The First Vocabulary of Transitive Verbs in Hebrew is Apparently Learned from Single-Word Parental Utterances with Null Objects

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**Abstract**

Children acquiring different languages have a large repertoire of verbs before they start combining words. This raises the possibility that they learn their early verbs from single-word rather than from multiword utterances in the input. This hypothesis was tested on the first verbs produced by a sample of young Hebrew-speaking children, the distribution of which was predicted by the relative token frequency of an unrelated corpus of mother’s verb-containing utterances, comparing single-word and multiword utterances. The focus was on transitive verbs that had different relative frequency distributions in single-word and multiword utterances, allowing for distinct predictions in the two cases. The frequency of single-word utterances in the input corpus was found to predict the acquisition of verbs by the children far better than frequency of multiword utterances. The results were replicated on a different sample of young children, using token frequency of their single-word utterances as the measure of acquisition. Early verbs appear to be acquired for particular pragmatic tasks, for which single-word utterances provide the functional input. Similarly to child Mandarin and Korean, in which verbs are also produced very early, availability of single-word input for transitive verbs in Hebrew makes early acquisition possible, with unexpressed null objects paving the way to pre-syntactic learning.

**Introduction**

The chapter deals with the question of how Hebrew-speaking children acquire their earliest verb vocabulary. The answer points to parents’ single-word verbs as possible input to this learning, involving phenomena such as subject pro-drop and object argument ellipsis. Hebrew is a partially pro-drop language, which also allows some object elision (Berman, 1980; Glinert, 1989). Such phenomena in the input are usually considered complicating factors for the learning process, since children are not presented with explicit information on the syntactic and semantic arguments of verbs ([Imai *et al*., 2008](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3043374/#R39)). Even if, as is assumed here, bare-verb single-word utterances are in fact helpful for verb-learning, the way children deal with argument elision needs to constitute a crucial component of the learning model.

There is a relatively rich literature dealing with Hebrew-speaking children’s acquisition of a verb vocabulary in the early stages of development. These include monographs, dissertations, and articles such as Armon-Lotem and Berman (2003), Berman (1978), Dromi and Gathercole (2008), and Uziel-Karl and Berman (2000). These studies provide important information about the kind of verbs Hebrew-speaking children learn at the start of acquisition and the processes of acquisition that may operate in this particular speech community. Some studies mention argument ellipsis as a phenomenon involved in the acquisition of a verb vocabulary, yet the question of how children manage to learn verbs at an early stage of development has not yet been answered. The present chapter attempts to contribute to solving this problem.

Children learning analytic languages such as Mandarin and Korean are known to use verbs early on, even among the very first words in their productive vocabularies (Gopnik & Choi, 1990; Tardif et al., 2008). In these languages, verbs are acquired much earlier than syntax. For example, in the Mandarin-speaking sample of the study by Tardif et al*,* of children who were reported to produce overall only 10 words or less, even among these beginning speakers, whose total vocabulary is between 7 and 10 words in all, there was an above 50% probability that a child would produce one or more verbs. The verbs with the highest occurrence were those glossed as *hit*, *grab* (or *grasp*) and *hug* (or *hold*), all three transitive verbs. Similar results were obtained for Cantonese-speaking children.

This early learning may be possible because these languages freely omit the subjects and objects of verbs when they are the already-established topics of the conversation, recoverable from the interactive situation (Huang, 1984). In addition to Chinese languages, Japanese, Korean and Thai are also known to exhibit maximal freedom in use of zero pronouns.

The free application of subject- and object-drop in a language not only establishes a pragmatic language norm to which children may be sensitive, it could also result in a high frequency of bare, complement-less verbs in parental input language. Either or both of these factors might facilitate children’s acquisition of verbs at an early stage of language development in such languages.

Children acquiring Hebrew as their first language are also known to produce verbs in the single-word stage, typically several months before they begin to combine words syntactically. For example, according to Armon-Lotem and Berman (2003):

Our analysis, so far, shows that children have a large repertoire of verbs even before they start combining words, and that these represent a range of predicate types: syntactically, both transitive and intransitive, and semantically, verbs which express activities, events, and even states. [...] A developmental implication is that these children have a lexical basis for moving into the syntax of clauses with different types of argument structure (pp. 857-863).

In view of the developmental timetable of vocabulary acquisition, it is unlikely that at this stage, the learning of the verbs as vocabulary items will already have been mediated by analysis of the syntax of multiword utterances. In fact, breaking into syntax may depend on children’s prior learning of a sizeable group of verbs (Caselli, Casadio, & Bates, 1999). Acquiring a “critical mass” of verbs appears to be a pre-condition for the start of the processes that consolidate children’s basic concepts, categories, and rules of syntax.

The conclusion is that there has to be a way for children to learn a verb’s argument structure from parental input which does not require syntactic interpretation. The best exemplars may be parents’ single-word utterances that consist of verbs. This analysis raises the possibility that children learn their early verbs from single-word rather than from multiword utterances in parental input. Prior studies have suggested that children learn their early nouns from parental single-word utterances (Brent & Siskind, 2001; Lew-Williams, Pelucchi, & Saffran, 2011). If the same applies in the case of verbs, this could explain why verbs appear so early in child speech in languages where there is object pro-drop like in Chinese and Korean: Adult input in such languages tends to contain single-word utterances consisting of verbs, more than in such non-pro-drop languages as English or Dutch.

