LEARNING ANIMACY HIERARCHY EFFECTS IN SESOTHO DOUBLE OBJECT APPLICATIVES

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Researchers have long debated the means by which children learn the argument structure of verbs. Making syntactic generalizations often entails learning the semantics of different verbs, complicating and delaying the acquisition process. This study investigates four- to twelve-year-olds' and adults' knowledge of animacy hierarchy restrictions on postverbal word order in Sesotho double object applicatives, constructions where verb semantics is kept constant. Performance on forced-choice elicited production tasks showed that four-year-olds have early knowledge of the animacy hierarchy restrictions, providing evidence of syntactic generalization even on low-frequency constructions. Although there were no verb frequency effects, performance was also better on the highest-frequency animacy constructions. The results suggest that learning restrictions on verb-argument structure is facilitated when verb semantics is not a confound, but that construction frequency also plays a role in mastering the argument structure of verbs.[*]

1. INTRODUCTION. Researchers of language acquisition have long been interested in how children learn the argument structure of verbs (e.g. Bowerman 1974, 1990, Pinker 1984, 1989, Tomasello 1992, 2000, Naigles 1996, 2002, Fisher 2002). This is part of the more general problem of how language learners come to avoid making syntactic overgeneralizations (Baker 1979, Baker & McCarthy 1981). Proposals have ranged from innatist views to lexical or construction theories of learning. For example, Pinker (1989) suggests that children come equipped with an innately given set of semantic verb classes and a set of thematic linking rules that might facilitate learning the syntax of verbs. The semantic bootstrapping view predicts certain semantic overgeneralizations, including misclassification of verbs with respect to the semantic class to which they belong. This view has recently been challenged by researchers suggesting that young children initially learn verbs and their arguments as unanalyzed lexical verb-islands, only later beginning to categorize verbs into productive verb classes (e.g. Tomasello 1992, 2000, Lieven et al. 1997). The item-based view predicts few overgeneralization errors, but also little flexibility with respect to the syntactic frames in which verbs are used. Alternatively, Bowerman (1990) proposed that children may begin to classify verbs from the beginning of language acquisition, but that verb classes are constructed through positive evidence from the ambient language (see also Naigles 1996, Fisher 2002). Thus, though errors may occur along the way, children have some idea about verb classes and the syntax of verbs from very early in the acquisition process.

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Some of the controversy surrounding the issue of when and how verb-argument structure is learned is confounded in English due to the very narrow semantic classes of verbs to which certain syntactic operations apply. For example, participation in English dative shift is determined by the lexical semantics of the verb, with recipient-like objects freely reordering (1), but benefactives not (2) (cf. Oehrle 1976, Goldsmith 1980, Stowell 1981).[1]

(1) a. We're baking a cake for grandma.
    b. We're baking grandma a cake.
(2) a. We're filing the report for the president.
    b. *We're filing the president the report.

Learning the restrictions on English dative-shift constructions therefore requires learning specific lexical semantic relations, a process that can extend to twelve years and beyond for low-frequency, multisyllabic Latinate verbs (cf. Mazurkewich & White 1984, Randall 1992). We suggest that this aspect of lexical learning has contributed to some of the controversy regarding how children learn to generalize verb-argument structures, especially in the domain of double object (DO) constructions (cf. Waryas & Stremel 1974, Cook 1976, Osgood & Zehler 1981, Roeper et al. 1981, Gropen et al. 1989, Snyder & Stromswold 1997).

In contrast, we predict that the syntactic constraints on the order of postverbal objects in Bantu double object applicative (DOA) constructions should be easier to learn. First, the same word-order constraints apply to all ditransitive applicative verbs in a given Bantu language (Machobane 1989, Bresnan & Moshi 1990). Second, these verbs are morphologically marked with an applicative morpheme, uniquely identifying the class of verbs to which these syntactic word-order constraints apply (e.g. Sesotho *reka* 'buy' > *rek-el-a* 'buy for'). Since these morphemes are extremely productive, occurring with a broad range of verb classes and with fairly predictable semantic consequences, the problem of learning the syntactic restrictions on verb-argument structure can be separated from issues of learning lexical verb semantics. Third, unlike English, DOA word order in Bantu languages is not influenced by discourse-pragmatic constraints (cf. Bresnan & Nikitina 2003 for a review, and Moshi 1999 for the exceptional case of Kichaga). Thus, Bantu languages, and DOAs in particular, provide an ideal testing ground for examining the learning of verb-argument structure when verb semantics is not a factor, reducing the learning problem to one of parameter setting (Hyams 1986). Under these simplified learning conditions it is then possible to focus on how and when children make generalizations regarding verb-argument structure, and if there are any lexical item effects. For example, if rule-like generalizations are affected by the frequency of the verb in the ambient language, this would provide support for a more lexical or item-based approach to learning syntactic generalizations.

