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Acquiring basic word order: evidence for data-driven learning of syntactic structure*

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ABSTRACT

Recent studies indicate that young English-speaking children do not have a general understanding of the significance of SVO order in reversible sentences; that is, they seem to rely on verb-specific formulas (e.g. NP_{pusher} – form of the verb PUSH – NP_{pushee}) to interpret such sentences (Akhtar & Tomasello, 1997). This finding raises the possibility that young children may be open to learning non-SVO structures with novel transitive verbs. To test this hypothesis, 12 children in each of three age groups (two-year-olds, three-year-olds, and four-year-olds) were taught novel verbs, one in each of three sentence positions: medial (SVO), final (SOV), and initial (VSO). The younger age groups were equally likely to use the novel (non-English) orders spontaneously as to correct them to SVO order, whereas the oldest children consistently corrected these structures to SVO order. These results suggest that English-speaking children's acquisition of a truly general understanding of SVO order may be a gradual process involving generalization (learning) from examples. The findings are discussed in terms of recent data-driven learning accounts of grammar acquisition.

INTRODUCTION

Natural languages use two grammatical devices to encode the relations among people, objects and events: case marking inflections and the

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sequencing of phrasal constituents within the clause (henceforth BASIC WORD ORDER).[1] Word order is a particularly important cue to sentence interpretation in English, especially in the case of semantically reversible sentences such as *The girl pushed the boy* (Bates & MacWhinney, 1989). The basic word order of English is subject-verb-object (SVO), but in Japanese it is subject-object-verb (SOV), and in Irish it is verb-subject-object (VSO); object-initial orders also occur, though less frequently (Derbyshire & Pullum, 1981; Pullum, 1981). A child learning the language of a specific community must therefore detect from linguistic input which is the prevailing basic word order in that community. How the child accomplishes this is the subject of some disagreement.

Some theorists describe the acquisition of basic word order as the setting of 'parameters' that capture the systematic variation among the world's languages (Pinker, 1984; Mazuka, 1996; Culicover, 1997). On this view, sample utterances act as 'triggers' for the setting of these parameters (Lightfoot, 1989; Gibson & Wexler, 1994). Other theorists, however, place more emphasis on linguistic input (data) and on the active role that children play in acquiring grammatical relations (Braine, 1988; Sampson, 1989; O'Grady, 1997). According to these authors, children's acquisition of grammar involves a slower process of inducing general patterns from specific examples. This theoretical approach can be characterized as invoking some form of 'data-driven learning' (Pine & Martindale, 1996; Pullum, 1996). A major difference between parameter setting and data-driven learning involves the quantity of linguistic data required by the child to master the basic word order of his/her language (Atkinson, 1987).

Proponents of parameter setting maintain that the acquisition of basic word order may be accomplished quite rapidly (triggered), on the basis of relatively little data. For example, Pinker (1994) states:

> All [children] have to learn is whether their particular language has the parameter value head-first, as in English, or head-last, as in Japanese. They can do that merely by noticing whether a verb comes before or after its object in any sentence in their parents' speech … Huge chunks of grammar are then available to the child, all at once, as if the child were merely flipping a switch to one of two possible positions. If this theory of language learning is true, it would help solve the mystery of how children's grammar explodes into adultlike complexity in so short a time. They are not acquiring dozens or hundreds of rules; they are just setting a few mental switches.

Support for this view comes from the fact that children do appear to learn

[1] Although there is some debate over the very notion of 'basic word order' (see Mithun, 1987), it will not be addressed here.

basic word order very rapidly; as soon as they begin to produce full sentences, they tend to employ accurate ordering of clausal constituents (Braine, 1976; Pinker, 1984; Bloom, 1991; Tomasello, 1992). Even in comprehension, very young children learning English seem to rely on strategies that indicate a sensitivity to the SVO order of English (Slobin & Bever, 1982; Bates, MacWhinney, Caselli, Devescovi, Natale & Venza, 1984; Hirsh-Pasek & Golinkoff, 1996).

