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Acquisition of derived nominals in Hebrew: developmental and linguistic principles

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Abstract

Derived nominals are abstract nouns derived from verbs and adjectives by nominalization. This study traces the route taken by Hebrew-speaking children in the acquisition of Hebrew derived nominals (HDNs) of two types: action nominals which conform in structure to the small set of obligatory verb patterns (*binyanim)* (e.g., *ktiva* 'writing') and deverbal nouns, which belong to separate nominal patterns (e.g., *maga* 'touch'). One hundred native speakers of Hebrew (children aged five, eight, eleven and fifteen, and adults) were tested on comprehension and production of HDNs. The test items were grouped by *binyan* patterns and by morphological regularity. Results showed that acquisition of HDNs starts at about age eight and is not complete by age fifteen, and that task type, *binyan* pattern and morphological regularity all affect ease of acquisition. We consider the strategies employed in the course of acquisition of HDNs and offer an explanation for this late acquisition which requires a vast amount of prior integrated knowledge.

Introduction

Derived nominals are abstract nouns derived from verbs and adjectives, e.g., English *acquire/acquisition, warn/warning, black/blackness.* The process whereby verbs and adjectives change lexico-syntactic category to become nouns is termed nominalization (Chomsky, 1970). Although this term usually refers to abstract nouns, some linguists extent it to other derived nouns such as agentive, locative or reason nouns (Comrie & Thompson, 1985). By 'derived nominals' we refer in this work mainly to nominalized forms which derive from verbs (also termed 'action nominals') and which denote activities, states and events, e.g. English *running, belief* and *demonstration,* but also resultative meanings (e.g., *gift, offer*) (Berman, 1976; Comrie & Thompson, 1985; Sproat, 1985). Derived nominals are of interest as a category that straddles lexicon and syntax, derivation and inflection (Fabb, 1988; Zucchi, 1993), but to date there have been no studies on how they are acquired. In this paper we consider Hebrew-speaking children's acquisition of derived nominals and the strategies they employ to cope with the semantic and grammatical complexities of the system. Nominalizations are shown to be a special case of the more general phenomenon analyzed below, namely 'late linguistic acquisition' or 'late-emerging systems' which necessitates integrated prior knowledge in the domains of morphology, syntax and discourse (Tyler & Nagy, 1989).

Different types of nominalized forms

The dual 'verbo-nominal' nature of nominalized forms has been accounted for in varying ways, yielding theories about the nature of morphology-syntax interface (e.g., Lebeaux, 1986; Di Sciullo & Williams, 1987; Zubizarreta & van Haaften, 1988). Nominalizations do not constitute a homogeneous category. Studies of English usually distinguish between gerundive *-ing* nominals, e.g., *amusing, giving,* and derived nominals, e.g., *amusement, gift* (Asher, 1993). Gerundives are more verb-like in a number of ways. (1) They typically refer to non-countable events, activities or processes; (2) they display inflection-like regularity and transparency; (3) they form part of the verb paradigm, e.g., *give / gives / gave / given / giving*; (4) syntactically, they are closer to verbs in several respects, e.g., they inherit the argument structure of the verb (*Tom amused the children with his stories / Tom's amusing the children with his stories*) and are modified by adverbs (*Tom's continuously amusing the children with his stories*); and (5) their semantics and

phonology is compositional and almost automatic. The regularity, predictability and extreme productivity of -*ing* nominals have led to the suggestion that they are inflectionally created in the syntax (Fabb, 1988; Zucchi, 1993).

Derived nominals are more noun-like. They often refer to concrete entities (*gift*) or to discrete events and abstract entities (*demonstration, belief*); their morphophonological structure and meaning is varied, often unpredictable and idiosyncratic, and includes zero-conversion and suppletion (compare *attendance, gift, amusement, walk*); the syntactic structures associated with them are nominal, including *of*-structures (*Charlie's gift of diamonds to Ann)* and modification by adjectives (*Ron's strong belief in life after death).* The irregular, unpredictable character of derived nominals places them in the lexicon as listed objects with limited productivity, as expressions memorized and stored as such by speakers (Chomsky, 1970; di Sciullo & Williams, 1987).

But this seemingly clear-cut division between -*ing* gerundive nominals and derived nominals in English is not entirely correct. -*Ing* nominals fall into two further groups: verbal gerunds, which take verbal constructions with a specified subject, e.g., *not singing is good enough for John,* where John is the underlying subject; and nominal gerunds, whose subjects may be interpretable from the context, e.g., *no singing is good enough for John,* where anybody can be the subject (Roeper, 1982; Roeper & de Villiers, 1992). Though they have the same morphological form, verbal gerunds belong with verbs and are derived by inflection, sometimes interchangeably with infinitival *to-V* constructions, e.g. *He began singing / to sing.* Nominal gerunds, though extremely regular and predictable, show some signs of being lexically derived. For example, there are -*ing* nominals with idiosyncratic, concrete, countable meanings, e.g. *a helping, John's cooking, go shopping, many readings of a text.* Thus it has been suggested that -*ing* nominals are simultaneously associated with two syntactic analyses - one verbal, one nominal (Zubizarreta & van Haaften, 1988).

The ambiguous nature of -*ing* and derived nominals is reflected in the controversy concerning synthetic compounds whose head is a deverbal noun, e.g., *golddigging, handwoven, school teacher,* and which express thematic relations between a verb and its arguments or adjuncts (Lieber, 1983). While some researchers consider only -*ing* gerundive nominals (together with -*en* and -*er* forms) to constitute

heads of synthetic compounds, others include in this class derived nominals (e.g., *troop deployment*) with less regular suffixes such as *-ion, -ment, -ance* (Selkirk, 1982; Sproat, 1985).

Nominalization in Hebrew

Nominalization is primarily expressed in Hebrew in the morphological class of action nominals (Hebrew š*mot pe'ula*), e.g., *gliša* 'surfing', *haclaxa* 'succeeding / success', which semantically and syntactically correspond to English nominal gerunds and derived nominals (Berman, 1976; Hazout, 1995). For example, Hebrew action nominals have a dual verbal / nominal character, and serve as heads in synthetic compounds, e.g. *nitnax ha-ma'amar* 'analysis (of) the-article', *axilat avokʔdo* 'avocado eating' (Berman, 1988). Thus in Hebrew, too, nominalizations do not constitute a homogeneous class.

A morphological analysis of Hebrew derived nominals (HDNs)

There are three main ways of forming new lexical items in Hebrew: Linear affixation in nouns and adjectives, akin to English word-structure, where stems and affixes are concatenated, e.g. *yaldut-i* 'child-ish', compounding (Berman, 1988), and the Semitic non-linear combination of two tiers - a consonantal root and a vocalic pattern (often preceded by a prefix or followed by a suffix) (McCarthy, 1981), e.g., *nihel* 'managed, directed', root *n-h-l*, verbal pattern *CiCeC*. This applies to all verbs and most nouns and adjectives. There are seven verbal patterns, traditionally called *binyanim* (literally 'buildings'), which convey distinctions of transitivity such as causativity and inchoativity (Berman, 1993); and about 40 nominal patterns, termed *miškalim* 'weights' which denote ontological categories such as agent, place and instrument (Blau, 1981; Ravid, 1990).

There are two main types of Hebrew derived nominals (henceforth: HDNs): action nominals (henceforth: ANs) and deverbal nominals, corresponding more or less to *-ing* gerundive and derived nominals respectively (Ravid, in press). Both types are constructed of non-linear root and pattern, and differ in the degree of relatedness to the verbal system.

Action nominals. Like Hebrew verbs, ANs are constructed of root and pattern, e.g., *haklata* 'recording', root *k-l-t* 'record' and AN pattern *haCCaCa.* They are related to verbs in a formal and systematic way: Every non-passive *binyan* pattern has a specific AN pattern associated with it[1]. For example, verbs in P1 *(Qal*) take the

CCiCa pattern, e.g., *kalat* ‘absorb’ / *klita* ‘absorbing, absorption’. The five canonical AN patterns are presented in Table 1[2].

Insert Table 1 about here

In addition to morphological relatedness, ANs have a systematic semantic relationship with inflectional verb paradigms: they convey an abstract, compositional, non-count gerundive meaning of ‘the act or the state of *V-ing’*, e.g., *yašav* ‘sit’, *yeshiva* ‘the act of sitting’ (P1); *hitmaked* ‘focus’, *hitmakdut* ‘focusing’ (P4). Their basic meanings are thus a function of the meaning of the source verb, and each AN pattern expresses the syntactico-semantic property typical of the *binyan* to which it is related. Thus P5-based *haCCaCa* in many cases expresses causativity, e.g., *higdil / hagdala* ‘enlarge / enlargement’. In some cases ANs are interchangeable with infinitive forms, e.g. *sxiya / li-sxot ze davar tov* ‘swimming / to swim is a good thing’ (Berman, 1976). But even ANs, the more productive and regular part of the HDNs class, are lexically derived, a fact reflected in the amount of formal and semantic irregularity, unpredictability and idiosyncrasy in the system. Below we review some of the derivational features of Ans.

Abstract and concrete meanings**.** Most ANs have both an abstract and a more concrete (even product), or discrete reading, e.g. P3-based *xitul* 1. ‘diapering’, 2. ‘a diaper’; P1-based *srita* 1. ‘scratching’, 2. ‘a scratch’) (Bendavid, 1957; Berman, 1976).

Unpredictable meanings**.** Moreover, the meanings of many ANs are not automatic and compositional, e.g., *kiven* ‘direct’ (P3) / *kivun* ‘direction’ (rather than ‘directing’); *histader* ‘arrange oneself’ (P4) / *histadrut* ‘trade union federation’; *histakel* ‘look’ (P4) / *histaklut* ‘psychiatric observation’; *kibel* ‘receive’ (P3) / *kibul* ‘capacity’.

Secondary action nominal patterns. In addition to the canonical AN patterns, three of the *binyanim* have secondary patterns, and verbs may take only the secondary or both the canonical and the secondary pattern. For example, the verb *hisbir* ‘explain’ (P5) has two corresponding ANs: *hasbara*, with the regular or canonical pattern *haCCaCa* and the irregular meaning ‘propaganda’; and *hesber*, with the secondary pattern *heCCeC* but compositional meaning ‘explanation’. And the P1 verb *sana* ‘hate’ takes only the secondary P1 AN pattern *CiCCa*, yielding *sin’a* ‘hatred’. Table 2 lists the canonical as well as secondary patterns of the five non-passive *binyanim*.

Insert Table 2 about here

Minor patterns. P1 is associated with a number of other, minor patterns, e.g., *CCuCa* (*tafas / tfusa* 'engage / occupancy'), *CCoC* (*caxak / cxok* 'laugh / laughter').