Recent research has increasingly shown that sensitivities to frequency effects appear in studies of both young children and adults, and in a variety of perception, priming, processing, and production tasks. Some of this research has focused on low-level linguistic structures such as segments, phoneme sequences, and stress placement (Vitevitch et al. 1997, Anderson et al. 2003), and higher-level phonological units such as syllable and prosodic word structure (Levelt et al. 2000, Roark & Demuth 2000, Demuth 2001, Kirk & Demuth 2003). But these effects have also been found on higher-level syntactic

[1] See also Oerhle 1976 for discussion of phonological constraints (number of syllables in the verb) on dative-shift verbs, and Bresnan & Nikitina 2003 for discussion of the discourse/pragmatic and other issues that determine the optimal conditions for dative shift.

structures such as the acquisition of passives (Demuth 1989, Braine et al. 1990, Gordon & Chafetz 1990) and the probability of different argument structures in adult and child sentence-processing tasks (Bock 1982, Bock et al. 1992, Boland et al. 1995, Garnsey et al. 1997, Trueswell & Kim 1998, Trueswell et al. 1999). These sensitivities to frequency effects at different levels of linguistic structure are also implicated in processes of historical change (e.g. Bybee & Hopper 2001). Thus, we also predict that children may exhibit frequency effects across construction types (Goldberg 1995), performing better on those DOAs they most frequently hear in everyday speech.

Previous investigation of children's spontaneous use of Sesotho applicative constructions shows that two- to three-year-olds productively use the applicative morpheme, alternating between applicative and nonapplicative uses of the same verb (Demuth 1998). In addition, these children use ditransitive applicatives with a number of different surface realizations of arguments (e.g. as DOAs, in passives, with preverbal incorporated pronominals (cf. Demuth & Johnson 1989)). It therefore appears that very young children have some productive knowledge of ditransitive applicative verbs and can use them in a number of different surface syntactic frames. However, DOA constructions are not overly abundant in the input children hear. This is primarily due to the fact that the benefactive argument of a ditransitive verb has often been previously mentioned in the discourse, therefore surfacing as a preverbal incorporated pronoun rather than as a postverbal argument. Furthermore, in cases where the theme object has been previously mentioned in discourse, it may be optionally realized as null (Demuth et al. 2000). Thus, although we predict that the word-order restrictions on Sesotho DOA constructions should be relatively easy to learn since the verbs are morphologically marked and no learning of verb semantics is required (cf. Naigles 2002), the fact that these constructions occur infrequently may mean that learning object word order and its interaction with the animacy hierarchy (AH) takes longer than might otherwise be expected.

Results from a previous experimental study of Sesotho-speaking three- to eight-year-olds found that all participants had some awareness that animacy plays a role in determining postverbal word order in Sesotho DOA constructions (Demuth et al. 2003). However, three-year-olds also showed lexical frequency and construction effects. The results of that study therefore showed evidence of syntactic generalization, construction effects, and item-based learning, calling into question the polarized nature of the debate about how verb-argument structure is learned. Only five verb stimuli were used in each condition in that experiment, however, and performance was extremely variable, with high levels of standard deviation. In addition, Sesotho DOAs actually show AH effects (Silverstein 1987, Woolford 1999), placing human objects before nonhuman animates such as animals. All of the animate objects in the previous study were human, leaving many questions unanswered about how and when these AH relations are learned. The goal of the present study is therefore to assess children's acquisition of verb-argument structure in these different animacy conditions to determine when children begin to show evidence of syntactic generalization, evaluating both lexical verb frequency and overall construction frequency as possible factors influencing the course of acquisition.

2. ANIMACY HIERARCHY EFFECTS IN SESOTHO DOUBLE OBJECT APPLICATIVES. The applicative morpheme in Bantu languages is infixed toward the end of the verb stem (after the verb root, but before the final vowel), adding another argument to the verb. In the case of a transitive verb, adding the applicative morpheme renders the verb ditransitive.

This is illustrated below, where 3a is the transitive form of the verb *reka* 'buy', and 3b is the ditransitive DOA form *rekela* 'buy for'.[2]

(3) a. Mosadi o-rek-a dijo.
woman AGR-buy-FV food
'The woman is buying food.'
b. Mosadi o-rek-el-a ngwana dijo.
woman AGR-buy-APL-FV child food
'The woman is buying food for the child.'

Bantu applicatives are used with a broad range of verbs where the applicative argument may take the thematic role of benefactive/malefactive, locative, goal, reason, and in some languages, instrument. The thematic role most frequently associated with the applicative is the benefactive, and this is the focus of the discussion below.