While these facts about acquisition might seem to support parameter setting models, it is important to note that practically all existing studies of word order comprehension and production have examined children's performance with FAMILIAR verbs. Therefore, the possibility remains that young children do not have a truly GENERAL understanding of word order, but are being conservative and using only the orders they have heard modelled with individual verbs (Tomasello, 1992). That is, on hearing sentences such as 'She gave me a toy', children may form not a general principle such as 'SVIO' (subject – verb – indirect object – direct object), but rather a much more specific schema that is centered around the particular verb used. For example, the schema could be as specific as '[phrase denoting donor(s)] – [form of the verb GIVE] – [phrase denoting recipient(s)] – [phrase denoting gift(s)]'. Similarly, on hearing multiple sentences containing the verb *push* in sentence-medial position (e.g. 'The boy pushed the cat'), children may form the schema '[phrase denoting pusher(s)] – [form of the verb PUSH] – [phrase denoting pushee(s)]'.

There is some evidence that very young children acquiring English do show this pattern of verb-specific comprehension; that is, they understand word order with some verbs but not with others. Roberts (1983) showed that a young toddler might be able to correctly enact a transitive sentence containing the verb *tickle*, but not a similar sentence containing the verb *hug*. Older children were able to enact transitive sentences containing a wider range of verbs, leading to the conclusion that children's initial comprehension of word order is 'verb specific, gradually expanding, verb by verb, to apply across a wider scope of verbs' (p. 443). Verb-specific formulas such as those outlined above would lead to appropriate performance on tests of production and comprehension of word order with familiar verbs. Consequently, error-free use and comprehension of word order with familiar verbs cannot distinguish between truly general knowledge of basic word order and verb-specific knowledge of word order. What is needed is a test of how general young children's knowledge of word order is.

The only appropriate way to test for general knowledge is to use novel items; that is, it is necessary to assess whether children understand the use of word order with novel (unfamiliar) verbs. If children can use and comprehend word order correctly with verbs they've never heard before, then their understanding is probably general. This approach is inspired by

the famous *wug* test designed by Jean Berko (1958) to assess children's morphological productivity. She taught children novel names for novel objects and then tried to elicit plurals from them. The fact that preschoolers could add a plural morpheme to a word they had never heard in the plural form showed that they knew something general about plural formation. The current focus is on whether children learning English understand something general about the use of word order in transitive sentences. So, if, for example, one invented a novel causative action and called it *dacking*, would children know what to do when asked to 'Make Big Bird *dack* Cookie Monster'? Similarly, in producing sentences with the verb to *dack*, would they know that they must place any agent of the action before the verb, and any patient of the action after the verb?

A recent series of studies using this methodology indicates that English-speaking two-year-olds do not have a truly general understanding of SVO order (Akhtar & Tomasello, 1997). In these studies, children were taught novel verbs for novel actions consisting of one toy character acting on another. One verb was modelled without word order information; i.e. without expressing the agent and patient arguments (e.g. 'This is called *dacking*'). Another was modelled with both arguments in a full transitive frame; e.g., 'Big Bird's *tamming* Cookie Monster'. Children younger than 3;0 were unable to use word order correctly with the verb modelled without arguments. Moreover, they were at chance when asked to act out commands such as 'Make Big Bird *dack* Cookie Monster'; that is, half the time they enacted these commands backwards.[2] They were, however, accurate on an identical test of word order comprehension with the novel verb that had been modelled in the full transitive frame (i.e. with word order information). These findings support Tomasello's (1992) VERB ISLAND HYPOTHESIS that children learn the appropriate use of grammatical relations (e.g. word order) on a verb-by-verb basis. That is, initially children may rely quite heavily on linguistic input for information about the grammatical properties of specific verbs. Indeed, young children may be paying close attention to patterns in the language they hear and may be constructing generalizations on the basis of recurring patterns (Bates & MacWhinney, 1987; Bowerman, 1988; Braine, 1988; Cartwright & Brent, 1997; Ninio, 1988; Goldberg, 1998).

This possibility was investigated further in the current study by presenting English-speaking children with novel verbs in non-English orders. This unique methodological approach – which essentially involves presenting

[2] These children (*M* age = 2;9) were attending to the task and seemed to know that there was a correct response in that they often queried the experimenter 'Like this?' as they were preparing to act. The same children performed above chance on tests of comprehension of word order with both a familiar verb and the novel verb they had been taught in a full transitive frame. Therefore, their difficulties with the novel verb presented without arguments are not likely due to performance deficits.

children with models of ungrammatical input – may provide an avenue for distinguishing between parameter setting and data-driven learning as mechanisms of grammatical development. There are no natural languages in which some transitive verbs follow one ordering and some follow another. Consequently, some linguists have hypothesized that word order (or head direction) is PARAMETERIZED: that is, it is one of those aspects of language that does not have to be learned but rather is triggered by environmental input. A strong version of the parameter setting view therefore predicts that children will establish the basic word order of their language relatively early, and that their grammar will likely be unaffected by subsequent orders they might encounter. More specifically, it predicts that children will use only one word order (within a given language) with ALL transitive verbs. As English-speaking children's linguistic input is very consistent (they generally hear only SVO sentences), the only way to test this hypothesis is to expose children to novel verbs associated with orders not used in their native language.