Cross-*binyan* matchings**.** Verbs in one *binyan* may take an AN associated with another *binyan*. For example, P1 *rakad* 'dance', P3 *rikud* 'dance' (cf. expected P1-based *rekida*, P1); P2 *nehena* 'enjoy', P1 *hana'a* 'enjoyment' (cf. expected P2-based *hina'ut*); P4 *hišta'el* 'cough', P3 *ši'ul* 'cough' (cf. expected P4-based *hišta'alut*).

No Action Nominal. A few verbs lack a corresponding AN, especially in P3, e.g. *miher* 'hurry', but no *mihur* 'hurrying'; *xika* 'wait', but no *xikuy* 'waiting'.

Deverbal nominals. In addition to the semi-regular canonical and secondary ANs, verbs often have HDNs in other non-verbal abstract patterns e.g., P3 *sixek* 'play', *misxak* 'game', *miCCaC* pattern (cf. expected P3-based *sixuk*). In some cases, a verb's only derived nominal may be a deverbal nominal, while in others the verb may have one or more ANs as well as a deverbal nominal. For example, P2 *ne'evak* 'struggle' takes a regular P2 *hiCaCCut* AN *he'avkut*[3] 'wrestling', along with the more semantically regular *ma'avak* 'struggle' in the abstract nominal pattern *miCCaC.*

In fact, a large number of verbs, mostly high-frequency, everyday verbs are related to multiple derived abstract nominals, usually including a canonical AN and also several others - secondary ANs and deverbal nominals. For example the P1 verb *zaxar* 'remember' is associated with the following deverbal nominals: *zxira* 'remembering', *mizkar* 'memorandum', *zʻxer* 'remembrance', *zikaron* 'memory'. There about ten abstract nominal patterns which are frequently employed in the formation of deverbal nouns and other abstract nouns: *CʻCeC* (e.g., *vʻtek* 'tenure'); *miCCaC* (e.g., *mivxan* 'test'); *miCCaCa* (e.g., *milxama* 'war'); *miCCoC* (e.g., *mistor* 'shelter'); *miCCʔCet* (e.g., *mi* 'safekeeping'); *CiCaCon* (e.g., *zikayon* 'franchise'); *taCCiC* (e.g., *tahalix* 'process'); *taCCeCa* (e.g., *tav'era* 'burning'); *tiCCʻCet / tiCCʔCet* (e.g., *toxʻlet* 'expectancy'); *taCCuCa* (e.g., *taxbura* 'transportation'). Some of them are loosely related to P1 verbs, others occur more frequently with P4 and P5 verbs, but no systematic relationship can be established. In addition, verbs (especially P1) may take totally idiosyncratic forms as their deverbal nouns, e.g. P1 *gar* 'live, reside', *megurim* 'residence' (cf. *rac / rica* 'run / running'); or P1 *ka'av* 'hurt,Int.', *ke'ev* 'pain' (cf. *patax / ptixa* 'open / opening').

Semantically, deverbal nominals have a variety of meanings, from the most automatic and predictable AN meaning of the act / state of *V-ing*, typically a

mass noun (e.g., *harag / hʾreg* ‘kill / killing’), through abstract though count nouns e.g., (‘lie / a lie’), more concrete and discrete meanings, e.g., a product noun (*katav / mixtav / katava* ‘write / letter / report’), to totally idiosyncratic meanings (e.g. *amad / ma’amad* ‘stand / status’) (Berman, 1976).

As noted, Hebrew derived nominals (HDNs) fall into two classes: Action nominals, which are morphologically and semantically more regular, and deverbal nominals, which are more idiosyncratic. The boundary between the two groups is not clear-cut: all HDNs share the meaning of an abstract, verb-related noun denoting the activity, the state, the event or the result of a verb; but their forms are not fully predictable, since a verb may take a morphologically regular or irregular form. There are, however, certain clear trends that yield a continuum of relative predictability or regularity: P1 verbs (both transitive and intransitive) take the most variable range of HDNs in addition to the canonical AN pattern and 3 secondary patterns; next, transitive P3 and P5 verbs have one canonical and one secondary AN patterns, and they also take other deverbal noun forms. Third, the most regular, almost inflection-like, are intransitive verbs from P2 and P4, with one canonical AN pattern per each *binyan*. In contrast to the preceding root-and-pattern P1, P3 and P5, P2 and P4 patterns (*hiCaCCut, hitCaCCut)* have an external suffix *-ut* which also occurs in linearly structured abstract nouns, e.g. *enoš-ut* ‘human-ity’, *tkef-ut* ‘valid-ity’. Note that when a deverbal nominal has the semantic features of an AN, it also behaves syntactically like an AN. Thus *ma’avak* ‘struggle’ (abstract pattern *miCCaC*) inherits the argument structure of the P2 verb *ne’evak* ‘struggle’, e.g. *dan ne’evak ba-šodedim* ‘Dan struggled in(=with) the-robbers / *ma’avako šel dan ba-šodedim* ‘Dan’s struggle in(=with) the-robbers’.

Since ANs and deverbal nominals seem to share the same range of morphological, semantic and syntactic properties, this study examines how Hebrew-speaking children learn about the class of derived nominals, which includes both types of verb-related nominals.

Acquisition of Hebrew derived nominals (HDNs)

To the best of our knowledge, children’s learning of derived nominals has not been studied, except for Roeper (1982), and Mayrose (1988). Roeper’s study focused on children’s innate ability to distinguish between the syntactic structures of verbal and nominal gerunds, extremely regular morphological entities. Mayrose’s

work focused on the acquisition of Hebrew ANs in 48 children aged 5, 7, 9, 11, and 12 adults, who were given comprehension, production and option selection tests. This study provided us with our basic assumptions: She showed that comprehension of ANs precedes production; that nominalizations are a late acquisition, starting to consolidate around age 9; that eleven-year-olds approach adult knowledge of ANs, although they differ from them in the intransitive *binyanim* (P2 and P4), which were the hardest to master.

There are several reasons why ANs - and certainly the broader range of derived nominals - emerge so late (Berman, in press). To begin with, derived nominals are nouns that refer to verbal entities. Thus they violate the transparency maxim typical of less-monitored language varieties, such as colloquial discourse (Biber, 1988) and have been found to be confounding factors in experimenting with nonce words (Tomasello, 1996). Moreover, they denote abstract entities which can only be conceptualized, and are thus difficult to grasp (Asher, 1993). Syntactically, derived nominals often appear in complex constructions that reflect their propositional ancestry (Lieber, 1983; Hazout, 1995). Hebrew morphology adds an extra dimension of complexity to this array of semantic, grammatical and pragmatic factors. In the first place, HDNs are non-linear structures whose components are less salient than linear forms (Clark & Berman, 1984). From the input point of view, HDNs characterize high-register, especially written, discourse. Since they are complex subordinating constructions that constitute a high-register stylistic device in the more marked part of the mental lexicon (Berman & Slobin, 1994), they rarely occur in spoken everyday usage, and their number increases markedly in more formal expository texts (Berman, 1985:355; Biber, 1988; Halliday, 1988).

Given this background, it is clear why HDNs do not occur frequently in the speech directed to and produced by young Hebrew-speakers. They appear occasionally as early as in three-year-old Hebrew speakers, but are usually malformed, e.g. *pehaka* ‘yawn’ for correct P3-based *pihuk.* But extensive, systematic and wellformed usage of nominalizations does not occur before age 8-9 and is not yet established by age 11 (Mayrose, 1988).

Method

A cross-sectional study was designed to test comprehension and production of HDNs in the five non-passive *binyanim.*

Subjects. 100 subjects divided equally into five age groups participated in the study, all monolingual native speakers of Hebrew, from a mid-to-high socio-economic background. Subjects' age was determined by previous research and pilot testing. (1) five-year-olds (age range 5;4-6;7, mean age 5;9), the youngest age bracket able to handle understanding and producing HDNs under experimental conditions (Mayrose, 1988); (2) eight-year-olds (age range 8;3-9;2, mean age 8;8) represent middle childhood, well-established as a stage in later language acquisition (Karmiloff-Smith, 1986; Ravid, 1995), have basic literacy skills and been exposed to schooltype language for three years; (3) eleven-year-olds (age range 11;2-12;4, mean age 11;8), the oldest group in Mayrose's study, pre-adolescents familiar with different varieties of written language usage, who have a fair degree of linguistic awareness (Berman & Slobin, 1994; Ravid & Malenky, 1997) To these we added (4) fifteen-year-olds (grade 10) (aged 15;1-16;0, mean age 15;7); and (5) adult university students in their twenties (aged 21-32, mean age 25) - two groups of literate subjects with a high degree of linguistic awareness. There were 41 boys and 39 girls in the younger groups. The adults were all women.

The experimental design. The Derived Nominals Test was divided into two parts: a comprehension test and 3 production tests. All test items were selected from a list of common verbs known to children 4-10 (see Appendix).

The Comprehension Test. Subjects were asked to give the verb corresponding to a given derived nominal, e.g., given the input nominal P3-based *isuf* 'collecting', the subject was required to give the P1 verb *osef* 'collects'. The aim of this test was to see whether subjects were able to understand HDNs by relating them to corresponding verbs for different *binyan* patterns. The test consisted of 15 HDNs, 3 in each of the 5 non-passive *binyanim*, with each group of 3 items in descending order of regularity. (a) The first was regular**,** an AN in the canonical pattern for that *binyan* (e.g., P3 *ipur / me'aper /* 'make-up / makes up'; (b) the second, an irregular item, was an AN in a secondary pattern in *binyan* different from that of the corresponding verb (e.g., P1-based *kvisa /* P3 verb *mexabes* 'washing / washes'; (c) the third item was the most irregular, a deverbal nominal not directly related to the verbal system, e.g., *xaluka* (*CCuCa* pattern) 'distribution' / P3 verb *mexalek* 'distributes'. The input items were preceded by two training items from two different *binyanim*, presented as follows: 'It's true, isn't it, that a person who is occupied in

writing (ktiva), writes (kotev) all the time?' Then the subject was presented with the 15 derived nominals in random order. The test question was 'Tell me, what does a person *do* who is occupied in *V-ing*?' And the subject was asked to supply the verb[4].

The Production Tests. Here, subjects were given source verbs and required to produce HDNs. Each of the three production test contained 20 input verbs, 4 in each of the 5 *binyanim*, 60 items in all. The first verb in each *binyan* category was regular, i.e., had a corresponding canonical AN, e.g., P1 source-verb *doxef* 'pushes / P1-based *dxifa* 'push/ing'; the second verb corresponded to a secondary AN in the same *binyan* or a cross-matched AN in another *binyan*, e.g., P1 source-verb *xozer* 'returns' / *xazara* 'returning (secondary P1 AN pattern *CCaCa*); and the third verb had either a cross-matched AN in another *binyan*, or else a deverbal nominal outside the verbal system (e.g., P1 source-verb *roked* 'dances' / P3-based *rikud* 'dance/ing'; finally, the fourth verb in each group always had the most irregular derived nominal, a deverbal nominal in a pattern unrelated to the verbal system, e.g., P1 source-verb *dag* 'fishes' / deverbal noun *דְּיג yig* 'fishing', *C'CeC* pattern.