Bantu DOAs are one of the best-studied constructions across Bantu languages (e.g. Sesotho (Morolong & Hyman 1977, Machobane 1989), Haya (Duranti & Byarushengo 1977, Hyman & Duranti 1982), Chichewa (Marantz 1984, Baker 1988, Alsina & Mchombo 1990), Kichaga (Bresnan & Moshi 1990), and Chishona (Harford 1993)). They are particularly interesting due to the fact that Bantu languages typically have few prepositions, raising the issue of which object is the true object of the verb. One of the tests for objecthood is whether the noun phrase can pronominalize (become a preverbal incorporated pronoun) and whether it can become the subject of a passive. Bresnan and Moshi (1990) have characterized this as a parameter of variation, where languages showing object properties for both object NPs are characterized as symmetrical languages (e.g. Kihaya, Kimeru, Mashi, Luya, and Chichewa-B), and those showing restricted object properties are characterized as asymmetrical languages (e.g. Kiswahili, Chimwini, Hibena, Chichewa-A). Importantly, symmetrical languages permit unspecified object deletion of the theme argument, whereas asymmetrical languages do not. Both symmetrical and asymmetrical languages, however, exhibit benefactive-theme word order after the verb (though see Moshi 1999 for evidence of changes in word order with discourse focus in Kichaga). Given this typology of applicative syntax, one can ask how this parameter of variation might be learned. Presumably learners would need to consider which objects undergo pronominalization and passivization, and whether unspecified themes can be dropped.

The situation is more complex in Sesotho—a symmetrical object language where the animate (rather than the benefactive) object must occur immediately after the verb (Morolong & Hyman 1977, Machobane 1989). The reverse order is ungrammatical, as show in 4b.

(4) a. Mosadi o-rek-el-a ngwana dijo.
woman AGR-buy-APL-FV child food
'The woman is buying food for the child.'
b. *Mosadi o-rek-el-a dijo ngwana.
woman AGR-buy-APL-FV food child

If both objects have equal animacy (i.e. both are animate or inanimate), either order of objects is permitted, even if it is obvious that one of the objects is semantically the

[2] A modified (more phonetically transparent) version of Lesotho orthography has been used (cf. Doke & Mofokeng 1985). Glosses are as follows: AGR: subject-verb agreement, APL: applicative, FV: final vowel (mood), OBJ: preverbal incorporated pronominal object.

benefactive, as *jase* 'jacket' is in 5. With the two human objects in 6, it is ambiguous as to which argument is the benefactive. This is shown by the two possible interpretations for each.

(5) a. Thabo o-rek-el-a konopo jase.
Thabo AGR-buy-APL-FV button jacket
'Thabo is buying the button for the jacket.'
b. Thabo o-rek-el-a jase konopo.
Thabo AGR-buy-APL-FV jacket button
'Thabo is buying the button for the jacket.'

(6) a. Re-tlis-ets-a ngwana nkhono.
AGR-bring-APL-FV child grandmother
'We're bringing the child for the grandmother.'
'We're bringing the grandmother for the child.'
b. Re-tlis-ets-a nkhono ngwana.
AGR-bring-APL-FV grandmother child
'We're bringing the child for the grandmother.'
'We're bringing the grandmother for the child.'

The literature has generally discussed this phenomenon as one of animacy distinction (Morolong & Hyman 1977, Machobane 1989). However, our research shows that these relations are actually sensitive to animacy hierarchy effects. Thus, if one of the animate arguments is human and the other an animal, the objects are no longer reversible; the object that is highest in animacy (i.e. the human argument) must be ordered immediately after the verb (7). Although both arguments are animate, they differ in the degree of animacy, thereby invoking a restriction on postverbal word order.

(7) a. Re-tlis-ets-a morena nku.
AGR-bring-APL-FV chief sheep
'We're bringing the sheep for the chief.'
b. *Re-tlis-ets-a nku morena.
AGR-bring-APL-FV sheep chief

Word-order restrictions on Sesotho DOAs are therefore quite subtle. Learning these syntactic restrictions becomes even more problematic given that constructions such as those in 5, 6, and 7 rarely occur in everyday speech. An examination of the Demuth Sesotho Corpus (ninety-eight hours of spontaneous speech between two- to four-year-old children and adults (cf. CHILDES database online: http://childes.psy.cmu.edu)) found 989 ditransitive benefactive applicatives used, but only eleven of these occurred as DOAs with two postverbal objects, all with a human benefactive and an inanimate theme.

One of the reasons DOAs are not more abundant is that one of the objects is typically realized as a preverbal incorporated pronoun (8a,b), and/or the theme is realized as a null argument (8a′,b′), either through processes of unspecified object deletion or through being previously mentioned in the discourse. Both processes effectively reduce the contexts in which DOA constructions occur.