Although free subject- and object pro-drop is particularly characteristic of analytic languages such as the East Asian languages mentioned above, it is also observed in morphologically rich languages including Hindi, Chamorro, Imbabura Quechua, and Brazilian Portuguese, so that the phenomenon cannot be considered restricted to the East Asian isolating group. In some of these languages, adult speech to children has been specifically documented to contain verbs with dropped arguments, as shown by studies exploring input in Japanese (Rispoli, 1995) or Hindi (Narasinham, Budwig, & Murty, 2005). Moreover, children acquiring such languages have been shown to be responsive to the pragmatic conditions under which omitted arguments are contextually retrievable topics; and they tend in their own speech output to omit arguments when their referents have been previously mentioned in the discourse. Such findings were demonstrated for Inuktitut, giving rise to the suggestion that young children learning verbs in this language can infer the existence of missing verbal arguments in input speech from the discourse context of an utterance (Allen, 2000, 2008).

Languages allowing such elliptical expressions for transitive verbs, although in a rather limited way, also include both English and Hebrew. English generally requires all arguments to be overtly expressed, unless lexically specified for object omission (Dixon, 2005; Fillmore, 1986; Goldberg, 2000, 2004; Huddleston & Pullum 2002; Liu, 2008; Quirk et al., 1985). There are also a few specific verbs that can omit the object argument when the pragmatic context clearly indicates what is the already-established topic. Hebrew allows object-dropping under somewhat restricted conditions, along lines that are more similar to English than to the free object-dropping languages like Mandarin (Doron, 1999; Goldberg, 2002; Uziel-Karl & Berman, 2000). Yet Hebrew parental speech does, nonetheless, include bare verbs that omit both subjects and objects (Ninio, 1992). Against this background, the present study tests the hypothesis that Hebrew-speaking children learn their initial verb vocabulary from parental verbs in single-word utterances, not from parental “sentences”.

Given that parent input in Hebrew contains single-word utterances consisting of bare verbs, including some declarative sentences, it is assumed here that, as in Mandarin and Korean, these are elliptical expressions that omit the verb’s arguments because the latter are “zero-topics” recoverable from the interactive situation. Such single-word verbs may serve as the functional input to learning of an initial verb vocabulary in young children, since adults typically produce such utterances in contexts they can be sure suffice to provide all the information necessary for identifying the meaning of the verbs in question, including their semantic argument structure.

The hypothesis underlying this study is thus that young children learn verbs from parents’ single-word input, rather than from multiword sentence-like utterances. An attempt is made to predict children’s early verbs by the relative token frequency of maternal utterances containing verbs, comparing those that are single-word versus multi-word in form. A dyadic sample of mothers and young children in interaction provided the estimate for the parental input. The focus is on transitive verbs that have different relative frequency distributions in single-word verbs and multi-word utterances, allowing for differential predictions for the two contexts. Below, the hypothesis is tested on two different sets of child data. The first set is taken from a study in which children’s first-learned verbs are documented. We use the number of children producing particular items as their first 20 verbs as the measure of acquisition of these verbs. The second set uses the children of the dyadic sample from where maternal verbs are taken. As we do not have well-documented information which are the very first verbs of these children, we are using the relative frequency of their single-word utterances consisting of various verbs as the measure of acquisition of these verbs. The logic of this measure is that early-acquired verbs would occur with higher frequency in children’s single-word speech than later-acquired verbs. This is a weaker measure of early acquisition of specific verbs than the direct estimate of number of children based on the first set of data.

**Study 1**

*Population*

Forty eight Hebrew-speaking mothers were observed in dyadic interaction with their infants, ranging in age from 0;10 to 2;8. Half of these dyads were recorded six times at two-month intervals (the longitudinal sample), and the other 24 (the cross-sectional sample) were met with only once each. The mothers of the cross-sectional sample had above high school education, while half of the mothers of the longitudinal sample were middle-class and half were of lower-to-middle-class background. The gender of the infants was counterbalanced in each subsample. All children were of normal health, from intact homes, and those of the longitudinal sample were all first born. The mothers participating in the cross-sectional sample were volunteers, acquaintances of the researcher, whereas those in the longitudinal sample were randomly selected from Jerusalem birth records and recruited through letters and home visits. The longitudinal sample participants were paid a fee for their participation.

*Procedure*

The mother-infant dyads were videotaped in their homes in free interaction sessions lasting 30-minutes. Mothers were asked to behave as they usually do at that time of the day, but to remain, as much as was possible, in the same room with the child. They were told that we wished to obtain a naturalistic sample of infants' interaction with their mothers, but they were not informed until the end of the study that either or both maternal or child language was the focus of analysis. The data-base yielded a total of 83 hours of observations, containing about 88,000 parental utterances.

*Data analysis*

All maternal sentences containing a verb were divided into single-word versus multiword utterances. Verbs were classified by their consonantal root and verb-pattern (*binyan*) value into groups of verb-lexemes. Hebrew-appropriate lemmatization was performed by grouping related forms of verbs (or items in other word classes) that share the same consonantal root and the same *binyan* verb-pattern conjugation, and differ only in inflection (for number, gender, tense, and/or person). All verbs in the data-base were lemmatized and divided into their respective lexeme groups for frequency analysis, focusing on transitive verbs. In case of multivalent verbs, the context of use was examined to determine whether the transitive or intransitive usage was the relevant one.