Production test type. Subjects were required to produce derived nominals in 3 subtests that differed in the syntactic environment of the elicited nominal and in the degree to how obligatory it is in that context (e.g., in some contexts both an infinitive and an HDN are possible). The three subtests covered a wide range (60) of verbs and HDNs in different semantic domains.

The 'machine' test. This constituted the most syntactically binding environment for a derived nominal. HDNs tend to appear in construct-state compounds both as heads and as modifiers (Berman, 1976; Ravid & Shlesinger, 1995), and the head *mexona* 'machine' frequently occurs in Hebrew in names for instruments (Clark, 1993), e.g., *mexonat ktiva* 'machine writing = typewriter', *mexonat kvisa* 'washing machine'. Subjects were given two training sentences with canonical ANs that do not occur in lexicalized compounds with *mexonat-*: 'What would you call a machine that closes (P1 source-verb *sog'ret*, Fm) things - *mexonat sgira* 'machine closing (P1) = closing machine', right?' They were then asked 'Now tell me, what would you call these machines: A machine that *V*-s all the time is a (*V-ing*) machine'. For example, 'a machine that loses (P5 source-verb *mafsida*, Fm) all the time is *mexonat-*....(P5-based *hefsed*, secondary pattern) 'losing machine'. The syntactic framework of the construct state compound *mexonat-*... requires a derived

nominal as the modifier in the input sentence; and other possible responses to the input verb, including the infinitive, are not grammatical. That is, a derived nominal is needed to produce a grammatical utterance.

The 'agent' test constituted the least grammatically binding environment for the production of a derived nominal. The two training sentences took the form: 'A person who talks (P3 source-verb *medaber*) is occupied in (Hebrew *asuk be-)* talking *(*P3-based *dibur*), right?' so that the subject understood the requirement for a derived nominal. The 20 test sentences had the following form: 'Now you tell me what all these people are occupied in. A person who *V-s* all the time is occupied in *V-ing*'. For example, 'a person who pays (P3 source-verb *mešalem*, P3*)* is occupied in paying (*tašlum*, idiosyncratic deverbal nominal)'. An infinitival is grammatical, though colloquial or lower register.

The 'sensations' test contained verbs denoting sensations, with a loose grammatical environment for the elicitation of related HDNs: a free compound with the genitive particle *šel* (Ravid & Shlesinger, 1995) whose head was the word *hargaša* 'feeling, sensation, sense', e.g., *hargaša šel xarata* '(a) feeling / sense of regret'[5]. The training sentences were: 'A person who *gets excited* (P4 source-verb *mitrageš)* has a *feeling of excitement* (*hargaša šel* P4-based *hitragšut*), right?' And the 20 input sentences had the following form: 'Now you tell me about the feelings of these people: A person who *V-s* (where *V* is a sensation verb) has the feeling of *V-ing*'. For example, a person who *envies* (P3 source-verb *mekane)* has the feeling of *envy* (P1-based *kin'a*, secondary pattern). This test had a large number of rote-learned items since most of the irregular items describing emotions and sensations were idiosyncratic rather than followed minor and secondary patterns.

The three production tests thus enabled us to look into subjects' strategies when faced with different degrees of obligatoriness in the production of HDNs and with productive, semi-productive and lexicalized forms.

Procedure. All the children were tested orally in a quiet room at school. Kindergartners were tested in two sessions to avoid the effects of stress and fatigue. The oldest group of adults was tested in writing in class, with a researcher resent to clarify points and answer questions. The order of the 3 production tests and, within them, the test items, was randomized. Subjects were given training in the form of examples similar in form to the test items. Responses were recorded and transcribed

on the same day. Each individual response sheet was checked separately by two expert judges, whose judgments correlated in 96% of the cases. The remaining 4% of the cases were resolved through discussion.

Results

Findings are described below for the comprehension and followed by results on the three production tests.

Analysis of results for the comprehension test. The criterion for success on the comprehension test was production of a form of the correct verb as a response to a derived nominal, that is, the verb used by adults which corresponds to the derived nominal (say, like English *destruction / destroy*), e.g., *kišalon / nixšal* 'failure / fail'. Table 3 presents the correct responses by *binyan* and age group, and Table 4 - the correct responses on the regular vs. irregular items of the test. We performed a three-way ANOVA with repeated measures on these data: Age (5) X *binyan* (5) X regularity (2). It revealed an effect for age ($F(4, 94) = 20.9$, $p = 0.000$), with an overall rise in comprehension scores with age. There was also an effect for *binyan* ($F(4, 380) = 35.14$, $p=0.000$), showing different scores on the 5 *binyanim*; the following ranking order emerged for comprehension: P1 > P3 > P5 > P4 > P2. That is, *Nif'al* (P2) HDNs were the hardest to match with verbs, while *Qal* (P1) HDNs were the easiest. And there was an effect for regularity ($F(1,95)=16.23$, $p=0.000$), with regular items being easier to match with verbs than irregular ones.

Insert Table 3 about here

Insert Table 4 about here

The production tests. Since the purpose of this test was to find out about the process of acquiring HDNs, the criterion for success on the production tests was a correct derived nominal. This is the derived nominal used by adults which corresponds to the input verb. Since our tests had the full range of HDNs from totally regular and predictable forms to idiosyncratic ones, with intermediate secondary patterns and cross-*binyan* forms, this enabled us to trace in acquisition not only awareness of regular derivational rules, which may lead to overregulaization, but also knowledge of minor, semi-productive patterns and pattern clusters, and of lexicalized forms. We graded as correct both singular and plural nominals, e.g., P1 source-verb *roked* 'dances/ P3-based *rikud / rikudim* 'dance/s'. This is because deverbal nouns, and especially ANs, are associated both with a more abstract, verbal, non-count

meaning, e.g., the act of *dancing*, and a more concrete or discrete count meaning, e.g., *the tango dance*, *many dances* (Berman, 1976; Zubizarreta & van Haaften, 1988). All the other responses were considered as non-correct.

Insert Table 5 about here

Insert Figure 1 about here

Comparing comprehension and production. Table 5 compares the means of correct responses on the comprehension with the means of correct responses on the combined 3 production tests, by age group. We performed a two-way ANOVA of these data: Age (5) X task type - comprehension vs. production (2) with repeated measures. This analysis revealed an effect for age ($F(4, 95) = 75.38$, $p=0.000$), an effect for task type (comprehension vs. production), with more success on the comprehension test ($F(1, 95) = 60.73$, $p= 0.000$), and an interaction between age and test type ($F(4, 95) = 11.26$, $p=0 .000$), as the gap between the two tasks closes in the older age groups from 11 years and up (see Figure 1). There was also a significant correlation between production and comprehension (pea = 0.6, $p< 0.001$).

Insert Tables 6,7, 8, 9 about here

Analysis of correct results on the production tests. The following breakdowns of the means of correct responses are presented as follows: Table 6 - correct responses on the 3 production tests by age group; Table 7 - correct responses on the 5 *binyanim* by age group; Table 8 - correct responses on the 5 *binyanim* by production test; Table 9 - correct responses on the regular vs. irregular items of the 3 production tests by age group. We performed a four-way analysis of variance on the data presented in Tables 6, 7 and 8: Age (5) X test type (3) X *binyan* (5) X regularity (2). This analysis showed an effect for age ($F(4,95) = 87.44$, $p= 0.000$), showing a rise of correct production rest with age (Tables 6,7,9). There was an effect for test type ($F(2,190) =22.26$, $p=0.000$), showing a difference between the higher scores on the 'sensations' test on the one hand, and the 'machine' and 'agent' tests, on the other (Table 6). There was also an effect for *binyan* ($F(4,380) = 66.59$, $p= 0.000$), reflecting the different correct scores on the 5 *binyanim*: The order found on the production tests is P1> P3> P5> P4> P2, exactly the same as the order on the comprehension test (Table 7). And there was an effect for regularity ($F(1,95)=312.88$, $p=0.000$), reflecting the higher scores on the regular items (first item for each *binyan*) than the irregular ones (2nd-4th item for each *binyan*) (Table 9).

Insert Figure 2 about here

An interaction was found between age and test type (F(8,190)=10.63, p= 0.000), presented in Figure 2. Though all tests start low in the five-year-olds, the least grammatically constraining 'agent' was the hardest for the three youngest groups, while the 'machine' test with the most binding syntactic environment had the lowest scores in the older groups. The 'sensations' test had a different pattern in the age groups: it was by far the easiest for the three oldest groups, the only test to reach ceiling in the adults. By age 11, the success score is over 60%, double the score of the eight-year-olds (Table 6).

Insert Figure 3 about here

We also found an interaction between age and *binyan* (F(16, 380) = 2.67, p< 0.004), reflecting differences of improvement with age in the different *binyanim* (Table 7 and Figure 3). P1 starts with 30% correct responses in the five-year-olds, and by 11, is close to 3/4 correct responses; but by adulthood, has the same score as P3; P2 has the lowest scores throughout, but the adult group has the same scores as in P5.

Insert Figure 4 about here

An interaction was also found between test type and *binyan* (F(8,760)=17.52, p= 0.000), presented in Table 8 and Figure 4. The 'sensations' test had especially high scores on P1 and P5, while the 'machine' test had a higher score on P3, and the 'agent' test had an especially low score on P5.

Insert Figures 5, 6 about here

We did not find an interaction between age and regularity: all age groups improved at the same rate for both types of items (Table 9). An interaction was found between regularity and test type (F(2,190)=23.49), p=0.000) (Figure 5): while regular items scored about 2/3 correct responses on all 3 tests, the irregular items received higher scores on the 'sensations' than on the other 2 tests (Table 9). Finally, an interaction was found between regularity and *binyan* (F(4,380)=18.66, p=0.000) (Figure 6): The difference between regular and irregular items is smaller in P1 and P2, and greater in P3.

Summary of correct results

Comprehension: 1. Regular HDNs were easier to match with their verbs than irregular ones and showed direct improvement with age, while irregular ones

showed a U-shaped developmental pattern; 2. The ranking order of *binyanim* in comprehension P1 > P3 > P5 > P4 > P2.

Comprehension vs. Production: Comprehension precedes production, but the gap closes in the older age groups.

