Semantic similarity in syntactic development

**Testing the role of semantic similarity in syntactic development**\*

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ABSTRACT

The study explored early syntactic development, and tested the hypothesis that children use similarity of meaning in order to move beyond the learning of individual item-based multiword constructions. The first 6 types of verb-object (VO) constructions in Hebrew-speaking children were analyzed for the occurrence of transfer of learning and facilitation, as well as for the semantic similarity of the direct objects (DO). Longitudinal naturalistic speech corpora of 20 children (1;06 - 2;06) were analyzed. We found facilitation (increased rate of learning) among the first 6 types of VO constructions (each type built on a different verb) as evidenced by the accelerating growth curves. Next, we measured the semantic similarity of the DOs using an 8-category system including Patient, Theme and Object of Result. The first 6 DO types represented 3.95 different semantic roles. On the average, after the first VO construction was learned, 3 out of the following 5 constructions produced were not preceded by another VO construction where the DO was of the same semantic category. The results indicate that facilitation of learning of early syntax is most probably not mediated by semantic similarity.

Introduction

The focus of this study is the earliest period of word-combinations, and more specifically, the earliest period of verbal argument constructions in the speech of young children. This period of development is said by many to be characterized by piecemeal, item-specific learning, evidenced by lack of uniformity in the syntactic frames in which different verbs appear in the same period (Clark, 1978; Bowerman, 1982; MacWhinney, 1982; Maratsos, 1983; Pinker, 1984; Ninio, 1988; Tomasello, 1992; Lieven, Pine & Baldwin, 1997). There seems to be a wide consensus that initially, young children learn syntactic rules for specific words in a piecemeal fashion, and that their syntax does not show the uniformity of application over all lexemes which is expected if they had general and categorical knowledge.1

Item-specific learning is thought by some authorities to imply a lack of relationship between the mini-grammars associated with individual items. For instance, the Verb Island hypothesis developed by Tomasello (1992, 2000) interprets the piecemeal acquisition of verbal argument structure constructions in terms of the insularity of the participant items and the absence of system characteristics of young children's grammars. At the insular stage of development, children are said to possess an inventory of item-specific schemas or `verb island' constructions, each applying only to the specific predicate involved and unrelated to any of the other constructions. Only at a later stage are children said to develop abstract categories and constructions, and build up an interconnected verbal system.

It appears, however, that if an insular stage indeed exists, it cannot last very long. Recently much evidence has accumulated regarding syntactic generalization and facilitation in young children, demonstrating considerable inter-item transfer in children's syntactic systems at a relatively early stage of development (e.g., Ninio, 1999, 2003; Childers & Tomasello, 2001; McClure & Pine, 2002; Kiekhoefer, 2002; Savage, Lieven, Theakston & Tomasello, 2002; Abbot-Smith & Behrens, 2003). Any effect of previous learning on the performance of a new task is a phenomenon reflecting transfer of learning (Singley & Anderson, 1989). When the effect is positive, exhibited in such consequences as increased rate of learning, reduction of errors during acquisition, creative application of some behaviour to novel items, creative overgeneralizations and so forth, we talk about facilitation of learning. When the effect is negative, bringing about reduced rate of learning, increased error rate and so forth, we talk about interference.

In the domain of syntactic development, the effect of past learning is facilitatory in nature. For example, McClure & Pine (2002) have shown that verbs learned after children reach the MLU of 2.0, generate, when first used, more complex utterances in terms of MLU and the number of verb-arguments expressed than the starting utterances of verbs learned earlier. This demonstrates that the general level of syntactic knowledge a child has at the time a new verb is being learned influences the specific syntactic knowledge she learns about individual verb's combinatorial possibilities. Childers & Tomasello (2001) and Savage *et al.* (2002) showed that experimentally presenting young children with many transitive sentences in a very short time brings about considerable productive use of novel or nonce verbs in transitive constructions, without the children having first heard these test verbs in a transitive sentence. Apparently, children at the earliest stages of producing combinatory speech are well able to transfer knowledge gained through the enhanced modelling of a syntactic construction for some items, to novel items. Finally, Ninio (1999, 2003), Kiekhoefer (2002), and Abbot-Smith & Behrens (2003) showed that the more verbs children already know how to express in a certain syntactic pattern, such as the subject-verb-object or the ditransitive constructions, the faster they learn new ones in the same pattern. Apparently children's lexically specific, item-based learning of individual word-combinations for some verbs facilitates the lexically specific, item-based learning of a similar construction for other verbs. The Kiekhoefer (2002) and Abbot-Smith & Behrens (2003) studies and their findings are especially convincing as the studies used the corpora of two children, one learning English and the other German, whose observational schedules were unusually dense: The children's speech was recorded five days a week, for one hour each time during the relevant period.

It might be summarized that the recent studies find considerable inter-item transfer and facilitation in children's early syntactic systems. It is, however, not yet known whether such transfer occurs immediately when children begin constructing multiword utterances, or whether this is a slightly later phenomenon, following a period of insular `verb-islands' that do not influence each other's acquisition. For example, item-to-item facilitation of learning has usually been demonstrated for the first 20 or 30 verbs in a particular construction, but not for the first 3, 5 or 10. It is an open question if the very first verbs in a particular syntactic pattern are in a facilitatory relation with each other, or whether this happens later on, after the acquisition of a `critical mass' of types in the same construction (e.g., Morris, Cottrell, & Elman, 2000; Tomasello, 2000). The first question asked in the present study is whether there is mutual facilitation already at the very earliest period of verb-based word combinations.

*Going beyond item-based word-combinations through semantics-based abstract schemas*

The existence of inter-item transfer and facilitation in syntactic development is, by itself, a theory-neutral empirical finding. However, the occurrence of transfer, by itself, does not illuminate the route by which old knowledge informs new performance in grammar. The second open question is, therefore, what are the processes underlying inter-item transfer, facilitation and generalization in children's syntax, and, in particular, what is the role of semantics in such processes.

One possibility is that the ability to transfer previously acquired knowledge to novel items makes use of abstract or general forms of linguistic representations such as abstract schemas, constructions or categorical rules. Abstract schemas of linguistic knowledge are generalizations about the grammatical behaviour of stored items in which the items are represented as a class, namely, by category symbols, rather than individually (Bybee, 2001: 22). In theories of development based on empiricist principles, children are thought to arrive at such general syntactic rules by induction from the linguistic input (Maratsos & Chalkley, 1980) or from the lexically-specific syntactic formulae which they had previously learned from the input on an individual basis (e.g., MacWhinney, 1982; Tomasello, 2000). Children are thought to abstract out commonalities across multiple utterances instantiating some construction and to store the generalization in the form of a schema. In such a process of schema-formation the specific details of individual formulae are ignored and only the relations among the participating linguistic objects are preserved.