For each transitive verb lexeme, the token frequency of utterances using that verb in single-word or multi-word utterances was tabulated. Mothers produced about 1,500 single-word utterances and about 30,500 multi-word utterances containing transitive verbs. Table 1 presents the 20 most frequent verbs in maternal single-word utterances, and Table 2 presents the 20 most frequent verbs in maternal multiword sentences. In Table 1 and the tables following, as well as in throughout the text, verb lexemes are represented in the morphologically simplex form of 3rd person masculine past tense, irrespective of the form in which they occurred in the data-base, and provided with an English gloss, with verb plus particle equivalents of Hebrew monolexemic verbs indicated by hyphens (e.g., *yaca* 'go-out', *hixnis* 'put-in') and where the English gloss is ambiguous, transitive verbs are specified as "Trans."

Table 1. The 20 most frequent transitive verbs in maternal single-word utterances by token frequency

|  |  |  |  |
| --- | --- | --- | --- |
| Shoresh and binyan | Hebrew verb | English gloss | Frequency of maternal single word utterances with verb |
| LQX1 | laqax | take | 556 |
| RAH1 | raa | see | 300 |
| EYM1 | sam | put | 119 |
| GMR1 | gamar | finish | 69 |
| NSH3 | nisa | try | 49 |
| BVA6 | hevi | bring | 46 |
| RCH1 | raca | want | 43 |
| PTX1 | patax | open | 38 |
| YCA6 | hoci | take\_out | 35 |
| XPE3 | xipes | search | 34 |
| UEH1 | asa | do | 33 |
| TPS1 | tafas | catch | 31 |
| SGR1 | sagar | close | 29 |
| XZQ6 | hexziq | hold | 28 |
| CYR3 | ciyer | draw | 26 |
| RVM6 | herim | lift | 26 |
| EXQ3 | sixeq | play | 25 |
| ETH1 | shata | drink | 25 |
| SDR3 | sider | arrange | 23 |
| SPR3 | siper | tell | 23 |

Table 2. The 20 most frequent verbs in maternal multiword sentences by token frequency

|  |  |  |  |
| --- | --- | --- | --- |
| Shoresh  and binyan | Hebrew verb | English gloss | Frequency of maternal multiword utterances with verb |
| RCH1 | raca | want | 5186 |
| UEH1 | asa | do | 4306 |
| EYM1 | sam | put | 3898 |
| RAH1 | raa | see | 3286 |
| BVA6 | hevi | bring | 2093 |
| NTN1 | natan | give | 1644 |
| LQX1 | laqax | take | 1408 |
| EXQ3 | sixeq | play | 946 |
| SPR3 | siper | tell | 945 |
| YDU1 | yada | know | 942 |
| YGD6 | higid | say | 844 |
| AKL1 | akal | eat | 810 |
| CYR3 | ciyer | draw | 785 |
| YCA6 | hoci | take\_out | 608 |
| YKL1 | yekal | be\_able | 574 |
| EYR1 | shar | sing | 564 |
| QRA1 | qara | read | 556 |
| CRK1 | carik | need | 534 |
| BNH1 | bana | build | 445 |
| AMR1 | amar | say | 435 |

As the distributions show, the ranking of specific transitive verbs by relative frequency is noticeably different in single-word and multiword utterances, a finding that may be attributed to the varying ability of specific verbs to appear without a direct object complement. For example, *raca* ‘want’ is the most frequent verb in multiword utterances but only the 7th most frequent verb in single-word utterances, with less than a tenth of the frequency of the most frequent single-word verb *lakax* ‘take’. The difference in distributions means that differential predictions can be made based on the relative token frequency of maternal single-word and multiword utterances.

*Children*

*Sample and data analysis*

The child data are taken from a published study carried out by Armon-Lotem and Berman (2003) who documented the acquisition of verbs in a sample of six Hebrew-speaking children aged between 1;2 and 2;1. All six children come from urban middle class families, in which at least one parent has obtained higher education. This sample is similar to the higher educated part of the sample of the mothers described above. Three of the participant children were first-borns with no younger siblings, the other three had older siblings. The data of three of the children were taken from a year and a half of weekly longitudinal recordings of interaction with their parents (two children) and with an aunt (one child), starting with their first word combinations, collected in the Berman lab. Their earliest verbs were identified over a period of one month defined as a transitional stage from single-word to multi-word utterances. The other three children were subjects of parental diary studies by the authors and by Dromi (1987), documenting the children’s speech at the one-word phase, before the emergence of word combinations. The difference in method of data collection for the two groups of children and the unrelated mothers’ sample reduces the risk of any correlations between them being due to artefactual reasons.