This was the rationale for the current study. Three groups of children (*M* ages = 2;8, 3;6, and 4;4) were taught three novel verbs, one in each of three sentence positions: sentence-medial (SVO), sentence-final (SOV), and sentence-initial (VSO). Of the six possible orders, these three are by far the most frequently found in the world's languages (Tomlin, 1986). They are also the three used by Bates *et al*. (1984) in their examination of Italian and American children's comprehension of word order (with familiar verbs). The prediction of parameter setting models is that even the youngest children hearing non-English orders will not acquire the non-SVO orders; that is, they will not be willing to use the SOV or VSO orders because they have already set the head direction parameter. Instead, they may either ignore these verbs or may actively switch to using them in SVO order. Alternatively, if children are forming a generalization based on sample sentences, they will be conservative early in development in that they may acquire word order on a verb-by-verb basis (Roberts, 1983); that is, young children will constuct verb-specific formulas such as '[phrase denoting kicker(s)] – [form of verb KICK] – [phrase denoting thing(s) kicked]' before constructing the broader subject-verb-object generalization. From a strong version of the verb island hypothesis then, the prediction is that the youngest children will be willing to spontaneously use the non-SVO orders. They are not expected to switch these orders to SVO. Older children, on the other hand, will either ignore these orders, or will actively switch them to SVO, as they will have already formed the generalization that English is an SVO language.

METHOD

Participants

Thirty-six children participated: 12 ranged in age from 2;1 to 3;1 (*M* age = 2;8), 12 ranged in age from 3;2 to 3;11 (*M* age = 3;6), and 12 ranged in age from 4;0 to 4;9 (*M* age = 4;4). There were approximately equal numbers of males and females in each age group.

Materials

Three novel actions were constructed. All involved (pseudo)animate agents (puppet characters familiar to young American children; e.g. Sesame Street and Winnie-the-Pooh characters) acting on inanimate patients (e.g. a toy car, plastic food items). It was thought that this asymmetry in animacy would aid the children in appropriate construal of the scenes described by the verbs as causative actions. The *tamming* action involved a prop on which the inanimate toy was placed; a puppet hitting this prop caused the toy to be catapulted into the air. *Gopping* involved a puppet springing a toy off a platform connected to a metal coil; *dacking* involved a puppet knocking a toy down a curved chute.

Design and procedure

Children in each age group participated in three within-subjects conditions: SVO (e.g. Elmo *dacking* the car), SOV (Elmo the car *gopping*) and VSO (*Tamming* Elmo the car). The assignment of verb-action pair to condition (SVO, SOV, VSO) was counterbalanced across the three age groups; that is, within an age group, each verb was represented an equal number of times in each sentence position. The order of presentation of the conditions was similarly counterbalanced. All children were seen individually in a room in their preschool after becoming familiar with the experimenter (E) and an observer (O) in their classrooms. At the beginning of each session, E ensured that the child knew the names of all the puppets and toys; any puppet or object the child did not readily produce a name for was set aside. Each child participated in two experimental sessions and a free play session. A subset of the children also participated in a Control condition (see below). All sessions were videotaped by O who also transcribed children's use of the novel verbs.

Experimental sessions. In each experimental session, the children were exposed to all three of the novel verbs (consecutively), and they had multiple opportunities to perform and verbally describe the actions. Each verb was modelled with different puppets and toys filling the roles of agents and patients of the action. To ensure appropriate construal of the actions, before each was performed children were told to 'Watch what (puppet's name) is going to do to (toy's name)'. E then proceeded to describe the action being

performed with one of the novel verbs; e.g. *Look! Big Bird the car gopping!* Verbs were modelled in both the present progressive and the past tense; no auxiliaries were used. Language models were given in pairs and after each E performance of the action, the child was given a turn to perform the action as well (with puppets and objects of his/her choosing). For the first 10 trials, E simply told the child 'It's your turn now'. For the next 10 trials, E asked the child 'What's going to happen now?' before the child performed the action or 'What happened?' after the child had performed the action. These questions were designed to elicit use of the novel verbs. Both spontaneous and elicited uses of the verbs were transcribed by O and subsequently checked (from videotape) by E. This procedure was followed for each of the three verbs in a preassigned order, and the entire procedure was repeated a day or two later. Thus, each child received a total of 80 models of each verb, and a total of 20 questions per verb that were designed to elicit use of the novel verbs in sentences.