Production: 1. Production scores rise with age; 2. The 'sensations' test was easier than the other two tests, especially for the older groups, and especially on P1 and P5; 3. The same ranking order of *binyanim* was found as in comprehension; 4. Verbs with regular HDNs were found to be easier than irregular ones, while irregular items were easier on the 'sensations' test, and in P1 and P3.

Age-related strategies in the acquisition of HDNs: descriptive data

In addition to the correct responses on the production tests, subjects produced forms that did not meet the criterion for 'correctness', e.g., *hitxartut* for *xarata* 'regret'. These responses reflect strategies in attempting to create or retrieve an abstract nominal based on lexical and morphological knowledge. In analyzing these responses, we found six categories that occurred in the test population: Suppletion, agent nouns, infinitives, *-ut* suffixed abstract nominals, P3-based *CiCuC*, and canonical AN patterns. Table 10 presents their distribution in the 5 age groups. We do not present statistics due to the ipsative nature of the data (i.e., the interdependency between the response categories).

Insert Table 10 about here

Suppletion. Suppletive paradigms with morphologically unrelated members (e.g., *go / went / goes / going / gone*) constitute a well-known morphological phenomenon (Plank, 1996). When faced with a lexical gap, especially under experimental conditions, children sometimes use familiar words as suppletive responses (Clark, 1993; Ravid, 1995). Here it occurred in the two youngest groups, the five-year-olds and the eight-year-olds, e.g., *mexonat tmunot* 'machine picture = picture machine' for *mexonat cilum* 'photography machine'. Suppletion was especially frequent in P2 (36% of the suppletion responses) and in the 'agent' test.

Agent nouns. Another strategy characteristic mainly of the two younger age groups is the production of an agent noun from the root of the given verb, e.g. *rakdanit* 'dancer,FM' for *rikud* 'dancing'. These responses are totally absent from the 3 oldest groups.

Infinitives. Even more frequent in the five-year-olds and the eight-year-olds, and to some extent in the eleven-year-olds, is the production of the infinitive form of the input verb, e.g. 'a person who explains all the time (P5 source-verb *masbir*)' *asuk be-le-hasbir* '(is) occupied in-to-explain' instead of *hesber(im)* 'explaining(s)', a colloquial form common in Modern Hebrew. 93% of the infinitives were produced, as we expected, on the 'agent' test, a non-obligatory context for derived nominals.

-Ut suffixed abstract nominals**.** Abstract nominals with the form stem + *-ut* (e.g., *mafsidanut* 'losership' for *hefsed* 'loss') characterized the three younger age groups, and especially the five-year-olds. The most *-ut* responses occurred in the 'sensations' test, and in P2.

CiCuC. Subjects also gave cross-matched ANs in response to the input verb, e.g., P4-based *hit'almut* 'ignoring' for P2-based *he'almut* 'disappearance', P2 source-verb *ne'elam* 'disappear'. The most frequent AN pattern in these responses was P3-based *CiCuC*, e.g., *riguz* for correct *rגgez* 'annoyance'. Cross-matched *CiCuC* forms characterize mostly the five-year-olds, but can also be found in all other age groups. *CiCuC* occurred most frequently with P4, its middle voice counterpart.

Canonical AN pattern. The most common strategy was to give an incorrect AN in the canonical pattern corresponding to the input verb, e.g., P4-based *hitxatnut* 'marrying' for correct *xatuna* 'wedding'. This response category occurred evenly across all age groups. In the 'agent' test the three older age groups revealed more canonical AN responses, while in the 'sensations' test the three younger age groups did so. The *binyan* with the most canonical pattern responses was P4.

Discussion

This study investigated the acquisition of HDNs, abstract nouns with varying degrees of morphological affinity to verbs (e.g., P3 *tiken* 'mend' / P3-based canonical *tikun* 'mending', secondary *takana* 'regulation'). A series of structured elicitations yielded the following conclusions:

1. HDNs constitute a late acquisition. Under experimental conditions, five-year-olds were able to assign the correct verbs to about half of the HDNs presented to them, but could provide HDNs for given verbs only about 20% of the time. Acquisition was still under way among highschoolers (age range: 15;1-16;0), while the overall production score in adults was around 75%.

2. Age, test type, *binyan* and item regularity interact in accounting for productive knowledge of HDN-formation rules with rote knowledge of irregular HDNs.
3. Children undergo a long and complex route from general expression of abstractness towards specific, correct HDNs which are systematically related to verbs. This route is expressed in the strategies adopted prior to and concurrently with producing correct HDNs.

The main issues raised by the findings are discussed below.

Productivity vs. lexicalization in the acquisition of HDNs

Our findings reflect the need for and facilitating effect of both kinds of knowledge in achieving mastery of HDNs: productive pattern assignment and rote knowledge. Productive patterns constitute an anchor for this knowledge: regular items in both comprehension and production score higher than irregular ones; ultra-productive cross-matched *CiCuC* and canonical AN responses are found in all age groups. But irregularity is not a mirror-image hindrance to acquisition: the 'sensations' test with the most idiosyncratic items has the highest scores of all three tests; P1, the *binyan* with the most secondary and minor patterns, leads both comprehension and production ranking clines, while P4 and P2, the two *binyanim* with only one extremely productive pattern, bring up its end; The 'sensations' test has especially high scores with the two *binyanim* with the most idiosyncratic forms, P1 and P5; the irregular items on the 'sensations' test get higher scores than on the other two tests; and finally, though P1 and P2 are two extreme poles of idiosyncrasy vs. productivity, they are also the two *binyanim* with the smallest differences between successful scores on regular and irregular items.

These findings, taken together, reflect Hebrew speakers' strategies in dealing with the classical challenge of morphology: knowing when to apply the set of rules governing regular *binyan*-related forms and when these rules are to be blocked and minor patterns are to be activated or idiosyncratic forms to be retrieved. Two recent models originally developed to account for the acquisition of inflectional morphology can be extended to dealing with learning derivational morphology, and especially HDNs where regular forms are almost construed as part of the inflectional verb paradigm. A *dual-system model* assumes the existence of two distinct processing systems: One handles regular formation by abstract, symbolic rule that can be extended to nonce forms, and another stores irregular forms by lexical memory or by

an associative network of subregularities that clusters together minor patterns (Halle & Mohanan, 1985; Prasada & Pinker, 1993). *Single-system models* propose an associative memory system (connectionist model) which regards each entry as a set of features that are shared by many other entries that overlap in their representation. The network learns to compute the most probable output form for any input string by using learning algorithms that capture the statistical regularities between them and can generalize automatically to both regular and irregular new forms that resemble forms it already knows (Daugherty & Seidenberg, 1994). Both models would account for the success on the regular items and the widespread canonical AN production as overregularization either by productive rule or by feature linking. Minor patterns and exceptions would have to be learnt separately by a dual system and by the same framework in the single system model. Since both models heavily rely on frequency of occurrence, they would both be able to explain success on learning items occurring more frequently in everyday discourse, like 'sensations' test items denoting basic emotions and sensations such as pain and fear. This growth pattern resembles the one found in inflectional systems of languages such as German and Arabic, where the default form is not the most frequent one, and a number of minor irregular patterns compete with each other, yet learning proceeds as well as it does in languages with highly frequent default forms (Nakisa, Plunkett & Hahn, 1997). The notions of 'productive' and 'irregular' should thus not be mapped synonymously onto 'easy' and 'hard' to acquire respectively: both current models of morphological mechanisms can handle productive and semi-productive pattern assignment as well as learning lexicalized forms by rote or by feature matching.

A closer look at subjects' performance on the 5 different *binyanim* reveals another aspect of the interaction of productivity and lexicalization in knowledge of HDNs. The five non-passive *binyanim* fall into three groups delineated on the cline found for both comprehension and production, and highlighting different aspects of the notion of 'word': P1; P3 and P5; P4 and P2. P1 is a separate verbal entity: semantically basic and the least productive of all *binyanim*, yet it contains most of the early-learned core verbs of Hebrew (Berman, 1993; Blau, 1981; Ravid, 1990). It has neutral transitivity, with both transitive and intransitive verbs in it (e.g., *write*, *work*). Its main HDN pattern, *CCiCa*, is just as basic and transitively neutral, and therefore requires a large number of sporadically occurring secondary patterns to express

idiosyncratic meanings that go beyond the meaning of 'act of *V-ing'*. (e.g., *š-t-f* 'wash', *štifa* 'washing', *š itafon* 'flood', 'fluency'). *CCiCa* aside, HDNs in P1 are well-established words with highly idiosyncratic meanings: the 'sensations' test which required rote learning had especially high scores on P1. The difference between the regular and irregular items in P1 is very small: its place as the easiest *binyan* derives from both the lexicalized status of its verbs and HDNs as well as from the simplex meaning of *CCiCa*.

P3 and P5 are also basic *binyanim*, though unlike P1, highly productive. P3 is the main denominal tool in Hebrew (e.g. *fikses* 'to fax' from *faks* 'fax'), is transitively neutral and usually reflects the meaning and structure of the base noun (Ravid, 1990). Note that productivity is the main feature of P3 which facilitates learning for those who know the rules: by adulthood, it has the same score as P1, and the 'machine' test, which requires application of regular AN rules, has especially high scores on P3. The difference between regular and irregular items is greater in P3.
P5 is mixed in function: system-internally, it adds causativity to the meaning of the root in P1 or P2 (e.g., P1 *axal* 'eat' / P5 *he'exil* 'feed', root *?-k-l*; P2 *nirdam* 'fall asleep' / P5 *hirdim* 'put to sleep', root *r-d-m*), but it also functions as a basic denominal pattern in new verb formation (e.g., P5 *hinc□ax* 'commemorate' from *n'cax* 'eternity') (Bolozky, 1978). These two serve as the two main patterns for new-verb derivation in Hebrew, and they too have a number of secondary patterns to express idiosyncratic meanings beyond 'act of *V-denom-ing* or causing X'. They occupy the middle section of the cline after P1, as correct responses on them require a combination of productive pattern knowledge coupled with the specialized meanings of their secondary patterns.