Armon-Lotem and Berman (2003) list the first 20 verbs produced by the six children. Two children produced 21 verbs, two of which were reported as occurring on the same day, so that the total language sample consists of 122 tokens. In order to provide a uniform representation of child and maternal data, the largely "bare stem" verb forms reported in the source study were lemmatized, with statistical analysis across the study applied to verb lexemes and not to verb forms. There were a total of 58 different verb lexemes in the children’s earliest 122 productions, defined as specific combinations of consonantal root plus *binyan* pattern, including 33 transitive verbs with a pooled frequency of 69 across the sample. The other verbs were either intransitive or verbs that take oblique objects, not employed in the present study. Some children produced more than one differently inflected exemplar of the same verb lexeme which were counted as separate productions. Table 3 presents the distribution of the verbs in the pooled sample.

Table 3. Number of children producing verb forms belonging to each verb lexeme among their first 20 verb forms in Armon-Lotem and Berman’s (2003) sample

|  |  |  |  |
| --- | --- | --- | --- |
| Shoresh  and binyan | Hebrew verb | English gloss | Number of children with verb among first 20 produced |
| LQX1 | laqax | take | 7 |
| SGR1 | sagar | close | 5 |
| PTX1 | patax | open | 5 |
| EYM1 | sam | put | 4 |
| YRD6 | horid | take\_down | 3 |
| YCA6 | hoci | take\_out | 3 |
| RCH1 | raca | want | 3 |
| RAH1 | raa | see | 3 |
| NTN1 | natan | give | 3 |
| BVA6 | hevi | bring | 3 |
| AKL1 | akal | eat | 3 |
| XPE3 | xipes | search | 2 |
| NQH3 | niqa | clean | 2 |
| LBE6 | hilbish | dress | 2 |
| KNS6 | hiknis | put\_in | 2 |
| GMR1 | gamar | finish | 2 |
| ZRQ1 | zaraq | throw | 1 |
| YKL1 | yekal | be\_able | 1 |
| UEH1 | asa | do | 1 |
| TQN3 | tiqen | fix | 1 |
| SPR3 | siper | tell | 1 |
| RVM6 | herim | lift | 1 |
| QRA1 | qara | read | 1 |
| PSQ6 | hifsiq | stop | 1 |
| NGN3 | nigen | play\_music | 1 |
| LBE1 | labash | wear/put\_on\_clothing | 1 |
| KTB1 | katav | write | 1 |
| HPK1 | hafak | turn\_over | 1 |
| GZR1 | gazar | cut | 1 |
| EXQ3 | sixeq | play | 1 |
| ETH1 | shata | drink | 1 |
| CYR3 | ciyer | draw | 1 |
| CLX6 | hicliax | succeed | 1 |

***Results***

Pearson correlation coefficients were computed between measures of input and learning by children, for the 33 transitive verbs produced by at least one child as one of their first 20. Two measures of input frequency were contrasted: the token frequency of verbs in maternal single-word speech and token frequency in maternal multiword speech. As a measure of learning, we used the number of children producing each verb lexeme among their first 20 verbs. Table 4 presents the correlation coefficients.

Table 4. Correlations of verb tokens in single-word and multiword utterances in the speech of a sample of mothers with the number of children producing the verbs among their first twenty (N=33)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Predictor | Number of tokens | Correlation coefficient | Significance level (31 *df*) | Percent variance explained |
| Verbs in mothers’ single-word utterances | 1,513 | 0.66 | *p*<0.001 | 43.38% |
| Verbs in mothers’ multiword utterances | 30,511 | 0.29 | N.S.  *p*>0.05 | 8.15% |
| Total maternal tokens of verbs | 32,024 |  |  |  |

The frequency of verbs in single-word utterances produced by mothers predict children’s first transitive verbs is highly and significantly correlated with the number of children reported to produce those verbs in their first two words, accounting for 43.38% of all variance. In contrast, the frequency of verbs in maternal multiword utterances do not significantly predict the number of children producing the verbs among their first 20, accounting for a mere 8.15% of variance. These results support the hypothesis that children learn their earliest verbs from parental single-word rather than multiword utterances.

In order to depict graphically which verbs in multiword input utterances are poor predictors of children's initial verb vocabulary, maternal single-word and multiword tokens of utterances containing the different verbs were plotted as a function of the number of children who had these verbs in their early vocabulary. Figure 1 presents the data, with a linear trend-line for the two correlations.

Figure 1. Tokens of maternal single-word and multi-word input predicted by number of children producing a given verb in their early speech (*r*=0.66, 0.29). High number of children learning a verb does not predict that the verb occurs in very many maternal multiword utterances.



Figure 1 shows that the verbs *asa* `make’, *raca* `want’, *ra'a* `see’, *hevi* ‘bring’ and `*sam* `put’ are critically over-represented in mothers' multi-word utterances relative to the few children who use them as part of their early verb repertoire, whereas *lakax* ‘take’ is underrepresented in the maternal multiword corpus. By contrast, the maternal single-word tokens are very close to the linear trend-line, including the six verbs mentioned above, neither over- nor under-represented according to the expected value relative to the correlation with number of children producing them. **The over-represented verbs are the ones with highest frequency in the mothers' speech overall, with a very high token size, yet this does not help children to adopt them in the early stages of developing their productive vocabulary. What they do learn to produce are verbs such as *lakax* ‘take’, which adult use often as isolated verbs but not as components of multi-word utterances**.

To double-check the validity of these results, a different sample was examined, with a second set of child data, taking into account the token frequency of young children’s single-word utterances. Again, the hypothesis tested was that parental single-word utterances are better predictors than their multiword utterances of the relative frequency of children’s early verbs.