Semantics is often allocated a central role in the development of syntactic abstractions by schema formation (e.g., Bloom, Lightbown, & Hood, 1975; Braine, 1976; Bowerman, 1982; MacWhinney, 1982; Pinker 1984; Goldberg, 1999; Morris *et al.*, 2000; Tomasello, 2000). For example, Tomasello (2000: 242) suggests that children create more general and abstract linguistic constructions by extracting the common structure of a set of different verb-specific constructions possessing similar semantics. He gives as an example the verbs *give,* *tell,* *show,* *send* and so on, which share both their semantics and syntax: they share a `transfer' meaning and also appear in an identical syntactic structure, namely, NP + V + NP + NP. The outcome of this process is, according to the hypothesis, an abstract ditransitive construction possessing the prototypical semantics of `transfer', which then can be used as a template for the generation of ditransitive sentences with novel verbs possessing the same semantics. Once the abstract semantics-based schema has been formed, it can be applied to novel items that possess the correct semantics, without having to learn their syntax on an individual-lexical basis. In this approach, semantically-based schema formation and schema-application are seen as necessary and sufficient conditions for the productive use of syntactic constructions, ending the hypothesized initial stage in which syntax is verb-specific.

A very similar approach is presented by Morris *et al.* (2000). They propose a stage-wise developmental process. In the first stage children acquire a set of `mini-grammars' consisting of the argument structures of individual verbs. In the second stage, the separate mini-grammars develop correspondences among themselves, and these correspondences are based initially both on semantic and syntactic similarity. The role that semantics plays decreases gradually, so that at the start of the process only very similar verbs will `merge' into a larger grammar, e.g., *eat* with *drink*, or *hit* with *kick*, while later on more distantly similar groups of verbs will also `merge' into more abstract schemas.

According to these theories, the degree of semantic similarity between verbs needs to be high in order for schema formation and schema application to be possible, at least at the start of this process. Semantic similarity can only be of use when a child has already learned, in an item-based manner, the mini-grammars of a number of verbs with similar semantics, such as the `transfer' set *give,* *tell,* *show*, and *send* mentioned above. At the least, two different verbs are required for semantics-based abstraction or `merger' to apply. In addition, transfer and facilitation based on semantic similarity can only apply to novel items which are very similar in meaning to some already-learned ones, as the abstract schemas themselves are defined for quite specific semantic content such as `transfer', `ingestion', or `physical assault'.

The theories thus make a quite precise prediction regarding the developmental preconditions for schema formation and application in young children, in terms of the composition of their already-learned lexically specific word-combinations. Semantically-based transfer and facilitation is expected to occur when and only when the children's inventory of item-specific schemas includes two or more earlier-learned items to which the current item is closely related semantically.

*Testing the role of semantic similarity in syntactic schema formation and transfer*

Surprisingly, the role of semantic similarity in syntactic schema formation and transfer has seldom been tested directly. Most of the evidence has been indirect and open to other interpretations, such as the co-emergence patterns reported by Bloom *et al.* (1975) or Braine (1976). These researchers judged that a child possessed a semantic rule such as agent-action for deriving multiword utterances if, in the same observation or within some short period of time, the child produced at least 5-6 different utterances expressing such a semantic relation. It was not checked whether the children made use of the categorical production rule attributed to them when learning novel verbs in the same pattern, or indeed whether there was any facilitation in the learning of further items of similar semantics. Conversely, in more recent longitudinal studies testing for transfer and facilitation in children's spontaneous production of multiword utterances (e.g. Ninio, 1999 or Kiekhoefer, 2002) there was no systematic exploration of the role of semantics in the transfer process.

Direct testing of the role of semantics in syntactic generalization needs to bring together in the same study a measure of facilitation, transfer or any other mutual influence of different items in the same construction, with a measure of semantic similarity, homogeneity, or convergence of the relevant items.

Such dual information on transfer as well as semantics is easier to provide in an experimental methodology where the semantics of the stimuli is controlled by the experimenter, and transfer is a response required from the children within the study. Unfortunately, in most experiments investigating transfer of learning and facilitation in syntactic development the focus of the study is whether or not children show transfer from training to testing, and the semantics of the training and the testing verbs is as a rule carefully equated, probably to ensure that semantics-based transfer can indeed take place. For example, in Childers & Tomasello's (2001) study on the generalization of the transitive construction to novel verbs, the majority of training verbs and all testing verbs expressed caused motion. The researchers presented young children with a large number of transitive sentences in a short period of time, then tested their ability to use novel nonce-verbs in the transitive construction when the verbs were introduced to the children either in intransitive or in passive sentences. Unlike a control condition where no such mass training has taken place, the children at 2;6 who underwent training produced a significant number of transitive sentences with the novel verbs. The authors interpreted the results as demonstrating that the enhanced input helped the establishment of a semantically coherent transitive schema in these young children, underlying the transfer of the transitive construction to the novel verbs.

This conclusion needs to withstand the test of a control condition not included in the original study, in which the semantics of the training and testing verbs is not closely related. Such a control study has been performed by Abbot-Smith, Lieven & Tomasello (in press). They carried out a partial replication of Childers & Tomasello's (2001) study, pointing out that in the absence of a control condition using verbs belonging to other semantic classes, it is unclear to what extent verb semantics played a significant part in the facilitation process demonstrated in that study. In the new study the testing verbs were from a different semantic class than the training verbs. While the training verbs were verbs of caused-motion (such as dropping or rolling) as were most verbs in the previous study, the testing verbs were nonce-verbs signifying light-emission and sound-emission. Despite the semantic difference between training and testing verbs, the study found the same amount of facilitation in these childen's production of transitive constructions without prior modelling as did the Childers & Tomasello study. These positive results put in question the claim that semantic similarity plays a decisive role in the facilitation achieved by the enhanced input.

The authors raise the possibility that the lack of significant difference between conditions could be due to the fact that semantic similarity effects may be difficult to show experimentally. They refer to a previous experimental study by Pinker, Lebeaux & Frost (1987) which also failed to show effects of semantic similarity on transfer, presumably for the same reasons. They caution against taking the negative results of these experiments to imply that in natural circumstances semantic similarity plays no role in the formation of syntactic schemas. This conclusion suggests that we should turn to analyzing naturalistically occurring learning for examining the role of semantic similarity in transfer, which is what the present study set out to do.

*The present study and its hypotheses*

The goal of the present study is to test the hypothesis that transfer of learning in natural conditions is mediated through semantic similarity.