Coding and reliability. The main dependent measure consisted of the frequency of sentences (spontaneous and elicited combined) that children produced with the novel verbs during the experimental sessions. Only non-imitative sentences with both the agent and patient of the action expressed were included in the analyses. Sentences were classified as either matching or mismatching the order in which the verb had been modelled; as will be shown below, virtually all of the mismatches were produced in the non-SVO conditions, and all of these consisted of corrections to SVO order. E initially coded all of the transcripts of the experimental sessions. They were all subsequently coded by an independent coder who achieved 100% reliability with E.

Control condition. The children who used either or both of the non-SVO orders at least once during the experimental sessions were also tested in a control condition. This condition was intended as a control for compliance; it was possible that some of the children might have known that the non-SVO orders were not grammatical but may have used them only to please the experimenter. In this control condition children were exposed to a familiar verb in an ungrammatical order; e.g. *Elmo the car pushing*. The order used for a given child was the one that individual had used most frequently in the experimental phase of the procedure. The procedure was identical to that followed in the experimental conditions. The hypothesis was that, if children acquire word order on a verb-by-verb basis, then they will have already learned the appropriate order to use with the verb *push* (e.g. [phrase denoting pusher(s)] – [form of the verb PUSH] – [phrase denoting pushee(s)]), and will therefore resist using this verb in a novel order. If, however, the children

were merely being compliant, they should use the novel order in the control condition as well.

RESULTS

Frequency analyses revealed that older children were far more likely than the younger children to produce sentences containing the novel verbs (see Table 1 for the mean frequency of matches and mismatches in the three conditions

TABLE 1. *Mean frequency of matches and mismatches as a function of age and condition* (*standard deviations are in parentheses*)

		Condition		
Age		SVO	SOV	VSO
Two years	Matches	5·83 (6·32)	1·67 (2·93)	0·92 (1·44)
	Mismatches	0·00 (0·00)	1·33 (2·81)	1·58 (2·27)
Three years	Matches	8·58 (7·29)	3·17 (4·53)	1·75 (3·52)
	Mismatches	0·17 (0·39)	2·42 (4·03)	4·92 (6·19)
Four years	Matches	14·08 (4·56)	0·42 (0·90)	0·25 (0·62)
	Mismatches	0·00 (0·00)	8·83 (8·43)	9·92 (7·09)

Note. All mismatches in the SOV and VSO conditions were corrections to SVO order.

as a function of age). Therefore a decision was made to graphically display the mean proportion of all sentences containing a given verb that matched the order modelled with that verb. This measure serves to equate baseline performance in the three conditions and three ages. Figure 1 depicts the

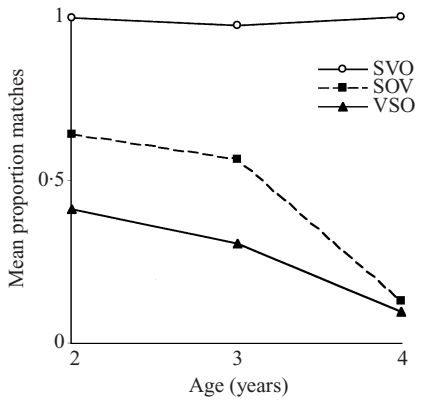

Fig. 1. Mean proportion of children's sentences matching the order modelled at each age in each condition. All mistakes in the SOV and VSO conditions were corrections to SVO order.

mean proportion of child sentences that matched the order modelled in each condition as a function of age. All statistical analyses reported below were conducted on the frequency data shown in Table 1.

As expected, all children consistently matched the order modelled in the SVO condition. There were only two utterances (one each from two three-year-olds) that did not match the order of the SVO verb. These exceptions are interesting because they each matched the order modelled with the immediately previous verb, indicating some type of priming effect. It should be noted, however, that any such effect was short-lived as it was seen only once in each of these two children and these same children also frequently matched the SVO order.