**Study 2**

The results of Study 1 were replicated on a different sample of young children, using token frequency of their single-word utterances as the measure of acquisition. The children were taken from the dyadic sample we used for the mothers in Study 1, from the same observations that we took the maternal frequencies from. This measure of children’s learning early verbs is less robust than the independent sample of children used in Study 1, especially since we cannot be certain that the verbs used by them as single-word utterances are indeed their first-learned verbs. With these caveats, the relative frequency of verbs in such early speech is a possible estimate of early learning and can serve to replicate the results of the first study.

Age-range of the children used in this comparison was matched to the Armon-Lotem and Berman sample by selecting children aged between 1;2 and 2;0. Thirty out of the total sample of 32 children in the observational study in the relevant age range produced one or more spontaneous single-word utterances consisting of a transitive verb. This sample yielded a total of 439 such utterances, representing 53 different verbs. Table 5 presents the 20 most frequent verb lexemes in this speech corpus and their pooled token frequency.

Table 5. The 20 most frequent transitive verbs in young children’s single-word utterances by token frequency (N=30)

|  |  |  |  |
| --- | --- | --- | --- |
| Shoresh and binyan | Hebrew verb | English gloss | Frequency of children’s single word utterances with verb |
| LQX1 | laqax | take | 63 |
| SPR3 | siper | tell | 41 |
| PTX1 | patax | open | 40 |
| RAH1 | raa | see | 35 |
| EYM1 | sam | put | 22 |
| AKL1 | akal | eat | 21 |
| SGR1 | sagar | close | 18 |
| RCH1 | raca | want | 17 |
| BVA6 | hevi | bring | 17 |
| NTN1 | natan | give | 16 |
| YCA6 | hoci | take\_out | 15 |
| ETH1 | shata | drink | 10 |
| EYR1 | shar | sing | 10 |
| UEH1 | asa | do | 9 |
| GMR1 | gamar | finish | 9 |
| EXQ3 | sixeq | play | 6 |
| EWP1 | shataf | wash | 6 |
| NKH6 | niqa | clean | 6 |
| NQH3 | nisa | try | 5 |
| TQN3 | tiqen | fix | 5 |

Table 6 presents the correlations of mothers’ tokens in single-word and multiword utterances with children’s tokens in single-word utterances for 53 transitive verbs.

Table 6. Correlations of mothers’ tokens in single-word and multiword utterances with children’s tokens in single-word utterances for 53 transitive verbs (N=30)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Predictor | Number of tokens | Correlation coefficient | Significance level (51 df) | Percent variance explained |
| Verbs in mothers’ single-word utterances | 1,797 | 0.76 | *p*<0.001 | 58.39% |
| Verbs in mothers’ multiword utterances | 38,755 | 0.44 | *p*<0.001 | 19.65% |
| Total maternal tokens of verbs | 40,552 |  |  |  |

Both maternal single-word and multiword token distributions revealed highly significant correlations with the frequencies of children’s single-word utterances of verbs, but **relative token frequencies of maternal single-word utterances accounted for three times as much variance as multiword maternal frequencies**. These results replicate the results obtained on the basis of children’s first transitive verbs in the Arnon-Lotem-Berman sample, namely, that early verb use is much better predicted by maternal single-word than by their multiword utterances. The similarity between the two sets of results reflects the fact that the number of children producing verbs as their earliest vocabulary in Study 1 is highly correlated with the relative token frequency in children’s single-word sample in Study 2. The correlation coefficient of the two measures was *r*(57) = 0.77, significant at *p*<0.001.

**Study 3**

Among maternal single-word verbs taken up by young children, the one verb standing out as a favorite was *lakax* ‘take' which, as noted, is often used by adults in isolation, but not as part of their multi-word utterances when addressing young children. In order to explore the possibility that this particular single-word verb is especially appropriate for very young children, age trends were computed for its use by mothers, using the same maternal sample as before, classified by the age of the children at the time. Recall that the observational data were based on mother-child dyads with children in 12 different age-groups spaced at every two months between the age-range of 10 and 32 months, and including from 8 to 24 different mothers in each group. Figure 2 presents the percentage of tokens of mothers' single-word verbs consisting of the verb *laqax* 'take', by age of the children.

Figure 2. Percent of tokens of mothers' single-word verbs consisting of the verb *laqax* 'take', by age of children (*r*=-0.91)



It is clear that the verb *laqax* 'take' is a favorite with mothers when the children are very young, accounting for 50 to 60% of all single-word verbs addressed to the children at the earliest ages measured in this study, a proportion that declines considerably with age. Pearson correlation of children’s age with proportion of *laqax* at that age group yielded a correlation coefficient of the two measures of *r*(10) = -0.91, highly significant at *p*<0.001. That is, this verb is not only highly frequent in child-directed Hebrew single-word speech, but its use is particularly common with young children around one year of age, at a time when they probably start to learn the first items of their active verb vocabulary.

Close analysis of the interactive context in which the single-verb *laqax* 'take' was produced by mothers showed that it was used almost exclusively when the speaker-parent held out an object for the listener-child to take. Thus, the formally unexpressed, elided direct object of the verb was a transparently apparent object of mutual attention at the moment of utterance. Cursory examination of the interactive situation of the various single-word verbs used by parents indicated that this feature of the utterance context was not unique to the verb ‘take’, but held for other verbs as well, providing the basis for the next facet of this study.