The alternative hypothesis is that transfer of learning in early syntax is mediated by similarity of form between the syntactic frames to be learned, rather than by similarity of semantics between the participating constituents. For example, SV constructions in English are formally similar in that the subjects are usually placed preverbally; they do not get prepositional casemarkers; if the subject is a pronoun, it is in the nominative case; and the verb vestigially agrees with the subject. Earlier-learned lexical-specific SV formulae can facilitate the learning of other SV formulae on the basis of similarity in the learning task, and there is no need to assume that anything like abstraction, generalization, or schema-formation is involved. Indeed, under the hypothesis that transfer relies on formal similarity, it is expected that conditions for facilitation exist immediately once a child had learned a single verb in some construction; a single lexical-specific SV pattern can be the source of positive transfer to the learning of the SV pattern for another verb. No minimal sets of 2-3 similar items are required as for abstraction and generalization, and there is no need for a 'critical mass' of different vocabulary items to be acquired in this pattern in order for transfer to take place.

The measure of inter-item transfer in natural production data is facilitation of learning (Singley & Anderson, 1989); in this case, the saving in the time it takes to learn a certain construction for a new verb, given that other verbs have already been learned in the same syntactic pattern. Facilitation will be measured as in the Ninio (1999) and Kiekhoefer (2002) studies, by the accelerating slope of the learning curve plotting the cumulative number of different verbs in the same syntactic construction as a function of age at first production. Accelerating growth curves are routinely interpreted as evidence of transfer and facilitation of learning for later-learned items, and see for example the discussion of vocabulary growth curves in Elman, Bates, Johnson, Karmiloff-Smith, Parisi & Plunkett (1996), where they suggest that the acceleration reflects `an increase in ability to learn words resulting from previous accumulation' (p.185).

The study focusses on one of the earliest multiword constructions learned by Hebrew-speaking children in natural circumstances, the verb-object (VO) combination. Specifically, we concentrate on the first 6 verbs in this construction produced by 20 children acquiring Hebrew as their first language. VO is an early syntactic multiword pattern, and most children have very little other verbal syntax at this period of time. On average, it takes children about 4 months to produce the first 6 verbs in this pattern. If indeed syntactic development begins with item-specific learning, the learning of the first 6 different types of VO combinations certainly falls within the period in which item-specific learning is expected to occur.

It is as yet unknown whether or not there is facilitation of learning among the first 6 different verbs with a direct object in a child's spontaneous speech. According to the hypothesis that initially, verbal argument constructions represent independent `verb islands', these early-learned constructions should not be related to each other in a child's grammar. If, however, the first 6 VO types are already in a facilitatory relation with each other, the question is, does this relationship rely on semantic similarity? In other words, we can ask, is there an association between facilitation or lack of it, and the learning of semantically similar verbs and objects in this construction?

Under the hypothesis that syntactic facilitation is based on semantic similarity, we predict a positive correlation between the presence of semantic similarity and facilitation of learning. The alternative hypothesis is that no such correlation will be found.

A positive correlation entails the following:

*If there is facilitation of learning among the first 6 verbs in the VO pattern, we expect it to be based on semantic similarity among the verb-object combinations;*

*If there is no semantic similarity among the first 6 types of verb-object combinations in the VO pattern, we expect that the verbs do not facilitate each others' acquisition in the VO construction.*

Under the alternative hypothesis, syntactic facilitation will be independent of the degree of semantic similarity among the items. Hence, the first 6 items in a VO constructions could facilitate each other or be insular and unrelated to each other, but their facilitation or lack of it will not be correlated with the degree of semantic similarity to each other.

The data on which the hypothesis is to be tested is the development of verb-object combinations in Hebrew-speaking children.

*The Direct Object in Hebrew*

Hebrew is an accusative language with an SVO canonical word order. Hebrew uses several different prepositions with core-arguments of verbs. Direct Objects (DO) are distinguished from Indirect Objects by the preposition they take: NPs taking the preposition *et-* when the object is definite and a zero alternative when the object is indefinite are DOs. This is the only type of core object in Hebrew that drops the preposition under condition of definiteness. Except for the preposition *et-*, there are also other obligatory prepositions *le-,* *el-,* *al-,* *be-,* *im,* *ke-,* *axarey,* *taxat*, etc., and the NPs they introduce are collectively known as Indirect Objects. The type of preposition a verbal object takes is lexically specified, and there is very little semantic rhyme or reason for which verbal object is encoded as a DO and which as an IO (e.g., Berman, 1978). For example, there are very many verbs that take a direct object in English but an indirect (prepositional) object in Hebrew, among them *hirbic* `hit', *ba'at* `kick', *hizik* `harm', *neevaq* `resist, oppose', *nilxam* `fight', *paga'* `injure, hurt', *axaz* `seize', *naga'* `touch', *bagad* `betray', *hegen* `defend', *hishpia'* `influence', *baxar* `choose', *hishtamesh* `use', *hivxin* `notice' and *xashak* `desire'. Other verbs with meanings similar to the above, such as *paca'* `wound', *tafas* `catch', and *raca* `want' take direct objects, just like their English translational equivalents.

Glinert (1989) points out that the category of direct objects has no semantic correlates:

`There are no recognized semantic criteria as to which verbs take direct objects. It is possible though to define some negative semantic criteria, so that for example 'recipients' normally have an indirect object (with the preposition *le-*), 'topics of discussion' normally have an indirect object with the preposition *al*, and so forth.' (159)

This implies that DOs are very heterogenous semantically, and except for types of semantic roles specifically marked by dedicated prepositions such as the Recipient role, virtually any other kind of complement may appear in this grammatical role. This arbitrariness means that children need to learn for each verb separately whether it takes a DO, on an item-specific basis.

The situation is quite similar to that in English. There are, according to Hornby (1945), Allerton (1982), and Levin (1993), about 25-30 different verbal argument structure constructions in English. The multitude of different complements that verbs can take, as well as the essential arbitrariness of which one each verb takes is well-acknowledged within theoretical linguistics, manifested by the requirement that individual `subcategorization frames' of verbs be registered in their lexical entry (e.g., Chomsky, 1981). As in Hebrew, the semantics of particular constructions is quite heterogenous; this is in particular true of the direct object. For example, Lyons (1968) says:

`The relation of 'direct-object-of' cannot be given a single interpretation in the semantic analysis of sentences. In traditional grammar, many different kinds of 'direct object' were distinguished.' (439)

The lack of clear mapping of semantics to transitive syntax makes this into an exceptional case even according to authorities who otherwise advocate a dominant role for semantics in the acquisition of syntactic patterns. For example, in a paper on the emergence of the semantics of argument structure constructions in English-speaking children, Goldberg (1999: 207, note 8) points out that in contrast to the lawful mapping of semantics to other basic syntactic constructions, there is no clear association of semantic transitivity with simple syntactic SVO status.