P2 and P4 offer an interesting combination of high, almost inflection-like, productivity together with a low lexical status of their HDNs. P2 and P4 are derived in the sense that they express a variety of syntactico-semantic functions such as reflexivity, inchoativity, and reciprocity as the intransitive counterparts of P1/5 and P3 respectively (e.g., P5 *he'elim* 'hide', P2 *ne'elam* 'disappear'; P3 *piter* 'fire', P4 *hitpater* 'resign'). The semantic specificity of P2 and P4 explains why they have just one AN pattern per *binyan* which expresses the exact semantics of the verb, e.g., P2 *he'almut* 'disappearance', P4 *hitpatrut* 'resigning'. Thus P2 and P4 ANs are extremely regular and transparent in meaning, adding nothing but 'the act of *V-ing*' to the

meaning of the corresponding verb, almost as automatic as part of the inflectional paradigms of P2 and P4 verbs. The result is extreme productivity - again inflection-like, with almost none of the lexical gaps that characterize the other *binyanim* - but with it, a loosening of the lexical independence of these ANs. The question 'does the AN *hitraglut* 'getting used to' from P4 *hitragel* 'get used to' exist?' has as much meaning as 'do the word *climbs, climbed, climbing* exist?' The answer is automatically yes, yet these words have no established lexical status. In other words, the more productive the morphological device, the lower the separate lexical existence of its products is. This is the reason for the low scores on P2 and P4 HDNs - speakers often 'escaped' to well-established though less regular forms when asked to provide P2 and P4 HDNs. Therefore, again, regular and irregular items in P2 do not differ by much, as the mirror-image of the P1 picture. Productivity and transparency do not necessarily ensure speakers' perception of a form as an established word worthy of being retrieved or assembled as a response on a task.

Why HDNs are acquired so late

The problem is why acquisition of HDNs is delayed to gradeschool age. One explanation is that they belong to the domain of derivational morphology, which is always acquired later than inflectional categories, due to its irregular, unpredictable and non-obligatory nature, as seen in the section above (Bybee, 1985). However, other derivational classes with restricted productivity such as agent and instrument noun and denominal verbs are acquired in Hebrew much earlier, and children are able to process them early on in both naturalistic and experimental conditions (Clark & Berman, 1984). Another factor is that HDNs in general, and ANs in particular, as the more regular and predictable cases, are an abstract, non-count category whose members have no tangible referents; they are therefore very different from the concrete, bounded objects that are the typical referents of items in young children's vocabularies (Dromi, 1987). Yet children as young as age 3 spontaneously produce forms with the abstract suffix *-ut*, e.g., *simxut* 'joy' for adult *simxa*, or *cmi'ut* 'thirst' for adult *cima'on*. Categorial ambiguity may be another delaying factor: HDNs are nouns that function as NP heads and modifiers in all syntactic positions (Berman, 1976; Hazout, 1995), but they designate entities that are typically denoted by verbs and propositions, such as facts, states, actions, and events (Asher, 1993). They also designate both verbal and nominal gerunds in Hebrew, straddling the

inflection/derivation boundary, especially in P2 and P4, as shown above. Indeed, the Tel Aviv University child language data-base indicates that HDNs occurring in the speech directed to young children and used by them are mostly noun-like with concrete denotations such as *a kiss* and *a hug*.

Our main account of why children do not reach 50% correct score in HDNs before age 11-12 relates to the problem of 'the prior network knowledge'. This refers to the fact that a great deal of prior knowledge is needed in order to master them, in the form off networks of pieces of interdependent information. The two main types of knowledge prerequisite to mastery of nominalization reflect the dual nature of HDNs: **t**ransitivity, a property of verbs, and compounding, restricted to nouns in Hebrew (Berman, 1988).

Transitivity. The systematic core of HDNs are canonical and secondary ANs, which correspond in form to *binyan* verb patterns and express the transitivity relations encoded in them (Berman, 1993). Before embarking on nominalization, children must organize their knowledge about the *binyan* system, a complex derivational apparatus which bootstraps and is bootstrapped by the argument structure of the verb. For example, root *k-t-b* appears in four *binyanim* to create basic P1 *katav* 'write', passive P2 *nixtav* 'be written', reciprocal P4 *hitkatev* 'correspond', and causative P5 *hixtiv* 'dictate', each verb entailing a distinct argument structure. Though children can find enough generalizations in the *binyan* system to coin innovative verbs, the semi-productive nature of this derivational system and its numerous contradictions and opacity mean that they do not master it fully before close to age 5. Specifically, children have to acquire two further types of knowledge about the internal organization in the *binyan* system. One is general: which *binyanim* are basic, which can serve for denominal formation, and which are derived and add meanings such as causativity or inchoativity to the meaning of the verb in the basic *binyan*. For example, consider root *š-t-l* 'plant' in basic P1 *šatal* 'plant', passive P2 *ništal* 'be planted', and new P5 *hištil* 'transplant'. Children have to learn about the general distribution of semantic roles in the *binyan* system in order to interpret and create new verbs. Yet the system is often inconsistent, since a single root almost never appears in all *binyanim* and the basic role may be taken on by (usually) derived *binyanim*, e.g. root *r-d-m* which only appears in P2 *nirdam* 'fall asleep' and P5 *hirdim* 'caused to sleep'.

Thus a crucial type of knowledge that children must have about the Hebrew verbal system is about the particular network relations formed among a set of verbs in different *binyanim* sharing the same root, e.g., the relationship between verbs of root *m-c-?* 'find': P1 *maca* 'find', *nimca* 'be found / present', P4 *hitmace* 'locate oneself', and P5 *himci* 'make up, provide'. In fact, since meanings of verbs are often unpredictable and idiosyncratic, Hebrew learners have to learn by rote a specific network for each and every verb set that shares a root, together with their given argument structure. For example, *hišta'el* 'cough', known early on to children for pragmatic reasons, appears only in P4. Moreover, verbs sharing the same root may have a slightly different meaning and syntax, often creating a vocabulary item from a higher, more literate register that is learnt later on, as in P1 basic *maxar* 'sell' and new inchoative P4 *hitmaker* 'become addicted'.

Our claim is that much of this vast knowledge of the verbal system needs to be there *before* children can begin to comprehend and produce correct HDNs. The meanings of specific verbs and verb networks serve as the semantic bedrock on which their ANs are founded and from which AN meaning can drift and lexicalize in action and deverbal nouns. Understanding general transitivity relations is an essential part of the acquisition of ANs, and is reflected in subjects' scores and strategies in the 5 *binyanim* of our study. ANs in the two basic *binyanim* P1 and P3 had the highest scores in both comprehension and production, while ANs in derived P4, P5, and P2, had the lowest. This ranking order also reflects subjects' sensitivity to transitivity values in the *binyan* system: while P1 and to a lesser extent P3 are neutral from the point of view of transitivity, P4, P5 and P2 are marked: P4 and P2 are intransitive, in many cases interchangeable in child language (e.g. P2 *nifrak* for P4 *hitparek* 'collapse'), whereas P5 is causative. Research has shown that knowledge of this verbal system does not consolidate in Hebrew-speaking children before age 4-5, and unconventional usage of verbs occur even in first graders (Berman, 1993).

Noun compounds. **C**hildren also need to know about what characterizes Hebrew nominals before they can embark on nominalization. Deverbal nominals inherit the argument structure of their underlying verbs and express them as modifiers in compounds whose heads are HDNs, e.g., *Dan bagad be-Rachel* 'Dan betrayed (in)-Rachel' / *bgidat Dan be-Rachel* 'betrayal Dan in-Rachel = Dan's betrayal of Rachel'; or *Dan paxad me-ha-kʾlev* 'Dan feared (from)-the-dog / *paxado š el Dan me-ha-kʾlev*

'Fear-his of Dan from-the-dog = Dan's fear of the dog' (Borer, 1988; Berman, 1988). Hebrew has three types of noun compounds with different thematic and semantic relations between heads and modifiers (Ravid & Shlesinger, 1995), and different types of HDNs have a differential distribution in these different compounds. For example, the nominalized form of verb *racax* 'murder' is the deverbal noun *rʿcax* 'murder' (*CʿCeC* pattern) in two of the possible compound forms (*rʿcax Rabin* 'Rabin's murder', *ha-rʿcax š el Rabin* 'The-murder of Rabin'), while the third takes the P1-based *recixa* (*recixat-o š el Rabin* 'his-murder of Rabin = Rabin's murder'. Such knowledge is crucial for the acquisition of nominalization, because it enables language users to take a more abstract perspective on events, states and ideas. While sentences refer differentially to propositional cores such as actions, states and properties and to typical nominal referents such as agents and instruments (e.g., *John invented the machine*), compounds with nominalized heads are NPs that refer to the whole proposition as a unified whole (*John's invention of the machine*) so that in its turn it can serve as an argument or adjunct in a sentence. This requires of the language user knowledge of both the underlying thematic relations of the verb with its arguments, but also an ability to reassign these relations to their proper nominal slots in the three types of Hebrew compounds, with the appropriate prepositions for each constructions. The reorganization of verbal thematic relations in such nominal subordinating structures constitutes another kind of network knowledge that is necessary for the development of discourse abilities, which go much beyond the structure of the simplex sentence (Berman & Slobin, 1994).

Nominalization, noun compounds and discourse. The inherent complexity of nominalizing constructions accounts, too, for the frequent occurrence of nominalized forms in high-register, especially written usage characterized by complex NPs (Ravid & Shlesinger, 1995). In an analysis of scientific texts in English, Halliday (1988) claims that 'the device of nominalizing, far from being an arbitrary or ritualistic feature, is an essential resource for constructing scientific discourse' (p.169) and has two discoursal effects: 1. packaging a complex phenomenon into a single semiotic entity, by making it one element of clause structure, so that 2. its rhetorical function - its place in the unfolding argument - is rendered fully explicit' (p. 168). Nominalization within compounds makes it possible to express a relationship between processes which can be backgrounded in the course of constructing an argument and

used in furthering the flow of information and in its packing and integration in the text (Biber, 1988; Chafe & Danielewicz, 1987). Thus it is not the case that the acquisition of HDNs is delayed primarily because children are not exposed to them early enough, but rather that nominalizations occur mostly in high-register, literate usage *because* of their function in the organization of textual information. The time it takes for knowledge of transitivity relations and compound structure to consolidate in integrated networks is responsible for the lag in the acquisition of HDNs. Nominalizing structures evidently first appear in the written language of Hebrew-speaking children around age 10.

The Route to Correct HDNs

Common, familiar, morphologically simplex words make up the core lexicon, are learnt early on by rote, and retrieved from the mental lexicon when necessary (Clark, 1993). Longer, morphologically complex words, are acquired later, during schoolage, mostly from the written language, to make up an expanded lexicon of literate, high-register, multimorphemic items. These words require a level of literacy, morphological knowledge, and linguistic awareness not found in the preschool child (Anglin, 1993). HDNs clearly belong to the latter category, since they are morphologically complex, they are verb-derived, they refer to abstract notions and are employed in literate discourse (Halliday, 1988). The route taken by Hebrew-speaking learners mastering nominalization in Hebrew involves several steps reflected in strategies used by the subjects in this study. In learning about HDNs, (1) knowledge about known, concrete referents precedes knowledge about abstract ones; (2) general abstract states are expressed morphologically before specific nominalization; (3) transitively neutral ANs are easier to process than transitively marked ones; (4) regular, productive patterns are easier to acquire than semi-productive, rote-learned structures; (5) creative innovations precede correct forms; and (6) plural HDNs are more 'real' than singular or non-count HDNs.