All single-word maternal utterances using transitive verbs were coded for the elided object, with such utterances defined by the code “Object of attention” in cases where, at the moment of utterance, the dyad were both quite obviously focused on a clearly visible object that represented the elided Direct Object (DO) of the verb. Table 7 presents the 22 transitive verb lexemes that had at least one ‘attended object’ as their omitted DO, by decreasing total frequency in maternal speech together with the percentage of tokens of the relevant verb which had attended objects as their elided DO.

Table 7. Transitive verbs in maternal speech with ‘attended objects’ as one or more of their omitted direct object

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Shoresh and binyan | Hebrew verb | English gloss | Frequency of mothers’ single word utterances | % direct objects which are ‘attended objects’ |
| LQX1 | laqax | take | 556 | 100.00% |
| RAH1 | raa | see | 300 | 86.61% |
| EYM1 | sam | put | 119 | 100.00% |
| BVA6 | hevi | bring | 46 | 92.86% |
| RVM6 | herim | pick up | 43 | 20.00% |
| NTN1 | natan | give | 38 | 100.00% |
| XZQ6 | hexziq | hold | 29 | 100.00% |
| RCH1 | raca | want | 28 | 33.33% |
| UZV1 | azav | leave, drop | 26 | 100.00% |
| PTX1 | patax | open | 25 | 15.38% |
| SGR1 | sagar | close | 19 | 50.00% |
| ETH1 | shata | drink | 14 | 81.82% |
| HPK1 | hafaq | turn over | 14 | 100.00% |
| KNS6 | heknis | put into | 11 | 100.00% |
| AKL1 | akal | eat | 10 | 87.50% |
| SBB3 | savav | turn around | 9 | 33.33% |
| MEK1 | mashak | pull | 6 | 100.00% |
| EWP1 | shataf | wash | 5 | 100.00% |
| LXC1 | laxac | push | 5 | 100.00% |
| NGB3 | nigev | wipe | 4 | 100.00% |
| BRG6 | hivrig | screw | 3 | 100.00% |
| XBR3 | xiber | join | 3 | 100.00% |

The hypothesis was that, at the earliest child ages, mothers address children not only by the verb *laqax* 'take' but that **they quite generally use transitive verbs having a jointly attended ‘attentional object’ present in the environment. This is because such utterances make it unambiguously and unequivocally transparent for the child which object to act on, to attend to, or, in general, to consider as the semantic target of the action or event referred to by the verb**. Figure 3 presents the distribution of single-word maternal transitive verbs by age of child, with the tokens categorized into utterances having and lacking such ‘attended objects’ respectively.

Figure 3. Percent of tokens of mothers' single-word transitive verbs having or not having an ‘attended object’, by age of children (*r*= -0.85)



The age trends in Figure 3 show that the proportion of tokens with an ‘attended object’ systematically declines with age of child addressed. Pearson correlation of children’s age with proportion of verbs having an ‘attended object’ at each of 12 age groups was computed, yielding a correlation coefficient of the two measures of *r*(10) = -0.85, highly significant at *p*<0.001. That is, single-word transitive verbs addressed to young children around one year of age tend in the great majority of cases to refer to an action on an object which is concurrently jointly attended by both parent and child. This tendency monotonically declines as the children grow and mature, until by 28 months of age, half of all tokens of single-word transitive verbs do not accompany a clearly attended object but refer to some non-present or unattended entity or event. This proportion continues to be a feature of maternal speech until the children reach the age of 32 months (the last age group included in the study), suggesting that **parental reliance on attended objects to disambiguate elided-object transitive verbs is characteristic of the first two and a half years of life, and becomes less prevalent subsequently**.

**Discussion**

The study found that **the frequency of verbs in single-word utterances in the input corpus predicts children's acquisition of verbs far better than frequency of verbs in multiword utterances**. As was hypothesized, the source of children’s earliest vocabulary appears to be single-word parental input, not the multiword input consisting of sentences whose syntactic structure poses a grave difficulty for pre-syntactic children to decode. Similar to Mandarin and Korean, where verbs are also produced very early, the availability of single-word input for transitive verbs in Hebrew makes early acquisition possible. Statistical analyses of the corpus examines shows that, **while single-word utterances represent only about 5% of all parental uses of transitive verbs, this relatively small amount of input appears to be sufficient for learning.**

The results were further replicated on a different sample of young children, using token frequency of their single-word utterances as the measure of acquisition. The high correlation of children’s early single-word verbs with the verbs in their early vocabularies based on observational and diary studies suggests that what are labeled as vocabulary items at this age are in fact very likely to be single-word utterances, with all the expected pragmatic effects influencing their choice by children. The much higher correlations with parental single-word utterances suggest that **early verbs are acquired for particular pragmatic tasks, for which single-word utterances and their functional meaning is the specific input, as suggested by Ninio (1992).**