The semantic variability and lexical-specificity of the Hebrew VO construction turns it into an optimal testing ground for the exploration of possible inter-item relations in a slice of grammar which in all probability must be learned in an item-specific manner. As piecemeal learning of this construction is virtually obligatory, inter-item relations of the kind underlying facilitation must co-occur with it, rather than follow it or substitute for it. If we indeed find facilitation of learning for this construction, it will strengthen the claim that verb-specific mini-grammars are related to each other in a child's system rather than being insular structures. How and through what dimension of similarity such relatedness is established is the question to be asked next.

The structure of the study is as follows:

First, we test for facilitation among the first 6 different verbs with a DO.

Second, we look for semantic similarity among the first 6 DOs.

The hypothesis of semantics-based abstract schema formation predicts a positive correlation between the presence of semantic similarity and facilitation of learning. The alternative hypothesis is that no such correlation will be found.

Method

*Subjects*

The earliest word-combinations of 20 children (12 girls and 8 boys) acquiring Hebrew formed the data base of the study. The children were observed weekly at home for 30 minutes at a time, in naturalistic interaction with their mother. Observations started when the children were still in the single-word stage and continued for 8-11 months. The children were between 1;06.00 and 2;06.00. The children's speech was audio-recorded and simultaneously transcribed by the observer. In addition to the weekly observations, parents also kept a diary on emergent constructions of the children. In it, they recorded all novel, previously unsaid multiword utterances the children produced, including their context.

We examined, for each child in the sample, the first 6 different transitive verbs produced with a direct object in a canonical VO word order.

*Data analysis*

All utterances were transcribed in standard orthography. The corpora were then divided into utterances, based on the presence of a perceptible pause separating it from other locutions of the same speaker. All spontaneous utterances of two words or more were included in the data base. Immediate repetitions of a single word within the same speaking turn were not taken as adding to the length of the utterance. Utterances in which a child makes a hesitation-pause between words are considered word-combinations, but `vertical constructions', in which two words belong to separate single-word turns at speech, were not classified in this way.

Child utterances were annotated during and also immediately after observation with detailed contextual comments regarding the communicative use of the utterance. Excluded from the present analysis were all non-spontaneous utterances produced by the children. This covers recitations of texts (e.g., of songs or of verse) as well as immediate imitations of a preceding adult utterance, whether explicitly elicited by the parent or initiated by the child. Also excluded were elicited completions from the child, either of texts or of words in non-text utterances.

*Type of utterances included in the speech sample*

The utterances included in the analysis contained transitive verbs accompanied by DOs, defined by the presence of the preposition *et-* or by a zero preposition. Sentences in which the DO was in a non-canonical preverbal position were excluded, as the focus of the study was the acquisition of the canonical postverbal syntactic pattern.

Results and discussion

The first 6 verbs in the VO pattern were produced within 3.41 months on the average (S.D. 1.79). There was much variability in the time it took to produce sentences with 6 different verbs in this pattern; the range was 0.90 to 6.93 months.

*Is there transfer and facilitation among the first 6 VO types learned?*

The first hypothesis to be tested is that earlier-learned verbs facilitate the learning of further verbs in the same syntactic pattern. The measure of facilitation to be used is the pace of the temporal spread of the VO construct across different verbs, and we expect a gradual acceleration as a child learns to produce DOs with more verbs. We plotted for each child the cumulative number of different verbs with DOs as a function of the age at which the relevant combination for each verb was first produced, up to the 6th verb produced. In a few cases there was a tie between several verbs for the 6th verb status; in this case all tied verbs were included in the analysis. Two trendlines were fitted to each cumulative growth curve by the Excel program: a linear one and a power-law function.

Figure 1 presents the growth curves of 6 of the children, with a linear and a power-law trendline fitted to their cumulative developmental curves. The children were selected randomly. If we order the whole sample in a decreasing order according to the percent of variance explained by the power function (the 1st representing the best fitting curve), the 6 growth curves presented in Figure 1 are ranked the 3rd, 5th, 8th, 14th, 18th and 19th of the sample.

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**Age (months)**

Figure 1. Cumulative growth curves of six children, with linear and power-law trendlines fitted to their curves

The pattern of results observable in Figure 1 is representative of the results as a whole. In all 20 children the cumulative frequency of the first 6 verbs in the VO pattern shows an accelerating function, and there was a very good fit of the power function to the cumulative distribution, explaining 90% or more of the variance. The linear trendlines fit the distribution less well.

The mean fit of an accelerating power-function was *R2* = 0.95 of the variance (S.D. 0.03, range 0.88 to 1.00). The mean fit of a linear function was *R2* = 0.86 of the variance (S.D. 0.10, range 0.68 to 1.00). Namely, on the average the power function explained 9% more of the variance than the linear function. The comparison of the fit of the power function with the fit of the linear function by paired *t*-test revealed that the difference is highly significant (*t*(19) = 5.21, *p* < 0.001).

The occurrence of acceleration in a graph was judged on the basis of the degree of fit of a power function to the cumulative graph relative to a linear function; if the power function had a better fit, the graph was judged to be an accelerating graph. Of the 20 children, 19 or 95% had accelerating graphs of the temporal spread. Against a null hypothesis that graphs will be non-accelerating, this result is significantly higher than chance by binomial sign test (*p* < 0.001).

Based on these results, there is strong evidence for a gradually accelerating spread of the syntactic pattern over different verbs, and hence for facilitation of learning. The more verbs a child already knows how to combine with a direct object, the faster she can learn a new verb in the same pattern. Transfer and facilitation happen very early in acquisition -- already the first 6 verbs undergo learning by transfer.

*Semantic similarity among the first 6 DOs as measured by thematic roles*

Next, we explored the possibility that children base the transfer among the VO types on a general similarity in the thematic role, semantic case role, or semantic category of the DO, such as Patient, Theme and so forth.

There exist many different category systems for the semantic roles of verbal arguments. In the case of direct objects, the literature usually mentions semantic roles such as Patient and Theme, Affected Object and Object of Result, Moved Object and Object of Transfer-of-possession, Percept and Concept, and many more. Some distinctions are considered crucial in the linguistic literature. For instance, Affected Objects and Objects of Result are seen as quite distinct, since Affected Objects are entities that exist prior to the described action and are seriously affected by it while Objects of Result (or Effected Objects, or Created Objects) do not exist prior to the action but rather, are created by it (Lyons, 1968: 439). Similarly, in most systems the distinction between Patients and Themes is seen as crucial: Patients are seriously changed by the action in their state or condition, e.g., get crushed or chopped, while Themes are merely moved around but not otherwise affected (Van Valin, 1993: 39-43).