All other mismatches (in the SOV and VSO conditions) consisted of corrections to SVO order. Therefore, the converse of the proportions shown for these two conditions represents the proportion of corrections to SVO order. In the SOV condition, the two younger groups were equally likely to match the modelled structure as to make corrections to SVO order (paired t's (11) both < 1), whereas the four-year-olds were far more likely to correct the SOV order to SVO (paired $t\,(11) = 3{\cdot}47$, $p < 0{\cdot}01$). The same was true in the VSO condition: two- and three-year-olds were equally likely to match as to correct (paired t's $(11) = 0{\cdot}89$ and $1{\cdot}34$, p's $> 0{\cdot}20$, for the two- and three-year-olds respectively), whereas four-year-olds were more likely to correct than they were to match the VSO order (paired $t\,(11) = 4{\cdot}61$, $p < 0{\cdot}01$).

Thus, the younger children were clearly willing to USE the ungrammatical structures with the novel verbs; e.g. they said things like *Tigger the fork dacking* to describe Tigger performing the *dacking* action on a fork. (These children also made several corrections to SVO order – see below for a closer examination of these utterances.) It is important to reiterate that these uses of non-SVO order were not imitative; that is, the children spontaneously used the verbs with different agents and patients than the experimenter had. It is also unlikely the children thought the novel verbs were from another language as the verbs were always presented with English inflections (*-ing*, *-ed*) in sentences with English lexical items. However, to ensure that their performance was not due to non-linguistic factors such as compliance or simply being agreeable it is necessary: (1) to compare the younger children's performance in Session 1 versus Session 2 (to see whether these children were more likely to match later; i.e. after repeated E models of the non-SVO orders); and (2) to examine children's performance in the control condition.

Session 1 versus Session 2

As the two younger groups were equally like to match the order modelled in the non-SVO conditions as to correct to SVO order, it was important to see if there were any order effects in the data; e.g. did children begin by correcting E's use of the non-SVO orders and only later begin to assume this

usage themselves? To address this question, the frequency of matches in Session 1 was compared to the frequency of matches in Session 2. To avoid empty cells, data were collapsed over age (two- and three-year-olds) and over the two non-SVO conditions (SOV and VSO). A paired samples *t*-test revealed no significant difference in the frequency of matches in Session 1 ($M = 1{\cdot}75$) and the frequency of matches in Session 2 ($M = 2{\cdot}00$); $t\,(23) < 1$. There was also no difference in the mean proportion of matches in Session 1 vs. Session 2; $t\,(23) = 1{\cdot}03$, $p = 0{\cdot}31$. Apparently children were not more likely to use the non-SVO orders after they had heard more models of these orders.

Control condition

Fifteen children matched a non-SVO order at least once; 11 of them (four two-year-olds, four three-year-olds, and three four-year-olds) participated in the control condition in which a familiar verb (*push*) was modelled in a non-SVO order (the other four children were not available for testing because their families went on vacation). Figure 2 depicts the mean proportion of

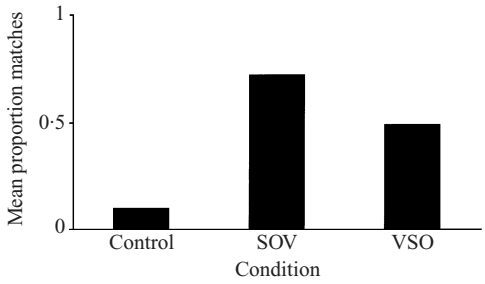

Fig. 2. Mean proportion of children's sentences matching the order modelled in the control and experimental conditions for the subset of children who matched the non-SVO orders. All mistakes were corrections to SVO order.

sentences matching the order modelled in the control, SOV, and VSO conditions for this subset of children who matched the non-SVO orders. In the control condition as well as in the two experimental conditions, all mismatches were corrections to SVO order. In the control condition, children were far more likely to correct the experimenter's use of the familiar verb to SVO order, than they were to match it (paired $t\,(10) = 4{\cdot}37$, $p < 0{\cdot}01$), whereas the same children were equally likely to match as to correct in the non-SVO novel verb conditions (both *t*'s < 1). Indeed, in the control condition, ALL of the children corrected to SVO several times, whereas only three of them occasionally matched this aberrant usage of word order with the familiar verb. Thus, it appears that the younger children were not simply mimicking the experimenter's use of non-English orders; they did so only

when the verbs were novel; that is, verbs for which they had not already developed a specific word order schema to follow (i.e., the SOV and VSO verbs). These same children systematically corrected the E's use of novel word orders to SVO order when the verb being used was familiar to them; that is, a verb for which they had presumably already constructed a schema (e.g. NP_{pusher} – form of the verb PUSH – NP_{pushee}).