The use of single-word input to acquire transitive verbs in the early days of vocabulary learning sheds light on a previously unresolved issue that presents a paradox for learning theory. The problem touches on the complex semantics of verbs, relating to their syntactic potential. **Verbs are logical predicates possessing an argument structure, with one or more logical-semantic arguments filling roles in the event referred to by the verb**. The acquisition of such relational semantics involves paradoxical and conflicting requirements. On the one hand, to learn about the verb’s arguments, children need to be able to decode a multiword sentence where the verb appears in a syntactic combination with its arguments. This requires that the child already understands the syntax of word-combinations (Fisher *et al*., 1994; Gleitman & Gillette, 1995). However, to learn the syntax mapping the semantic argument to some syntactic role (with word order, case-marking and so on), children need to already have the verb in their vocabulary (Macnamara, 1972; Pinker, 1984). Without knowing the words and their meaning, it would be impossible to understand that there are certain semantic relations between the different words in a sentence and that these are encoded by such syntactic devices as word-order, case marking, and morphological agreement. **That is, to crack syntax, you need the vocabulary of verbs. Obviously, verbs can either be known ahead of learning syntax, or learned as an outcome of sentential syntax -- but not both. This is a logical contradiction which, without resolution, yields a situation where the influential theories of syntactic bootstrapping (Gleitman & Gilette) and semantic bootstrapping (Pinker) appear to contradict each other rather than illuminate either syntactic acquisition or the learning of a verb vocabulary. This problem exists not only for verbs but for all predicate words in the vocabulary, that is, for adjectives, adverbs, prepositions, etc. as well.**

Results of the present study resolve the paradox of predicate acquisition by cutting the Gordian knot between being a logical predicate and needing sentences to express this fact. **The solution is provided by the usages in which logical arguments are unexpressed by syntactic complements. This includes, first of all, omitted subjects as in imperatives but, more specifically, omitted direct objects of transitive verbs, labelled variously in the literature as object ellipsis, understood objects, dropping of established themes, null objects, zero pronouns, zero anaphora, zero topics or topic deletion.** The explanation for such unexpressed arguments is that languages may allow the omission of arguments that are pragmatically inferable (Harley & Noyer, 2000; Huang, 1984). This generalization also applies to Hebrew, as evidenced by the occurrence of single-word sentences consisting of transitive verbs focused on in the present study.

**As is known from the linguistic literature (e.g., Fillmore, 1986), omission of the theme or patient argument is possible in two different cases: First, when the object is de-emphasized or indefinite and, second, in cases where the object is super-emphasized since it is topical or focal, and contextually given**. In the case of the parental single-word utterances containing transitive verbs under discussion here, the unexpressed objects of action have a definite interpretation which can be immediately retrieved from the context. These are the first verbs children learn as vocabulary items: predicates with a super-pragmatic character, transparently context-embedded, whose interpretation by the hearer is part and parcel of the process by which hearers interpret speakers’ communicative intents.

The solution for the acquisition paradox concerning verbs (and other predicates), then, consists of usages in which the logical arguments of verbs are provided not by a syntactically related word in a sentence but by the extra-linguistic context, in a particularly transparent and pragmatically interpretable manner. Predicates are seen by logical linguistics as “words with holes”, their logical character being that of a function with one or two variables -- f(x) or f(x,y) and so on – when the value of the variable(s) is provided outside of the predicate word. It has been claimed that the only way to provide the value of their variable(s) is to use syntax, placing the values of the arguments in a syntactic dependency. If this were true, the only way to learn a predicate would require understanding that some of its components are in different words, and being able to identify those words by the rules of syntax. Yet this is wrong: **There is another way to provide the value of a verb’s arguments, which lies in the context. The only condition that needs to be fulfilled is that the argument be topical or given, and so be transparently interpretable in a given context**. This condition is amply fulfilled in the case of parental single-word verbs. Taking the most frequent transitive verb, which is *laqax* ‘take’ in the Hebrew corpus, it becomes clear why this is a transparent two-argument verb: **As a single-word verb, it is used almost exclusively when the speaker-parent holds out an object for the listener-child to take. The subject is transparently the addressee; the object is transparently the one handed to the addressee. Nor does any ambiguity remain as to the meaning of the verb: It is a request for the addressee to take the object handed to him or her. No wonder many children adopt this verb into their early speech output, as shown by the results of this study.**

As was seen, **this phenomenon is a general one**. At the earliest ages, children are addressed by single-word input utterances in the form of transitive verbs, with parents ‘scaffolding’ the comprehension of their utterance by referring almost exclusively to existing objects concurrently attended by both members of the dyad. This scaffolding apparently enables the very young child to learn the relevant transparent verbs as single-word utterances. As children mature and their comprehension and verb-vocabulary increase, maternal use gradually decreases the scaffold provided by mutually attended objects. Children apparently receive a precisely fine-tuned facilitation to their needs to understand what is said to them and to learn the same word-forms for their own use.

