hila 2;9]	
'got-broken OM the tree'		
17. <i>nishpax et hakaze</i>	[Matan 3;0]	
'got-spilt OM that thing'		
P3 Transitive for P4		
18. <i>hakadur megalgel</i>	[Yasmin 3;0]	
'the-ball rolls + Trans.'		
19. <i>ze megahech levad</i>	[Yasmin 3;0]	
'it irons alone = by itself'		

 APPENDIX II. Number of correct responses given on 12 novel items at each age-group, by direction of change, in descending order of success^a

			2s	3s	8s	Ads	Total ^b
	Input verb						
Intrans >	<i>mitgalech</i>	'slide'	2	9	10	10	31
Trans	<i>nisdak</i>	'crack'	2	7	10	10	29
	<i>zoxel</i>	'crawl'	3	7	9	8	27
	<i>colet</i>	'dive'	1	5	9	9	26
	<i>soxe</i>	'swim'	3	5	10	8	24
	<i>yashen</i>	'sleep'	0	3	8	9	20
	Total ^c		11	36	56	54	157
Trans >	<i>markiv</i>	'assemble'	0	4	9	5	18
Intrans	<i>soreg</i>	'knit'	0	3	6	8	17
	<i>megahech</i>	'iron'	0	3	6	8	17
	<i>shote</i>	'drink'	0	0	3	6	9
	<i>mavrish</i>	'brush'	0	0	0	6	6
	<i>xovesh</i>	'bandage'	0	0	1	3	4
	Total ^c		0	10	25	36	71

^a Each score for each item is based on 10 forms.

^b Each total for each item is based on 40 forms.

^c Each total for each group is based on 60 forms, totalling 240 across.