Pre-abstract phase: known and concrete before abstract. The cognitive burden involved in performing a morphological operation under experimental conditions may cause children to revert to well-known words as a way out (Ravid, 1995). The HDNs test subjects often responded by using familiar words, preferably with concrete referents. For example, when asked for the HDN from P1 source-verb *dag* 'fishes' (adult *דגyig* 'fishing') Amir [boy, 5;11] said *dagim* 'fishes' and Yakir [boy, 8;10] said

dayag ‘fisherman’. Instead of *mexonat rʿvax* ‘machine profit = profit machine’ from P5 source-verb *marvיבx* ‘earns’, Amir said *mexonat kʿsef* ‘money machine’. Mor [girl, 6;0] called a feeling of anger (adult *kבas*) *acavim* ‘nerves’, while both Gonen [boy, 6;2] and Idan [boy, 9;0] called a feeling of enjoyment (adult *hana’a) kef* ‘fun’. Amir referred to a machine that *xozʿret* ‘returns,Fm’, also ‘repeats’ simply as *tחki* ‘parrot’. These suppletive responses occurred almost exclusively in the two younger groups, especially when required to form morphologically deviant HDNs (although some adults, too, produced *mexonat nisuim* ‘marriage machine’ for *mexonat xatuna* ‘wedding machine’ from P4 source-verb *le-hitxaten*). Another facet of this early preference of the concrete is the 8’s tendency to select an agent noun form for an HDN, e.g., *šakranit* ‘liar,Fm’ for ‘lie’ [Yakir, 8;10], or *aclan* ‘lazy’ for *aclut* ‘laziness’ [Aviel, 8;8].

(2) Initial abstract expression: general abstract states before specific nominalization**.** Suppletion and agent noun response types account for only about 5% of the responses in the two younger age groups. Most subjects were aware of the need for an abstract response which is morphologically related to the source verb, but the younger children were far from being able to give an AN. Their solution was *-ut* suffixed nominals (e.g., *ke’evut* for adult *ke’ev* ‘pain’ [Eden, girl, 5;7]), accounting for close to 15% of all five-year-olds’ responses, and for around 6% in the two next groups. Linear suffixation with *-ut* is widespread in adult Hebrew and allows both nouns and adjectives as bases (e.g., *enoš-u*t ‘man-kind’ and *enošiy-ut* ‘humane-ness’. This strategy has both semantic and formal advantages for children as an initial step on the route to HDNs. Semantically, *-ut* is one of the truly transparent suffixes in Hebrew, a single form with a single meaning, catering to a well-known preference of children (Clark, 1993; Ravid, 1995). Moreover, *-ut* denotes non-specific abstractness, and thus has the advantage of generality over ANs which denote the name of an action and require specific verb-related knowledge of *binyan* meanings. Formally, *-ut* is a separate, linear suffix, easier to perceive and process than non-concatenative patterns (Clark & Berman, 1984). Unlike root+pattern stems, which must retain an internal formal similarity (cf. *havtaxa* ‘promise’, and *haklata* ‘recording’, P5-based *haCCaCa*), *-ut* is attached to a wide array of formally different stems in Hebrew, e.g., *adiv-ut* ‘polite-ness’, *kal-ut* ‘ease (easi-ness)’, and *nagar-ut* ‘carpentr-y’. The result is a situation defined in Berman (1994) as a state of *flux* - a torrent of (sometimes ill-

formed) stems, all with the suffix *-ut*, e.g., *havanut* for adult *havana* 'understanding' [Aviel, 8;8]; *dxifut* for adult *dxifa* 'push/ing' [Hadas, girl, 8;8]; and *sanut* for adult *sin'a* 'hatred' [Inbar, girl, 5;6].

Children's *-ut* suffixed forms in our study indicate a fair knowledge of the relevant morphology. They were most common in the 'sensations' test, where the input forms were the least verbal and in many cases denoted adjectival ideas (*to worry, to fear, to envy, to be angry...*) and thus indicate children's perception of *-ut* as a Hebrew deadjectival abstract suffix, e.g., *akšan-ut* 'stubborn-ness'. Preschoolers showed they knew that present-tense passive participles are commonly used as bases for *-ut* derivation (e.g., P3-related *mecuyan-ut* 'excellence'; P5-related *murkav-ut* 'complex-ity') by extending the rule to all present-tense participles, e.g., P5 *mevin-ut* 'understand-ing' (for *havana*), P2 *nivhal-ut* 'fright' (for *behala*) [Dor, 5;8]. Another type of base form given by the two youngest groups was patterned after the two *-ut* suffixed AN P2-based *hiCaCCut* and P4-based *hitCaCCut* where *-ut* is attached to a verbal base (future and modal base in P2 *hiCaCeC-ut*, past-tense base in P4 *hitCaCeC-ut*). Accordingly, children said *bilbel-ut* 'confused-ness', with past tense P3 as base for adult *bilbul* 'confusion'), [Hadas, girl, 8;8]; or *cam-ut* 'fast-ness', with P1 past tense as base for adult *com* 'fasting' [Shirit, girl, 11;3]; and *hifaxad-ut* 'getting-afraid-ness', with a future / modal P2 base for adult *pחxad* 'fear [Yotam, boy, 5;10]. A third type of strategy was overmarking *-ut* on a correct HDN (not unlike English children's *wented*), e.g., *ka'as-ut* 'anger-ness', cf. adult *kחas* 'anger', given by several children; or *inyan-ut* 'interest-ness' for adult *inyan* 'interest' [Inbar, girl, 5;6; Meytal, girl, 11;9] Finally, children found it especially easy to coin *-ut* suffixed forms when the last root radical was *t*, e.g., *xirut* and *hitxarut* (for adult *xarata* 'regret') and also ill-formed *mabut* (adult *mabat* 'look'), all of which are ambiguous between root-and-pattern forms and *-ut* suffixed stems [Micky, boy, 8;9; Yoni, boy, 8;4; Bat-El, girl, 8;3].

(3) Emergence of prototypical 'name of action': transitively neutral is easier to process than transitively marked**.** Emergent ANs make their appearance as early as in preschool, but they are a far call from the diverse forms that are found in older groups. A popular choice among the preschoolers was the P3-based *CiCuC,* which accounted for close to 15% of their responses[6], as well as for a steady 3-4% of all of the non-adult responses. For example, Dror [boy, 5;6] gave often ill-formed *CiCuC*-patterned

ANs in response to 14 out of the 20 source verbs in the 'machine' test (e.g., *rivuבx* 'profit', for adult *rʿvax*, or *hizurim* 'carefulness,Pl' for adult *zehirut* 'caution'. It is clear that children initially seek a single root-and-pattern form to embody the name for an action as distinct from general abstract state, and *CiCuC* best serves this purpose as the prototypical AN pattern over the other canonical AN patterns. First, it is based on P3, where virtually all new denominal formation takes place (Bolozky, 1978; Ravid, 1990). *CiCuC* is simple in form, with a canonical CVCVC syllabic structure, easily accommodating more than 3 root consonants as in *lixlux* 'dirt'. But most importantly, *CiCuC* is one of the two highest-ranking canonical patterns in our study with the advantage of neutralizing transitivity. The highest-ranking of them is P1-based *CCiCa,* however it has many rote-learnt, idiosyncratic forms (Ravid, 1990); whereas *CiCuC* denotes a transitively neutral action, in many cases serving as the AN for intransitive P4 (e.g. P4 *hit'ateš* 'sneeze' / P3 *ituš* 'sneeze') yet is very productive in adult Hebrew, sometimes even without a related verb (e.g., *šitur* 'policing'). Children find it easier to start processing the notion 'name of action' with *CiCuC* as a transparent, prototypical, morphologically and semantically neutral root-and-pattern form.

(4) Initial diversification: regular, productive patterns before semi-productive, rote-learned structures. The next step in the route to standard HDNs is the diversification from a single, prototypical *CiCuC* to the 5 canonical ANs *CCiCa, hiCaCCut, CiCuC, hitCaCCut* and *haCCaCa.* Preschoolers' responses were mainly in the form of *-ut, CiCuC* or 'don't know', whereas gradeschoolers' replies were more varied and included mostly regular (though often non-correct) ANs in all *binyanim*, e.g., canonical P1-based *xazira* 'return/ing' for adult P1- secondary *xazara*. Across age groups, subjects preferred these five regular, canonical patterns to the irregular ones as bearing the transparent, prototypical meaning of 'name of action in *binyan X*'. This tendency was especially manifest in the responses of the 11+ schoolage groups on the 'agent' test, e.g., canonical P5-based *habata* 'looking' for correct *mabat* 'look' [Esti, girl, 11;2]. That was because the younger subjects took refuge, as we saw above, in the infinitive response. In the 'sensations' test, with affective source verbs in a loose syntactic environment, it was the younger (11-) groups that produced significantly more canonical ANs, e.g., P4-based *hicta'arut* 'being sorry' for adult *cבar* [Yarden, girl, 8;9]. Age 11 emerges as the critical cut-off point where Hebrew

speakers are already to represent the notion of 'name of action' in five different canonical forms.

(5) Morphological expansion: creative innovations before correct forms**.** Once the five canonical AN patterns are established, further diversification occurs as less productive, minor patterns are brought into focus. Now, gradeschool children learn about the secondary AN patterns, e.g., P3-based *CaCaCa,* and about deverbal nominals which have no clear connection to source-verbs (e.g., *miCCaC, C'CeC, CiCaCon*). This new knowledge is expressed in the creative errors abounding in the responses of subjects aged 11 years and up. In sharp contrast to 8's reliance on infinitives, agent nouns, and canonical ANs, some eight-year-olds and most eleven-year-olds produce mainly correct responses, canonical ANs, and an array of other, innovative forms patterned after existing deverbal nominals. These included various allomorphs of the *C'CeC* pattern (e.g., *elc'* for adult *aclut* 'laziness', cf. *cev'* 'sadness' [Esti, girl, 11;2]; *dכham,* cf. *kב'as* 'anger' for *tadhema* 'amazement' [Micky, boy, 8;9;]; and *kבis* for *kב'as* 'anger', cf. *dבyig* 'fishing' [Bat El, girl, 8;3]), as well as other secondary patterns, e.g., *xizaron* for *xazara* 'return/ing', cf. *zikaron* 'memory' [Oshrit, girl, 11;6]; and *hexlef* for *haxlafa* 'changing', cf. *hesber* 'explanation' [Shlomi, boy, 15;1]. These errors attest to a knowledge of both major and minor HDN structures. In a broader perspective, they demonstrate how knowledge of a morphologically complex system consolidates by establishing links between clusters of words sharing minor patterns (Nakissa et al., 1997).