Placing the acquisition of verbs squarely into the context of pragmatic interpretation of speech utterances resolves another problem with which researchers have struggled regarding this process: **The apparent temporal mismatch between the uttering of verbs by adults addressing children and the event referred to by the verb. In some previous studies of the acquisition of verbs, the expectation was that parental input would line up temporally with ongoing events. The measures of the transparency of input were the occurrence of the event referred to by the verb within a narrow temporal window adjacent to the utterance** (Gleitman, 1990; Ibbotson, Lieven, & Tomasello, 2013; Lederer, Gleitman, & Gleitman, 1991; Tomasello & Kruger, 1992; Verlinden & Gillis, 1988). This expectation was found to be incorrect in the majority of cases: **About 60-70% of all parental uses of verbs are temporarily “mismatched” with regard to the event the verb refers to, mostly referring to imminent actions**. Indeed Gleitman (1990, p.15) claimed that “positive imperatives pose one of the most devastating challenges to any scheme that works by constructing word-to-world pairings, for the mother will utter '*Eat your peas*!' if and only if the child is not eating the peas at the time. Thus a whole class of constructions is reserved for saying things that mismatch the current situation.” Under the assumption that the meaning of verbs is learned by a kind of ostensive definition as are noun, it seems unclear how the child would be able to match the verb to the world and get its meaning. **Since learning verbs from the “world” or the nonlinguistic context appeared a problem insoluble in these terms, Gleitman and her colleagues have suggested that the only way children can get the meaning of verbs is from the *linguistic* context, that is, from the sentences in which the verb appears.**

Our argument is that it is a mistake to assume that children search for the meaning of verbs parents utter in the events referred to by the lexical meaning of the verb. That is, the process by which children learn new words in interaction with their parents is not, as assumed, one of matching the unknown novel form with a referent whose identity is guessed from the context. **We think that the true process -- and this applies to common nouns as well as to verbs -- is one of “*pragmatic matching*” in which children interpret parents' utterances as communications and learn the verbal content as expressions of intents.** Pragmatic matching is a fundamental process of learning first suggested by Macnamara (1972) in his seminal article on word learning and language acquisition in general; further developments of this concept are to be found in publications by Bruner (e.g., 1975/76, 1983) as well as by Antinucci and Parisi (1975), Bates (1976), Dore (1974), Halliday (1975), Nelson (1978), Ninio (1992), Ninio and Snow (1988). and Ninio and Wheeler (1984). **Our redefinition of the learning process, from a kind of ostensive definition or semantic matching of word to world to a ‘pragmatic matching’ of word to guessed utterance meaning, solves the temporal mismatch problem by sidestepping it**. It follows that in attempting to explain the process of acquisition of verbs by young children, the mapping that should be sought is not of the verb with a concurrent, past, or future action-event which the verb may describe or refer to, **but with a speaker’s communicative inten**t in uttering the verb. The question thus turns out to be whether parental single-word requests can be interpreted as requests for a specific kind of action. The hypothesis motivating this study is that single-word verb input is transparent, namely, that parents present such utterances in contexts that provide all the information necessary for identifying the speech act expressed by the verbs, as well as the verb's semantic argument structure.

The difference between the model of ‘pragmatic matching’ and the model used by Gleitman and other researchers is clearest when taking into account the gestures that accompany the verbal utterance, often considered in the literature not to be informative for acquisition since they do not parallel the verbal content (e.g., Schaffer, Hepburn, & Collis, 1983). Under the perspective of ‘pragmatic matching’, the wrong kinds of parallels were sought. For example, handing an object to the addressee may be unrelated to the semantics of the verb *take* in the utterance “*Take it*!” (Hebrew simply *kax* to a boy, *kxi* to a girl), but it renders the communicative intent of the speaker transparent – as a proposal that the addressee take the object. **If under the word-to-referent theory of learning, such utterances pose a grave problem of interpretation, under the model proposed here of the child matching words to communicative intent, such utterances are transparent, since they are accompanied by the gestural or action equivalent of a request to take.**

The major advantage of learning verbs at the single-word stage is that it can provide the child with the verb vocabulary considered necessary for learning the basics of syntax, in the view of such authorities as Caselli, Casadio, and Bates (1999), Macnamara (1972), and Pinker (1984), with unexpressed null objects paving the way to pre-syntactic learning. The next step in development can then be expected to be one at which the previously unexpressed objects get a nominal or pronominal expression, heralding in syntactically accurate multiword speech.

In concluding, it should be noted that results of this study are not specific to Hebrew, since single-word sentences consisting of verbs exist in English as well (e.g., Goldberg, 2000, 2004; Liu, 2008) and certainly in English parental speech. Children acquiring English as their first language are also known to produce verbs at the single-word stage, typically several months before they begin to combine words in syntactic word-combinations (Caselli, Casadio, & Bates, 1999; Ingram, 1979; Nelson, 1973). **An ongoing study reveals that the distribution of parental single-word verbs correlates extremely highly with the token frequency of young children’s single-word verbs, replicating the Hebrew results reported in the present context**. Using large samples consisting of 3,374 single-word transitive verbs in parental speech and 2,005 in child usage, the correlation for over 126 different verbs was *r*(125) = 0.95, with *p*<0.001 (Ninio, 2014). These results now need to be compared with parents’ multi-word utterances containing verbs and their context-embeddedness needs to be computed with age-trends, as done in the Hebrew study presented here. Yet even at this point, the correlations with parental single-word utterances are high enough to justify the expectation that the English findings will be a close replication of the Hebrew ones.

**The overall conclusion is that pragmatics is important in conceptualizing vocabulary acquisition, even – perhaps particularly -- in the case of such logically complex lexemes as verbs. It is once again demonstrated that in models of language acquisition, emphasis should be on the pragmatics of use and social meaning, as suggested early on by Bruner (1975/76).**

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