Characterizing individual children's performance

The analyses reported above indicate that, as a group, two- and three-year-olds were equally likely to match the non-SVO orders as they were to correct them to SVO order. It is necessary to examine individual children's patterns of performance in the non-SVO conditions to determine whether the group means conceal a bimodal response pattern, such that some children never corrected to SVO and others always did. Table 2 presents the number of

TABLE 2. *Number of children in each age group displaying different patterns of performance in the non-SVO conditions*

	Two-year-olds	Three-year-olds	Four-year-olds
No sentences	3	0	0
Matched only	1	3	1
Matched & corrected	5	2	3
Avoided use	2	3	0
Corrected only	1	4	8

children in each age group who showed qualitatively different patterns of performance in the non-SVO conditions.

Three of the two-year-olds did not use any of the novel verbs in full sentences; nothing can be said about their knowledge of SVO order. Selectively avoiding use of the non-SVO verbs (that is, using the SVO verb but neither the SOV nor the VSO verb in full sentences) could be considered to be a measure of sensitivity to SVO order; two of the two-year-olds and three of the three-year-olds showed this pattern of performance. Only one two-year-old (along with three three-year-olds and one four-year-old) consistently matched the non-SVO orders. Only one two-year-old consistently corrected the non-SVO orders to SVO, whereas four three-year-olds and eight four-year-olds did so. Five of the two-year-olds showed some mixing of matching and correcting, as did two three-year-olds and three four-year-olds. Recall, however, that the frequency analyses demonstrated that the two-year-olds matched the non-SVO orders about as frequently as they corrected, whereas the corresponding four-year-olds made far more frequent corrections than matches. In combination with the group analyses then, the individual data indicate developmental trends in children's willingness to

spontaneously use the non-SVO orders such that, compared to the four-year-olds, the younger children were: (1) more likely to match these orders; and (2) less likely to consistently correct these orders to SVO. However, as indicated previously, the two younger groups of children were equally likely to correct the non-SVO orders to SVO as they were to use the non-SVO orders. As a strong version of the verb island hypothesis would not predict any corrections to SVO order in the youngest children, it is important to examine more closely the nature of these corrections.

Corrections to SVO order

There are indications from previous studies that children's early grammatical knowledge may be organized around any high frequency word or grammatical marker (e.g. case-marked pronouns; Akhtar & Tomasello, 1997), suggesting that children may construct syntactic schemas that are structured around lexical items other than verbs. For example, two-year-olds may form schemas of the sort 'He-verb-him' in addition to schemas centred around specific verbs (pusher-push-pushee). Examining children's use of pronouns in their corrections to SVO in the non-SVO conditions may provide further support for this more general hypothesis of lexically specific (as opposed to verb-specific) syntactic knowledge. All of the children's corrections to SVO order in the SOV and VSO conditions were collated and coded for number of lexical NP arguments (e.g. *the spoon*, *Ernie*) and number of pronominal arguments (e.g. *He*, *him*, *it*). As E never modelled pronominal arguments with any of the novel verbs, any use of pronouns by the children were, by definition, productive. Data were collapsed over the two non-SVO conditions (SOV and VSO) and are displayed in Table 3.

TABLE 3. *Number of pronominal and lexical arguments produced by children in their matches and mismatches* (*corrections to SVO*) *in the non-SVO conditions*

	Matches		Mismatches (corrections to SVO)	
Age	Pronominal	Lexical	Pronominal	Lexical
Two years	0	62	33	37
Three years	0	118	82	96
Four years	1	15	233	221

This table presents the number of pronominal and lexical arguments produced in children's matches and mismatches (i.e. corrections to SVO) in the non-SVO conditions. The most striking finding is that, with one exception, NONE of children's matches in the SOV and VSO conditions

contained pronominal arguments; in other words, whenever children used a pronoun with the non-SVO verbs, they used SVO order. This is significant because it supports the hypothesis that children may be learning the privileges of occurrence of specific pronouns; that is, some sentence schemas may be structured around pronouns as opposed to verbs (see Pine, Lieven & Rowland, in press). Another possibility is that the young children have some general knowledge of the SVO structure of English; they may know for example that animate agents should come before verbs in sentences and inanimate patients should be placed after the verb (Dodson & Tomasello, in press). It is impossible to assess this hypothesis with the current data because all of the actions used were always enacted with animate patients and inanimate patients; i.e. animacy of the participants was not systematically varied. The important point, however, is that even the youngest children were able to sometimes produce SVO sentences (with both lexical and pronominal arguments) with verbs they had only heard in non-SVO sentences. This finding is not consistent with the strong version of the verb island hypothesis outlined in the introduction. The implications of this finding will be explored in the discussion.