Lexical anchor: plural vs. singular HDNs. Both singular and plural correct responses were counted as 'correct', e.g., *misxak / misxakim* 'game/s'. True, 'pure' ANs, with the meaning 'the act of *V-ing*', e.g., *srita* 'the act of scratching' or *sipur* 'the act of telling a story' are non-count (Berman, 1976); but they easily lexicalize as count nouns with distinctive, often concrete denotations, e.g., *srita / sritot* 'scratch/es', *sipur / sipurim* 'story/s. When gradeschoolers produced correct and canonical AN responses, these were in some cases in the plural, e.g., correct *dxifot* 'pushes' and non-correct *harvaxot* 'making profits, Pl', for correct *r'vax* 'profit' [Yoni, boy, 8;4]. This strategy was used almost exclusively by eight- and eleven-year-olds, mainly in the obligatory 'machine' test context. For example, Yoni [boy, 8;4] produced 17 mostly correct HDNs in the 'machine' test, out of which 9 were in plural form, 19 HDNs in the 'agent' test, 9 of them plural, and 17 HDNs in the 'sensations' test, 3 of them

plural. Plural HDNs express Hebrew speakers' developing construal of the dual nature of deverbal nominals: as nouns, and so inflected for plural, that are specially linked to verbs. Plurality also serves as a bridge towards a full understanding of the nature of derived nominals as younger children find it easy to latch onto the notion of 'derived nominal' via its concrete or discrete meaning.

Actual and Potential HDNs: Adult knowledge. Finally, the question arises why adults failed to reach 100% success in the production tests. This is due to the interaction of two factors: the test situation and the differential status of the test responses as actual and potential words. Production of an HDN under experimental circumstances can occur in one of two ways: retrieval and combination. In the first case, the subject retrieves an existing form in response to the input item, which is possible only when the required item is firmly lexicalized. The nominals in the 'sensations' test (where subjects 11 years and up have high scores) are a good example of rote-learned items. They are names of feelings and cognitive states, many of them irregular in form. They are well-known to adults and useful in describing primary states of mind. Most of the items in the other tests are not so strongly lexicalized, and this is where the older groups produced regularized non-correct forms, e.g., *hizaharut* 'being careful' for *zehirut* 'carefulness'; *xitun* 'marrying' for *xatuna* 'wedding'; *berux* 'the act of blessing' for *braxa* 'blessing'; and *hitxanenut* 'the act of begging' for *txina* or *taxanunim* 'begging'.

We interpret this behavior as deriving from the test situation, one which directly addresses the morphological system by presenting a subject with a source verb with certain properties and requiring the corresponding verb-derived nominal. Since HDNs are in many cases construed as part of the verb paradigm, combinatorial rules are applied in answer to the demand for 'an act of *V-ing*', and thus may override retrieval of an actual word and create a canonical AN. The *binyan* in question also plays a role in the selection of the appropriate strategy, as discussed above. ANs with P1 source verbs and in the two transitive *binyanim* (P3, P5) are usually established lexical items, with a strong lexicalized status. However, intransitive P2-based *hiCaCCut* and P4-based *hitCaCCut* are in many cases not so well-established, yet they are very easy to coin, since their meaning is transparent and there is less likelihood of idiosyncratic lexicalization. For example, the authors could not reach agreement whether *hitraglut* 'getting used to' and *hit'amcut* 'making an effort' are actual words

in Hebrew. It was in these two *binyan* patterns that older subjects erred in the direction of combination rather than retrieval, producing regularized canonical ANs for correct rote-learned forms, e.g., P4 *hitxartut* for *xarata* ‘regret’, P2 *he’anxut* for *anaxa* ‘sigh’.

Conclusion

A young language learner involved in the acquisition of general, often obligatory systems such as syntactic and inflectional categories first concentrates on local systems which do not require much prior knowledge, and only later on moves on to merge them into larger multi-faceted configurations such as the HDN system at issue here: a category of abstract verb-related nouns which requires a vast amount of complex prior grammatical and lexical knowledge. It thus takes far into middle childhood before HDNs are acquired and start appearing in their appropriate discourse contexts.

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Table 1. The 5 canonical Action Nominal Patterns

Binyan	Source verb	Action Nominal
P1 *Qal*	*gadal* 'grow, Intr'	*gdila* 'growing / th'
	katav 'write'	*ktiva* 'writing, script'
P2 *Nif'al*	*nixtav* 'be written'	*hikatvut* 'being written'
P3 *Pi'el*	*gidel* 'raise'	*gidul* 'raising, growth'
P4 *Hitpa'el*	*hitkatev* 'correspond'	*hitkatvut* 'correspondence'
P5 *Hif'il*	*higdil* 'enlarge'	*hagdala* 'enlarging / ment'
	hixtiv 'dictate'	*haxtava* 'dictation'

Table 2. The five nonpassive *binyanim* with canonical and secondary action nominal patterns.

Binyan	Canonical action nominal	Secondary action nominals
P1 *Qal*	*ktiva* 'writing, script'	*braxa* 'blessing'
		gneva 'theft'
		sin'a 'hatred'
		tfusa 'occupancy'
P2 *Nif'al*	*hikatvut* 'being written'	
P3 *Pi'el*	*kivun* 'direction'	*kavana* 'intention'
P4 *Hitpa'el*	*hitkatvut* 'correspondence'	
P5 *Hif'il*	*haskama* 'agreeing'	*heskem* 'agreement, pact'

Table 3 Mean percentages and standard deviations of subjects' responses on the comprehension test, by age group and *binyan*

Age group	*Binyan*>	P1	P2	P3	P4	P5
5s	Mean	93.33	8.33	53.33	63.33	46.67
	SD	13.68	14.81	29.42	30.40	46.67
8s	Mean	78.33	18.33	76.67	35.00	38.33
	SD	29.17	22.88	32.62	31.48	22.36
11s	Mean	58.33	26.67	73.33	31.67	41.67
	SD	38.91	27.78	23.20	25.31	26.21
15s	Mean	91.67	88.33	75.00	60.00	80.00
	SD	14.81	27.09	26.21	31.72	19.94
Adults	Mean	96.67	91.67	68.33	76.67	88.33
	SD	10.26	21.29	20.16	24.42	19.57
Total	Mean	83.67	46.67	69.33	53.33	59.00
	SD	27.67	42.64	27.50	33.17	29.91

Table 4 Mean percentages and standard deviations of subjects' responses on the regular vs. irregular items of the comprehension test, by age group

Age group		Regular Items	Irregular Items
5s	Mean	59.00	50.00
	SD	15.18	9.73
8s	Mean	63.00	42.50
	SD	25.36	19.43
11s	Mean	63.00	38.00
	SD	27.74	19.36
15s	Mean	75.00	81.00
	SD	18.21	16.82
Adults	Mean	80.00	86.50
	SD	12.98	16.63
Total	Mean	68.00	59.60
	SD	21.84	26.09

Table 5 Mean percentages and standard deviations of subjects' responses on the comprehension and production tests, by age group

Age group		Comprehension	Production
5s	Mean	53.00	22.50
	SD	8.51	12.18
8s	Mean	49.33	28.25
	SD	19.87	12.18
11s	Mean	46.33	49.92
	SD	19.28	10.52
15s	Mean	79.00	67.83
	SD	14.55	13.30
Adults	Mean	84.33	76.17
	SD	10.87	6.51
Total	Mean	62.40	48.93
	SD	21.95	23.88

Table 6 Mean percentages and standard deviations of subjects' responses on the 3 production tests, by age group

Age group	Test Type	'Machine' Test [obligatory]	'Agent' Test [free]	'Sensations' Test [loose]
5s	Means	26.00	20.25	21.25
	SD	13.24	15.35	14.50
8s	Means	35.75	19.50	29.50
	SD	15.67	17.39	17.01
11s	Means	44.75	43.75	61.25
	SD	13.62	14.77	10.50
15s	Means	58.25	63.50	81.75
	SD	19.35	13.09	15.15
Adults	Means	64.50	68.25	95.75
	SD	10.75	11.39	3.73
Total	Means	45.85	43.05	57.90
	SD	20.30	25.16	31.70

Table 7 Mean percentages and standard deviations of subjects' responses on the 5 *binyanim*, all production tests, by age group

Age group	*Binyan*>	P1	P2	P3	P4	P5
5s	Means	30.42	12.50	29.58	22.08	17.92
	SD	20.64	11.31	14.17	8.23	18.59
8s	Means	44.58	16.25	35.42	19.58	25.42
	SD	20.99	15.88	16.86	9.08	15.88
11s	Means	72.08	34.17	56.25	42.92	44.17
	SD	15.36	14.02	16.86	14.63	15.08
15s	Means	84.17	54.58	69.58	66.67	64.17
	SD	11.75	17.41	17.58	22.13	12.12
Adults	Means	89.58	64.17	86.67	74.58	65.83
	SD	11.75	11.18	8.72	12.23	10.78
Total	Means	64.17	36.33	55.50	45.17	43.50
	SD	27.89	24.78	25.93	26.49	24.38

Table 8 Mean percentages and standard deviations of subjects' responses on the 5 *binyanim*, by production test

Binyan	Test Type	'Machine' Test [obligatory]	'Agent' Test [free]	'Sensations' Test [loose]
P1	Means	57.50	59.00	76.00
	SD	28.70	34.73	33.51
P2	Means	27.50	34.50	47.00
	SD	24.75	28.16	39.77
P3	Means	62.25	51.50	52.75
	SD	28.09	32.14	30.13
P4	Means	43.50	42.50	49.50
	SD	24.52	31.08	40.36
P5	Means	38.50	27.75	64.25
	SD	28.30	22.72	33.94
Total	Means	45.85	43.05	57.90
	SD	20.30	25.16	31.70

Table 9 Mean percentages and standard deviations of subjects' responses on the regular vs. irregular items of the 3 production tests, by age group

Test type >>>>		'Machine' Test [obligatory]		'Agent' Test [free]		'Sensations' Test [loose]	
Age group	Regularity>	Regular Items	Irregular Items	Regular Items	Irregular Items	Regular Items	Irregular Items
5s	Means	44.00	20.00	38.00	14.33	34.00	17.00
	SD	23.93	16.19	23.31	14.39	21.62	14.90
8s	Means	56.00	29.00	31.00	15.67	39.00	26.33
	SD	24.79	15.34	28.64	15.49	25.55	16.96
11s	Means	69.00	36.67	72.00	34.33	69.00	58.67
	SD	21.00	15.22	23.75	16.51	27.13	9.82
15s	Means	76.00	52.33	93.00	53.67	93.00	78.00
	SD	25.63	22.82	11.74	17.23	13.42	17.18
Adults	Means	92.00	55.33	96.00	59.00	99.00	94.67
	SD	11.97	12.26	8.21	16.51	4.47	4.64
Total	Means	67.40	38.67	66.00	35.40	66.80	54.93
	SD	27.22	21.27	33.93	24.41	33.42	32.59

Table 10. Mean percentages of incorrect response categories

	Response Type					
Age group	Suppletion	Agent Nouns	Infinitives	*-ut* suffix	Cross-matched *CiCuC*	Canonical AN
5s	3.92	3.25	10.25	13.58	14.92	18.00
8s	4.42	5.25	14.08	6.92	3.41	15.50
11s	0.75	1.66	3.25	4.83	4.00	20.00
15s	0.33	0.08	0.17	1.17	3.00	15.83
Adults	0.83		0.17	0.50	1.33	15.42

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Appendix: The Derived Nominals Test

I The comprehension test

Training items

1. Isn't it true that a person who is occupied in exercise (Hebrew P4 *hit'amlut*) exercises (P4 *mit'amel*) ?
2. And isn't it true that a person who is occupied in writing (Hebrew P1 *ktiva*) writes (*kotev*)?