Since in other details there are considerable differences between the systems proposed by different authorities, we decided to base our coding system on Levin's (1985) categories. Levin is a highly respected authority on syntax-semantics interface and her categories are systematic and exhaustive. That paper lists about 20 different semantic roles for direct objects (among them the crucial Patient, Theme and Entity Created), including all the distinctions among types of Hebrew direct objects mentioned by Berman (1978) and by Glinert (1989). Many of Levin's 20 categories were not represented in the early sentences the children generated. Based on the remaining categories and with minimal collapsing of close categories, we constructed an 8-category coding system for the semantics of the direct object. These are presented in Table 1, together with some Hebrew exemplars.

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Insert Table 1 about here

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All direct objects produced by the children were coded for their semantic role. The Appendix presents the first six different verbs for each child in the VO pattern in the order they were produced. Table 2 presents the verbs produced by at least one child as one of their first 6 different verbs, classified by the semantic role of the Direct Object.

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Insert Table 2 about here

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Table 3 presents the distribution of the thematic categories among the first 6 DOs produced by the sample.

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Insert Table 3 about here

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The thematic role of Patient, thought to be the prototypical semantics of direct objects, is represented by only 10% of the early DOs produced by this sample. The most popular thematic role in this set of utterances is Object of Desire, representing an object that the speaker wishes to get possession of.

As an example of the method of coding, one child's coded sentences are presented in Table 4. The table presents for each verb all the different VO sentences recorded with that verb before the child went on to produce a VO combination with a novel verb. The sentence tokens (excluding exact repetition) are presented in this table merely to provide some information about the active learning period of the verbs during the acquisition of the VO pattern, but they are not otherwise further analyzed.

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Insert Table 4 about here

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The child M-08, hereafter referred to by the pseudonym Udi, generated his first 6 types of direct objects with 4 different general semantic roles. Udi's sentences demonstrate that the kind of semantic similarity coded for by the 8-category instrument used in this study is much more distant than the close semantic similarity deemed necessary by Morris *et al.* (2000) for the semantics-based abstraction process at its initial stages. Had we adopted a more detailed semantic coding system only acknowledging close semantic similarity, as advocated by Morris *et al*., none of Udi's 6 DOs would have fallen into a common category. There is no close semantic similarity between sweeping the floor and opening up a table-top, although in our coding system both are coded as operations on a Patient or Affected Object. There is no close semantic similarity between extracting a bone from a piece of chicken and being taken down from a chair to the floor, although in our coding system both are seen as operations on a Theme or Moved Object. In other words, an 8-category coding scheme for semantic roles maximizes the chances that children's early-produced direct objects are seen as semantically homogenous, and makes it more likely that the hypothesis of semantic schema-formation be accepted, relative to the use of a more detailed coding system crediting only close semantic similarity among items.

We counted for each child the number of different semantic roles which the first 6 different DO types expressed. Table 5 presents the distribution of different semantic roles per child, for the children of the sample.

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Insert Table 5 about here

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There was a mean of 3.95 different semantic roles represented among the first 6 types of verb-object combinations (S.D. 0.76). None of the children had less than 3 different semantic roles among the first 6 DO types, and most children had more, with as many as 70% of the sample generating their first 6 VO combinations with four or more different semantic roles. The large number of different semantic categories among the first 6 different DOs implies that each category consisted of only a few exemplars for a given child. On the average, there were 1.57 different VOs per semantic category (S.D. 0.31), less than 2 per category.

In order to test the quantitative prediction of the hypothesis that facilitation is based on semantic schemas, we checked for each child the number of direct objects among the first 6 types which were preceded by at least two different DOs that expressed the same general thematic role. This analysis focussed only on the 3rd or later produced DOs, as the first and the second DOs were not preceded by two previously-learned items. There were 80 DOs in the whole corpus which were produced 3rd, 4th, 5th or 6th by a given child. Of these, only 4 (5%) were preceded by 2 semantically similar antecedents. The other 76 (95%) of these later-learned DOs were not preceded by 2 or more semantically similar antecedents. The results were clear-cut: The basic conditions for the formation of abstract schemas based on semantic similarity do not exist in the set of verb-object types comprising children's first 6 VO constructions. Given the near-absence of sets of at least three different verb-object types possessing similar semantics among the first 6, the observed facilitated production of the construct cannot be a consequence of the formation of general schemas or `mergers' of mini-grammars on semantic basis. The hypothesis of semantically based general schemas underlying the observed facilitation was rejected.

We further checked a less strict hypothesis that children's later-learned direct objects had at least one semantically related antecedent among the DOs learned before it in the VO pattern. The relevant set of items are the five items per child which were learned 2nd to 6th. There were 100 DO types produced by the sample which could have had at least one semantically similar antecedent. Of these, only 41 had such an antecedent, meaning that 59% or the majority of later-learned DOs were not preceded by even one single semantically similar item in the child's productive repertoire. The scarcity of semantically similar antecedents was inevitable, given the multiplicity of semantic roles among a child's first 6 that we have seen in Table 5. The absence of even one single semantic antecedent for the majority of verb-object types implies that individually modelled semantic transfer cannot account for the facilitation either.

These results imply that the amount of semantic similarity among the first 6 types of VO constructions cannot support a facilitatory process based on semantic commonality among the different VO types. In simple terms, there is too much jumping from one kind of semantics to another for it to be feasible that anything like semantics-based schema formation accounts for the saving in the learning time of the shared syntactic pattern.

*Correlation of semantic homogeneity with acceleration*

Another way to examine the possible semantic factor is to see if the number of different semantic categories in a child's first 6 verb-object combinations predicted the amount of facilitation of production in that child's development. Namely, did children who produced more DOs which were semantically related among their first 6 VO types, accelerate their acquisition faster than children who learned a set of unrelated semantic roles for the first 6 DOs?

An examination of our `model child' M-08, or Udi, suggests that varied semantics does not preclude highly accelerated learning. Figure 2 presents his growth curve. Figure 2. Cumulative growth curve of Udi's first 6 types of Verb-Object combinations, with linear and power-law trendlines fitted to the curve

We can see that this child, whose first 6 VO types represented 4 different semantic roles for the DOs and who did not have a single DO which was preceded by two other items with a similar semantics, nevertheless learned these verb-object combinations in an accelerating, facilitated learning process. The increasing power function gave a better fit than the linear function, explaining almost all of the variance (99%) whereas the linear function explained only 91% of the variance.

We computed the correlation coefficient between the number of different semantic categories of the DOs and the percent of variance of the growth curve explained by the power-law accelerating function. The correlation was not significant (*r* = -0.16, *df* = 18, *p* > 0.05, NS). In other words, the semantic variability of the first 6 DO types did not correlate significantly with the amount of facilitation previously-learned direct objects provided for later-learned ones.