DISCUSSION

In this study, children were exposed to novel (non-SVO) grammatical structures used to describe the actions of an animate agent on an inanimate patient. The main question was whether the youngest children, who presumably do not have a fully general understanding of the SVO order of English (Akhtar & Tomasello, 1997), would acquire these structures. Two-year-olds did use the non-SVO orders with novel verbs; e.g. half of their sentences employing the SOV verb were of the form *Big Bird the grapes gopping* to indicate that Big Bird was performing an action on some grapes. As a group, three-year-olds showed the same pattern. The oldest children tested, however, were resistant to the experimenter's odd usage of word order and, for the most part, tended to correct the non-SVO orders to make them sound like English. Finally, control analyses indicated that the younger children's performance was not simply the result of a tendency to mimic or please the experimenter: children who used non-SVO orders with novel verbs did not do so when a familiar verb was presented in a non-SVO sentence (*Elmo the car pushing*).

These results support the hypothesis that acquisition of a general understanding of the syntactic significance of word order is a gradual process (Akhtar & Tomasello, 1997; Roberts, 1983) and therefore do not fit with strong parameter setting models of acquisition. However, Hyams (1994) has recently proposed that while setting parameters involves discrete changes in the child's grammar, these discrete changes may not necessarily be reflected in the child's use of language. Hyams invokes the distinction between

I(nternalized)- and E(xternalized)-language to explain this paradoxical statement. She claims that parameter setting affects I-language (the system of grammatical knowledge the child possesses), whereas E-language (the set of actual or potential utterances) is a result of many interactions between parameters and factors outside of core language. Therefore, one should not expect to see discrete steps in the development of the child's actual speech. If this is true, parameter setting models can be consistent with gradual acquisition of grammatical relations. However, it is important to note that child language researchers only have access to E-language; there therefore appears to be no empirical way to test Hyams's claims. Moreover, it is not at all clear that this view of grammatical development would actually predict that specific characteristics of the input would influence children's E-language in the specific way they obviously did in this study.

Although in general the data do seem consistent with the notion that children's early grammatical development is data-driven, it is important to point out that they also do not support the strong version of Tomasello's (1992) verb island hypothesis that children initially frame their grammatical knowledge around individual verbs. Previous research has shown that young children tend to be quite conservative and use verbs only (or mainly) with the argument structures with which they have heard them used (Akhtar & Tomasello, 1997; Olguin & Tomasello, 1993). Recall, however, that the youngest children in the current study were just as likely to employ SVO order with a verb they had heard only in SOV or VSO order as they were to replicate the order modelled. There are two possible interpretations of this finding.

One interpretation is that two-year-olds have more verb-general knowledge than they have previously been credited with. Perhaps the unique methodology used in the current study (presenting novel verbs in ungrammatical sentences) was better able to elicit this verb-general knowledge than previous methods. The second possibility, not incompatible with the first, is that the young children's corrections to SVO order may be based on knowledge of the privileges of occurrence of the specific lexical items that were used as arguments of the novel verbs (Dodson & Tomasello, in press; Pine *et al.*, in press). For example, by 2;8, children may have formed schemas of the sort 'he-verb-him' that allowed them to insert the novel verbs into the appropriate (sentence-medial) position. Knowing that words like *he* and *I* almost always occur in sentence-initial position and that *him* occurs most frequently at the end of sentences would constitute enough information for children to demonstrate the type of productivity exemplified in many of their corrections to SVO order.

The same type of knowledge can also explain children's tendency to place the names of inanimate objects after the verb in their corrections to SVO order: the names of most inanimate objects tend to occur postverbally in

transitive sentences. For example, before participating in this experiment, children may have heard the word *grapes* far more frequently in the postverbal position (*I want the grapes*; *He ate the grapes*). This lexically specific knowledge may have allowed them to form SVO sentences with the non-SVO verbs. As Pine *et al*. (in press) maintain, this account of children's early grammatical knowledge can explain verb island type effects as well as the limited productivity shown by two-year-olds in the current study. All other things being equal, verbs tend to occur more frequently and in more consistent positions in English input than do the nouns or noun phrases that occur as the arguments of these verbs in sentences: therefore, children should be more likely to construct verb-specific schemas than noun-specific ones.