Test items (regular AN - canonical pattern; secondary - secondary AN pattern; cross-*binyan* - cross-matched pattern; devN - deverbal nominal outside the *binyan* system)

Now tell me, what does a person do who is occupied in...

Input HDN		Gloss	Regularity	Target verb		Gloss
isuf	P3	collecting	cross-*binyan*	*osef*	P1	collects
haxlafa	P5	exchanging / exchange	regular AN	*maxlif*	P5	exchanges
ituš	P3	sneezing / sneeze	cross-*binyan*	*mit'atešš*	P4	sneezes
hidaxafut	P2	pushing oneself forward	regular AN	*nidxaf*	P2	push oneself
heskem	P5	agreement	secondary	*maskim*	P5	agrees
ipur	P3	making up / make up	cross-*binyan*	*mit'aper*	P4	makes up
kni'a	P1	surrendering / surrender	cross-*binyan*	*nixna*	P2	surrenders
xaluka		distributing / distribution	devN	*mexalek*	P3	distributes
yerida	P1	going down / descent	regular AN	*yored*	P1	goes down
tisporet		haircut	devN	*mistaper*	P4	gets a haircut
kvisa	P1	washing	cross-*binyan*	*mexabes*	P3	washes
kišalon		failure	devN	*nixšal*	P2	fails
cxok		laughter	devN	*coxek*	P1	laughs
hitpocecut	P4	exploding / explosion	regular AN	*mitpocec*	P4	explodes
te'ura		lighting	devN	*me'ir*	P5	lights

II The production tests

1. The 'Machine' test (all test items in feminine gender)

Training items

1. What would you call a machine that closes (Hebrew *sogʿret*) things? Closing machine (*mexonat sgira*), right?

2. And what would you call a machine that strolls (Hebrew *metayʿlet*)? Strolling machine (*mexonat tiyul*), right?

Test items (regular AN - canonical pattern; secondary - secondary AN pattern; cross-*binyan* - cross-matched pattern; devN - deverbal nominal outside the *binyan* system)

Now tell me, what would you call the following machines: A machine that *Vs* all the time? *mexonat-....* (*V-ing* machine).

Input verb		Gloss	Target HDN		Gloss	Regularity
mitnagʿš et	P4	crashes	*hitnagš ut*	P4	crahing / crash	regular AN
doxʿfet	P1	pushes	*dxifa*	P1	pushing / push	regular AN
marvixa	P5	gains	*rʿvax*		gaining / profit	devN
dגga	P1	fishes	*dגyig*		fishing	devN
ni	P2	leans	*hi□ a'anut*	P2	leaning	regular AN
mexabʿret	P3	joins	*xibur*	P3	joining	regular AN
nizhʿret	P2	is careful	*zehirut*		carefulness	devN
mekalʿlet	P3	curses	*klala*	P1	cursing / curse	cross-*binyan*
me'ifa	P5	makes fly	*te'ufa*		flight	devN
rokʿdet	P1	dances	*rikud*	P3	dancing	cross-*binyan*
nirdʿmet	P2	falls asleep	*tardema*		sleeping	devN
me	P3	lies			lying / lie	devN
maxlifa	P5	changes	*haxlafa*	P5	changing	regular AN
mi	P4	coughs	*□ i'ul*	P3	coughing / cough	cross-*binyan*
mafsida	P5	loses	*hefsed*	P5	losing	secondary
mitxatʿnet	P4	gets married	*xatuna*		wedding	devN
xozʿret	P1	returns, Int	*xazara*	P1	returning, Int.	secondary
nixnʿset	P2	enters	*knisa*	P1	entering / entrance	cross-*binyan*
mesaxʿket	P3	plays	*misxak*		playing / game	devN

mitxapʿset	P4	dresses up	*taxpʿset*	costume	devN

2. The 'Agent' test

Training items

1. A person who talks (Hebrew *medaber*) is occupied in talking (*dibur*), right?
2. And a person who exercises (Hebrew *mit'amel*) is occupied in exercising (*hit'amlut*), right?

Test items (regular AN - canonical pattern; secondary - secondary AN pattern; cross-*binyan* - cross-matched pattern; devN - deverbal nominal outside the *binyan* system)

Now tell me, what what are these people occupied in: A person who *Vs* all the time is occupied in...(*V-ing*)

Input verb		Gloss	Target HDN		Gloss	Regularity
mevarex	P3	blesses	*braxa*	P1	blessing	cross-*binyan*
malšin	P5	tattles	*halšana*	P5	tattling	regular AN
mešalem	P3	pays	*tašlum*		payment / paying	devN
nilxam	P2	fights	*lexima*	P1	fighting	cross-*binyan*
			milxama		war	devN
cam	P1	fasts	*com*		fasting	devN
xolem	P1	dreams	*xalom*		dreaming / dream	devN
mit'arev	P4	interferes	*hit'arvut*	P4	interference	regular AN
masbir	P5	explains	*hesber*	P5	explaining / ation	secondary
mecalem	P3	photographs	*cilum*	P3	photograph / ing / y	regular AN
ozer	P1	helps	*ezra*	P1	helping / help	secondary
mabit	P5	looks	*mabat*		look	devN
mit'amen	P4	trains, Int	*imun*	P3	training, Int	cross-*binyan*
ne'elam	P2	disappears	*he'almut*	P2	disappearance	regular AN
mevakeš	P3	asks	*bakaša*	P3	asking / request	secondary
borʿax	P1	escapes	*brixa*	P1	escaping / escape	regular AN
nivxar	P2	is (s)elected	*bxira*	P1	(s)electing	cross-*binyan*
meš iv	P5	replies	*tš uva*		reply	devN
mitxanen	P4	begs	*txina / taxanunim*		begging	devN
ne'enax	P2	sighs	*anaxa*	P1	sigh	cross-*binyan*

mitpalel P4 prays *tfila* praying / prayer devN

3. The 'Sensations' test

Training items

1. A person who is excited (Hebrew *mitrageš*) has a feeling of excitement (*hitragšut*), right?

2. And a person who feels like something (desires - Hebrew *mitxašek*) has a feeling of desire (*xšek*), right?

Test items (regular AN - canonical pattern; secondary - secondary AN pattern; cross-*binyan* - cross-matched pattern; devN - deverbal nominal outside the *binyan* system)

Now tell me about the feelings of the following people: A person who *Vs* all the time has a feeling of ... (*Ving*).

Input verb		Gloss	Target HDN		Gloss	Regularity
do'eg	P1	worries	*de'aga*	P1	worry/ing	secondary
mitbayeš	P4	is ashamed	*buša*		shame	devN
me'anyen (oto)	P3	interests,Tr	*inyan*		interest	devN
margizim (oto)	P5	annoy,Pl him	*rגez*		annoyance	devN
navox	P2	is embarrassed	*mevuxa*		embarrasment	devN
me□ ag'im (oto)		drive,Pl him crazy	*□ iga'on*		madness	devN
mevin	P5	understands	*havana*		understanding	regular AN
ko'ev lo	P1	hurts to-him	*ke'ev*		pain	devN
nehene	P2	enjoys	*hana'a*	P1	enjoyment	cross-*binyan*
mit'acel	P4	is being lazy	*aclut / aclanut*		laziness	devN
sone	P1	hates	*sin'a*		hatred	secondary
mitxaret	P4	regrets	*xarata*	P1	regret	cross-*binyan*
mevalbelim (oto)	P3	confuse,Pl him	*bilbul*	P3	confusion	regular AN
ma'amin	P5	believes	*emuna*		belief	devN
mekane	P3	envies	*kin'a*	P1	envy, jealousy	cross-*binyan*
nidham	P2	is amazed	*tadhema*		amazement	devN
mafxidim (oto)	P5	frighten,Pl him	*pאxad*		fear	devN
micta'er	P4	is sorry	*cב'ar*		grief	devN
nivhal	P2	is frightened	*behala*	P3	fright	cross-*binyan*

ko'es	P1	is angry	*כע'as*	anger	devN

Notes

[1] The two passive *binyanim* - *Pu'al* and *Huf'al* - form their abstract nominals by attaching the abstract suffix *-ut* to the present tense (*benoni*) form, e.g., *murkav-ut* 'complex-ity' (*Huf'al*).

[2] *Nif'al* (P2) is not considered a passive *binyan* for a number of reasons. One is that many of its verbs express middle transitivity, incohativity and ingressiveness rather than passive voice, e.g., *nirdam* 'fall asleep', *niftar* 'die, get rid of', *ne'elam* 'disappear'. Unlike the truly passive *binyanim*, P2 verbs do not automatically correspond to P1 active verbs; it has an imperative inflection, unlike the passive *binyanim*; and a pattern-based action nominal, like the active *binyanim*, rather than a present-tense suffixed form (see above).

[3] Word-form undergoes changes as a result of underlying irregular root with a glottal stop *ʔ-b-k* `struggle'.

[4] Since the subject has to produce a form, this is not what is usually meant by a comprehension test, but the production of a verb is much easier than the production of an HDN, and the selection of a correct verb occurring in early child speech shows an understanding of the meaning of the HDN.

[5] The form *hargaša šel le-havin* 'a feeling of to-understand' for correct *hargaša šel havana* 'a feeling of understanding' is marginally acceptable, though not grammatical. An infinitive is not as totally impossible in that context as in the 'machine' test.

[6] Note that we counted only nonconventional *CiCuC* forms, rather than all *CiCuC* responses, because each production test required at least one or two correct *CiCuC* *forms, e.g., mexabʼret* ‘joins,Tr,Fm’ (P3) / *xibur* ‘joining’ (the ‘machine’ test).