Although the semantic similarity of the verbs was not measured in this study by formal means, informal inspection of the first 6 verbs of each child in the VO pattern (see Appendix) discloses that these were mostly unrelated to each other in their lexical meaning. Given that similar verbs allocate similar thematic roles to their direct objects, it was obviously impossible that the verbs would be semantically similar while the DOs were not; however, the degree of semantic variability actually observed in the lexical semantics of the verbs seems to be extreme and worth further study.

Conclusions

*Early facilitation of learning in syntactic acquisition*

As in most other studies of the acquisition of syntax in natural circumstances using a longitudinal growth measure, the results of the present study demonstrate that there is acceleration in the cumulative learning curves, and hence suggest that there is transfer of learning and facilitation among the first 6 verb-object constructions. The more verbs children already know how to express in a certain syntactic pattern, the faster they produce new ones in the same pattern; thus previous learning saves time and effort in the acquisition of this syntactic argument-structure construction for further verbs. Similar findings have been obtained in several previous studies (e.g., Ninio, 1999; Kiekhoefer, 2002).

The novelty in the findings of this study is in localizing facilitation: it occurs early in acquisition, it parallels item-specific (piecemeal) learning, and it does not have to wait for the accumulation of a `critical mass' of the same type of combinatory patterns. Apparently, development does not separate into an initial stage of piecemeal learning and a later stage in which relations are established between item-specific mini-grammars. Instead, children's initial grammar is an interconnected system from day one.

The facilitation of learning found in this study and previous studies belongs to a family of phenomena collectively known as type-frequency effects. The term refers to effects associated with the size of the class to which some processing rule or task applies. Among other effects, type frequency usually correlates with the productivity of a particular linguistic pattern, that is, with the extent to which it is likely to apply to new forms. The more items a particular schema applies to, the more available is it for application to new items (e.g., Bybee, 2001: 13). Our findings indicate that type-frequency effects already operate in the very early stages of the acquisition of syntax. Moreover, we demonstrate that type-frequency effects are dynamic: with the growing size of the class which a given schema encompasses, its productivity increases.

This already intimates that there is little room for a semantic similarity-based schema formation process as the explanation for the occurrence of facilitation of learning. This impression strengthens as we inspect the data on the relation of facilitation and semantics.

*Facilitation and semantics*

Under the hypothesis that syntactic facilitation is mediated by semantic similarity, the expectations were that we would find a correlation between facilitation of learning among the first 6 verbs in the VO pattern and semantic similarity among the participant verb-object combinations. If there was no semantic similarity among the first 6 verb-object combinations in the VO pattern, we expected that the verbs would not facilitate each others' acquisition in the VO construction.

This prediction was not supported by the findings. There is facilitation among the first 6 verbs in VO, but the semantic heterogeneity of the relevant verb-object combinations implies that the facilitation is most probably not mediated by semantic similarity, even if it quite widely defined. The observed facilitation cannot rely on similarity in the general semantics of the first 6 direct objects, at least not in the way semantic roles of DOs are usually conceptualized, such as Patient vs. Theme, or Affected Object vs. Object of Result and so forth. It is even less likely that the observed facilitation can be attributed to the similarity in the specific lexical meaning of the verbs, as informal examination of the participant verbs revealed that the first verbs the children learned in the VO pattern were quite unrelated semantically.

This means that semantically-based abstraction across different items (e.g., Tomasello, 2000) and incremental `mergers' of mini-grammars, ordered by how closely the verbs are semantically related (e.g., Morris *et al*., 2000), probably do not constitute part of the basic processes of syntactic development. At the start of syntax, children seem to move beyond individual item-based word-combinations by assimilatory processes for which semantic similarity is irrelevant.

This leaves us with the other dimension in which the various VO constructions are similar to each other, and that is their syntax. It seems that learning one or two different verbs expressed with their direct objects facilitates the learning of other verbs in this construction, regardless of the semantics of the verb-object combination. Children seem to perceive and make use of similarity of form, and this is a possibility worth exploring in future research.

It has been claimed before that there is no evidence that early syntactic development is mediated by abstract semantic concepts of the Agent and Patient kind. Bowerman (1976) found that her child Eva began the acquisition of verbal multiword constructions very slowly, but then acquisition accelerated, and very soon she generated combinations with words of virtually all semantic subtypes. Her pattern of co-emergence of varied relational semantics did not support semantic groupings and similarity as a mediator for the accelerated learning. In a later paper, Bowerman (1982) concluded that patterns such as VO are apparently learned on a word-by-word, piecemeal basis for each verb, up to the attainment of adult competence by about 2;6. Only later do children start to generalize from one pattern to another on a semantic basis, this development bringing in its course overgeneralization errors. In Bowerman's two daughters this development occurred a year to a year and a half after mastery of the basic syntactic patterns. During the initial period of learning, there is no analogy or generalization from one pattern to another. Maratsos & Chalkley (1980) also concluded that children arrive at an adult level of knowledge of syntactic combinations without necessarily leaning on semantic categories as central mediating constructs.

The present study joins the literature in not finding evidence for semantic grouping and categories in children's early syntax. However, the results also show that transfer and facilitation do take place. This raises a new possibility, which is that item-specific learning is immediately and routinely accompanied by item-based transfer of learning. This process makes use not of analogy based on similarity of meaning among the participant items but, apparently, of analogy based on similarity of form among the syntactic patterns, and this is what mediates transfer and facilitation.

Moreover, the results suggest that there is no contradiction between item-based learning and facilitation. Apparently, it is perfectly possible that children learn grammatical rules for each lexeme separately from the linguistic input, on an item-specific basis, but nevertheless are able to use the same item-specific knowledge in order to deal with other lexical items. The key to these inter-item relations can be item-to-item transfer, not categorization, abstraction, generalization or any other switch from concrete to abstract representation of grammatical knowledge.

The reason why this possibility has not yet been explored in the field of syntactic development is probably because of the adoption of a paradigm of extrapolation (or innovation) rather than facilitation as a measure of generalization and productivity.

*Extrapolation from existing knowledge versus facilitation of learning*

Productivity of syntactic knowledge is very often modelled on the paradigm of analogical problem solving. In such a paradigm, one problem and its solution are already known to a person. Then, a new and unsolved problem presents itself, and the expectation is that the person would notice the correspondence or analogy between the old and new problems, and on the basis of this similarity, derive the solution to the novel problem. Applying this paradigm to syntactic development, authors have been looking for evidence of syntactic constructions in the child's speech without such constructions having been directly modelled in the linguistic input. One method has been searching for creative generalizations or overgeneralization errors in naturalistically occurring child speech, such as using an intransitive verb in a transitive construction (e.g., Bowerman, 1982). Another method is experimental: to present children with novel verbs in some neutral construction such as `This is verb-ing', then attempt to elicit from them the use of these verbs in specific argument-structure constructions such as the transitive or the passive. (e.g., Savage *et al.*, 2002).