The current findings thus add to a growing body of literature indicating that young children's grammatical knowledge is initially organized around specific lexical items (Pine & Martindale, 1996; Lieven, Pine & Baldwin, 1997; Akhtar & Tomasello, 1997; Pine *et al*., in press; Tomasello & Brooks, in press). They also fit well with a recently proposed computational model of syntax acquisition (Cartwright & Brent, 1997). Cartwright & Brent (1997) describe and provide evidence for a formal model in which children initially form syntactic 'templates' on the basis of distributional analyses of linguistic input. These templates (which are analogous to what we have described as sentence schemas) serve as the basis for the formation of syntactic categories and the resulting productivity these categories license. According to this view, children do not have any general knowledge of syntactic categories until they have acquired enough similar templates from which they can abstract a general pattern. This view is consonant with Marchman & Bates' (1994) CRITICAL MASS HYPOTHESIS (another specific form of the data-driven learning hypothesis). The essential idea is that children must acquire a sufficient number of exemplars (data) before abstracting general patterns that lead to productivity of the sort demonstrated by the four-year-olds in the present study. In the specific case of word order in transitive sentences, it is probably only after children have acquired many different transitive verbs, and have heard others use word order contrastively with these verbs, that they will be able to form a truly general understanding of SVO order. Before this point, however, they tend to replicate the structures modelled with individual verbs they encounter.

While the current findings provide strong support for data-driven learning of syntactic structure, it should be emphasized that the claim being made is not that English-speaking two-year-olds know nothing about the canonical order of English sentences. Young children clearly attend to word order (even infants do; Mandel, Kemler Nelson & Jusczyk, 1996); they are also able to respond appropriately in tests of word order with familiar verbs (see recent review by Hirsh-Pasek & Golinkoff, 1996). Even in the current study, the two younger groups of children displayed their sensitivity to SVO order

in a number of ways: most of them were more likely to use the SVO verb than the non-SVO verbs, some consistently avoided use of the non-SVO verbs, and, most importantly, some even switched the non-SVO verbs to SVO order. The main point is that there is considerable development taking place between two and four years of age in just how general children's understanding of word order is. Whereas the younger children seem to be in the process of constructing a truly general understanding of the syntactic significance of word order (that all English sentences must employ SVO order), the four-year-olds were simply not willing to use the non-SVO structures. These older children systematically and consistently corrected the experimenter's non-SVO usage to SVO.

The fact that development of this very basic grammatical device is protracted and involves general processes of exemplar-based learning (Chandler, 1993) challenges the notion of a specialized acquisition mechanism dedicated to grammar (O'Grady, 1997). The rationale frequently offered for postulating domain-specific mechanisms for grammatical development is that they account for the rapidity and accuracy with which children acquire language (e.g. Pinker, 1994; Culicover, 1997). However, the current findings indicate that one cannot infer mastery of a given grammatical device from children's appropriate use of that device in their daily speech (Rubino & Pine, 1998). Early correct use of word order with familiar verbs, for example, is most likely the result of lexically-specific formulas such as those described above. The current findings therefore highlight the importance of assessing children's linguistic competence with novel items. With this approach, it becomes clear that English-speaking children's mastery of SVO order is a rather gradual process: two- and three-year-olds happily say 'Big Bird the ball *gopping*' if that is how they have heard the verb *gopping* used. Four-year-olds, however, have encountered enough English sentences to form a generalization that allows them to actively switch non-English orders to English.

Whereas these specific findings would not have been predicted within most parameter setting models of syntax acquisition, the results are perfectly compatible with theoretical perspectives that grant a larger role to the linguistic environment and to the learning capabilities of the young child (Sampson, 1989; Goldberg, 1995; Lieven *et al.*, 1997; O'Grady, 1997; Tomasello & Brooks, in press). As even infants appear to be armed with powerful abilities to detect statistical regularities in the speech stream (Saffran, Aslin & Newport, 1996), the current findings raise the intriguing possibility that many aspects of linguistic structure may be acquired by attention to patterns in linguistic input (Cartwright & Brent, 1997).

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