It is however questionable if the paradigm of analogical reasoning with its creative extension of old knowledge to new problems has much relevance to the basic processes of syntactic development. It has been pointed out by Bowerman (1982) that syntactic overgeneralization errors are a late phenomenon, occurring in her two girls as late as a year to a year and a half after they had attained a level of adult competence in the expression of argument structure constructions.2 Moreover, the context in which children learn the basics of syntax is fundamentally different from the paradigm case in which analogical reasoning is expected to be applied: Young children are not, as a rule, presented with `unsolved problems' in the form of novel verbs presented in uninformative (i.e., syntactically neutral) sentence frames. Instead, there is copious parental modelling of the basic verb vocabulary, the verbs embedded in the appropriate syntactic constructions (Naigles & Hoff-Ginsberg, 1998; Goldberg, 1999; Ninio, 1999, 2003).

The task facing children is to learn `solved problems', namely, verbs and their syntax, from the input, rather than to make guesses about the correct `solutions' (syntax) for `unsolved problems', namely, for verbs lacking models for their syntactic behaviour. This is especially true for the learning of argument-structure constructions which are inherently arbitrary and a lexical feature of each verb (Chomsky, 1981). In concrete terms, children learning Hebrew syntax need to learn the preposition that goes with each verb on an item-specific basis. As piecemeal learning of argument-structure constructions is virtually obligatory, the learning task needs to be defined as learning from the input, not going beyond it.

However, it is clear that just having the data in the input is insufficient to have the children learn it -- otherwise they would immediately produce all the different VO combinations their elders produce in their presence, instead of having to work on the acquisition of this pattern for all participant verbs for quite a long time. Modelled forms might be necessary conditions for learning to happen, but they are not sufficient.

It follows that a model of syntactic development should address the question, what are the processes by which children confront and internalize the well-modelled exemplars they are presented with? What in this learning causes the difficulty and the delays, and makes the initial learning of syntactic patterns so drawn-out? And, what makes the later-learned exemplars so much easier, as evidenced by the fast rate by which new exemplars are assimilated to a novel construction after the first two or three have been learned in it? The results of this study contribute a new piece of information, which is that semantic similarity is not a factor in these processes.

It is very possible that, as Bowerman (1982) claims, semantic similarity plays a central role in children's creative overgeneralizations. However, semantics is apparently irrelevant to the learning process explored in this study, which is facilitated learning of item-specific syntactic constructions from modelled exemplars in the input. It seems that in this case the facilitation comes from having already mastered a similar task, at previous occasions in which such a type of multiword utterance was acquired. This kind of facilitation is best observed in the development of motor skills like learning to drive a new car after having driven previous ones, but it occurs also in cognitive development which, as Fischer (1980) has pointed out, resembles motor development quite closely.

In this model of development, each verb and its direct object is learned from modelled exemplars in the input and in this sense the learning is indeed item-specific, piecemeal, and time-consuming. However, each event of item-specific learning is facilitated by previously learned items, not because the items are semantically similar but because the to-be-learned syntactic construction is similar. Each different multiword construction poses a novel set of structural problems to be solved. When the construction is first learned for some specific verb, a child needs to solve the conceptual problems associated with that pattern, be it the mere construction of a two-word utterance, the concept of word order, the logico-semantic relation between a verb and its dependent object, or the use of a preposition for the object term. In a Piagetian, constructionist view, learning these fragments of information, developing all these pieces of linguistic skills, and putting them all together into a single complex schema for generating a novel kind of two-word combination such as the first VO sentence *want bottle* is the most difficult part of change and development. Using the same component skills for the generation of another VO combination centered on the same verb or for that matter on another verb is already less demanding, as the child has met and dealt with such a task before. This could explain why the learning of a novel syntactic pattern starts slowly but accelerates almost immediately, within the learning of the first 6 verbs in the construction; Apparently, breaking into a new syntactic combination means solving the conceptual problems associated with that pattern once and for all. The maximal effort goes into the learning of the construction with the first one or two verbs, but once that is done, the child's system is ready for transfer of learning, and the learning of further items in the same construction is done almost effortlessly.

In conclusion, the results of this study support a model of syntactic development which can be dubbed the paradigm of item-and-analogy: learning is lexically specific and concrete, but also transferable through structural analogy. This term refers in the literature to the similarity of the relational structure of two situations or domains despite differences in the objects that make up the domains (Gentner & Markman, 1997). It is not similarity of meaning but similarity of syntactic form that underlies the ability to transfer previous learning to new tasks. This conclusion fits well not only the current lexicalist approach to early argument structure constructions in young children, but also the lexicalist emphasis of theoretical linguistics regarding the best description of the adult knowledge. As mentioned in the Introduction, it is widely claimed (e.g., Chomsky, 1981) that the `subcategorization frames' of individual verbs must be registered in their lexical entry. Apparently, subcategorization frames are inserted into the many entries of the lexicon with a relatively low expenditure of learning effort, due to the operation of item-to-item analogy and transfer.

Footnotes

Note 1. Item-specificity is not only a characteristic of argument structures and syntactic multiword constructions. The same is true of the acquisition of morphology and other kinds of grammatical learning. The grammatical patterns for which this phenomenon has been documented include verb-morphology such as inflection for tense, aspect, and person; wh-question constructions; auxiliaries e.g., in yes/no questions; constructions with complement-taking matrix verbs getting *to* infinitives and other connectives and more. For a representative study, see Bloom, Lifter, & Hafitz (1980).

Note 2. Morphological overregularization errors are also quite late, see Maratsos (1982) for a review.

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Appendix

*The first six verbs learned in the VO pattern by each child*

|  |  |
| --- | --- |
| Child | First 6 verbs in the VO pattern |
| F-01 | *raca* `want'; *achal* `eat'; *shata* `drink'; *laqax* `take'; *xipes* `search'; *sam* `put' |
| M-02 | *hevi* `bring'; *raca* `want'; *laqax* `take'; *shata* `drink'; *yad'a* `know' |
| F-03 | *asa* `make/do'; *hevi* `bring'; *ahav* `love'; *hishpric* `spray'; *raca* `want'; *ciyer* `draw' |
| M-04 | *gamar* `finish'; *laqax* `take'; *bishel* `cook'; *achal* `eat'; *hevi* `bring'; *asa* `make/do' |
| M-05 | *raca* `want'; *sam* `put'; *shata* `drink'; *ciyer* `draw'; *pireq* `take apart'; *asa* `make/do' |
| M-06 | *laqax* `take'; *natan* `give'; *asa* `make/do'; *raca* `want'; *hishpric* `spray'; *hevi* `bring' |
| F-07 | *shata* `drink'; *patax* `open'; *asa* `make/do'; *carik* `need'; *laqax* `take'; *badaq* `examine' |
| M-08 | *raca* `want'; *hoci* `take out'; *patax* `open'; *tita* `sweep'; *horid* `take down'; *shata* `drink' |
| F-09 | *achal* `eat'; *raa* `see'; *patax* `open'; *horid* `take down'; *asa* `make/do'; *sagar* `close' |
| M-10 | *raca* `want'; *laqax* `take'; *hevi* `bring'; *sagar* `close'; *xipes* `search'; *asa* `make/do' |
| Appendix -- continued | |
| Child | First 10 verbs in the VI pattern |
| F-11 | *xipes* `search'; *bishel* `cook'; *hevi* `bring'; *raca* `want'; *patax* `open';  *shamar* `keep' |
| F-12 | *asa* `make/do'; *raca* `want'; *sagar* `close'; *mila* `fill'; *hirsha* `allow'; *raxac* `wash' |
| F-13 | *raca* `want'; *laqax* `take'; *asa* `make/do'; *shata* `drink'; *hoci* `take out';  *natan* `give' |
| F-14 | *natan* `give'; *asa* `make/do'; *hevi* `bring'; *hechin* `prepare'; *achal* `eat';  *ciyer* `draw' |
| M-15 | *raca* `want'; *natan* `give'; *achal* `eat'; *laqax* `take'; *hoci* `take out'; *nipeax* `blow up' |
| F-16 | *raca* `want'; *horid* `take down'; *asa* `make/do'; *hirsha* `allow'; *siyem* `finish'; *hilbish* `put clothes on someone' |
| F-17 | *raca* `want'; *natan* `give'; *niqa* `clean'; *horid* `take down'; *qana* `buy'; *raa* `see' |
| M-18 | *raca* `want'; *shata* `drink'; *lavash* `put on clothes'; *achal* `eat'; *hevi* `bring'; *asa* `make/do' |
| M-19 | *xipes* `search'; *laqax* `take'; *katav* `write'; *natan* `give'; *raca* `want'; *raa* `see' |
| F-20 | *raca* `want'; *laqax* `take'; *sam* `put'; *qara* (*shem)* `call' (name); *shamar* `keep'; *asa* `make/do' |

Table 1. *Types of semantic roles for Direct Objects in Hebrew*

|  |  |  |
| --- | --- | --- |
| Semantic Role  of Direct Object | Verb Semantics | Examples of Verbs |
| Affected object =Patient | Change of State | *shavar* `broke'  *mila* `fill' |
| Moved Object =Theme | Change of Location | *sam* `put'  *heziz* `move' |
| Transferred Object  =Gift & Object of Desire | Object Transfer & Desire for Object | *natan* `give'  *raca* `want' |
| Transferred Information | Transfer of Information | *amar* 'say'  *her'a* `show' |
| Object of Result  =Effected Object | Creation | *asa* `make/do'  *bana* `build' |
| Ingested Entity | Ingestion | *achal* `eat'  *shata* `drink' |
| Object of Perception & Cognition = Percept | Perception & Cognition | *raa* `see'  *yad'a* `know' |
| Contacted Object | Surface Contact - Emotion | *hika* 'hit'  *ahav* `love' |

Table 2. *Verbs learned by at least one child as one of the first six verbs with a DO, by the semantic role of the DO*

|  |  |
| --- | --- |
| Semantic Role of Direct Object | Verbs |
| Affected Object = Patient | *patax* `open'; *sagar* `close'; *niqa* `clean'; *gamar* `finish'; *tita* `sweep'; *pireq* `take apart'; *raxac* `wash'; *nipeax* `blow up'; *siyem* `finish'; *mila* `fill' |
| Moved Object = Theme | *horid* `take down'; *sam* `put'; *hoci* `take out'; *hishpric* `spray'; *lavash* `put on clothes'; *hilbish* `put clothes on someone' |
| Transferred Object = Object of Desire | *hevi* `bring'; *natan* `give'; *raca* `want'; *lakax* `take'; *xipes* `search'; *shamar* `keep'; *carik* `need'; *kana* `buy' |
| Transferred Information | *hirsha* `allow'; *qara* (*shem)* `call' (name) |
| Object of Result  =Effected Object | *asa* `make/do'; *hechin* `prepare'; *bishel* `cook'; *ciyer* `draw'; *katav* `write' |
| Ingested Entity | *achal* `eat'; *shata* `drink' |
| Object of Perception and Cognition | *raa* `see'; *yad'a* `know' |
| Contacted Object | *badaq* `examine'; *ahav* `love' |

Table 3. *Distribution of semantic categories among the first 6 DO types produced by the sample*

|  |  |  |
| --- | --- | --- |
| Semantic Role of Direct Object | Frequency | % of 6 DOs |
| Affected Object = Patient | 12 | 10.00% |
| Moved Object = Theme | 17 | 14.17% |
| Transferred Object = Object of Desire | 48 | 40.00% |
| Transferred Information | 3 | 2.50% |
| Object of Result = Effected Object | 21 | 17.50% |
| Ingested Entity | 13 | 10.83% |
| Object of Perception and Cognition | 4 | 3.33% |
| Contacted Object | 2 | 1.67% |
| Total | 120 | 100.00% |

Table 4. *Udi's sentences with his first 6 verbs with a DO, with classification of the direct objects' semantic role*

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Sentence Gloss Semantic role of direct object

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*Roce et-ze* `want this' Transferred / Desired Object

*Lo roce lishon* `don't want to-sleep'

*Lo roce bakbuk* `don't want bottle'

*Roce laredet* `want to-get-down'

*Roce hakadur* `want the-ball'

*Roce lishtot* `want to-drink'

*Lehoci ecem* `to-take-out bone' Moved Object

*Lehoci kof* `to-take-out monkey'

*Lehoci et-ze* `to-take-out this'

*Ima, lehoci madaf* `Mommy, to-take-out shelf'

*Lehoci et-ze madaf* `to-take-out this shelf'

*Liftoax et-ze* `to-open this' Affected Object

*Liftoax et shulxan* `to-open table'

*Liftoax, Ima, ze* `to-open, Mommy, this'

*David, tiftax kadur* `David, open ball'

*Tetate et-ze* `sweep this' Affected Object

*Lo torid Udi* `don't take-down Udi' Moved Object

*Udi lishtot mic* `Udi to-drink juice' Ingested Object

Table 5. *Distribution of number of different semantic roles among the first 6 DOs of the children*

|  |  |  |
| --- | --- | --- |
| Number of different semantic roles | Number of children | % of sample |
| 1 | 0 | 0% |
| 2 | 0 | 0% |
| 3 | 6 | 30% |
| 4 | 9 | 45% |
| 5 | 5 | 25% |
| 6 | 0 | 0% |
| Mean = 3.95 (S.D. 0.76) |  |  |