(8) a. Banana ba-mo-pheh-el-a nama.
girls AGR-OBJ_{ben}-cook-APL-FV $meat_{theme}$
'The girls are cooking the meat for her.'
a.′ Banana ba-a-mo-pheh-el-a.
girls AGR-PRES-OBJ_{ben}-cook-APL-FV
'The girls are cooking (the meat) for her.'

b. Banana ba-e-pheh-el-a mme.
girls AGR-OBJ$_{theme}$-cook-APL-FV mother$_{ben}$
'The girls are cooking it for my mother.'

b.′ Banana ba-pheh-el-a mme.
girls AGR-cook-APL-FV mother$_{ben}$
'The girls are cooking (it) for my mother.'

Pronominalization and passivization in Sesotho also interact with animacy, the theme being prohibited from undergoing these syntactic operations if the benefactive is inanimate and the theme animate (Morolong & Hyman 1977). However, there were no cases of this distribution of animacy in the Sesotho Corpus. Thus, human–inanimate pairings of objects are common in Sesotho DOAs, where the human is typically the benefactive argument and the inanimate argument is the theme. In contrast, human–animal, animal–inanimate, and objects of equal animacy (e.g. human–human, or inanimate–inanimate) occur much less frequently, both in the input children hear and in their own speech. This raises questions about how and when Sesotho-speaking children learn about the AH and its role in determining postverbal word order in DOAs.

If learning the AH is protracted, we might expect children to perform well on the high-frequency human–inanimate conditions, and less well on the lower-frequency constructions. By contrast, children could have some understanding that the AH is implicated in determining DOA word order, performing above chance on all conditions, but still showing differences in performance between higher- and lower-frequency constructions. Either would indicate that the relative frequency of different syntactic constructions also plays an important role in determining how and when children make syntactic generalizations regarding verb-argument structure. Alternatively, children might initially learn DOAs verb by verb, with syntactic generalization taking place at a later point in time (e.g. Tomasello 1992, Lieven et al. 1997). If so, we would expect to find lexical frequency effects. Finally, given that the benefactive argument is typically human, and it is the benefactive argument that is ordered first in most other Bantu languages, learners might assume that it is the benefactive, rather than the most animate object, that should be ordered immediately after the verb. That is, learners might extract the wrong generalization, assuming that thematic role, rather than the AH, determines DOA word order in Sesotho.

In order to test these hypotheses we conducted a forced-choice elicited production experiment to examine children's and adults' knowledge of Sesotho animacy effects on the word order of Sesotho DOAs. The study followed closely the procedures used in Demuth et al. 2003, but included new conditions designed to examine AH issues, many more stimuli per condition, older children, and inherently ditransitive (nonapplicative) DO constructions.

3. METHOD. The goal of the experiment was to assess children's knowledge of the word-order constraints on Sesotho DOA constructions. The study was therefore designed to test children's knowledge of various animacy conditions. Sesotho-speaking children occasionally produce DOA constructions by 2;8 years (Demuth 1998), and these constructions are generally used when both objects are introduced into the discourse for the first time. Recall that objects that have been previously mentioned in the discourse are typically realized as a preverbal incorporated pronominal or as a null object. It was therefore decided that a forced-choice elicited production task, where both postverbal word orders were modeled with no previous discourse, would most effectively tap children's underlying grammatical knowledge of these constructions (cf. Thorton 1996). Furthermore, this procedure had been successful in the previous set of experimental studies (Demuth et al. 2003).

3.1. PARTICIPANTS. The experiments were conducted in the southern African country of Lesotho. Child participants were drawn from Sesotho-medium preschools and primary schools in the capital city Maseru and the university area in Roma, and included sixty-four children between the ages of four and twelve (see Table 1). Twelve adults were also tested at the National University of Lesotho in Roma and included lecturers, students, and staff. The children were all monolingual speakers of Sesotho, English being introduced only as a subject in first grade. The adults were bilingual in Sesotho and English. Each age group was balanced for gender.

NUMBER	AGE GROUP	MEAN AGE	AGE RANGE
16	4-year-olds	4;6 yrs.	4–5;5
16	6-year-olds	6;1 yrs.	5;6–6;11
16	8-year-olds	8;3 yrs.	7;6–8;11
16	12-year-olds	12;5 yrs.	12–12;11
12	Adults	42	33–58

TABLE 1. Participants.

3.2. STIMULI. The stimuli consisted of five conditions, each containing twelve sentence-pairs, for a total of sixty sentence-pairs (see the appendix).[3] Stimulus sentence-pairs for four of the conditions were composed of common Sesotho verbs that can also be used in the applicative (e.g. *phehela* 'cook for', *batlela* 'look for'). The stimulus sentence-pairs for the fifth condition were composed of nonapplicative, inherently ditransitive verbs (e.g. *fa* 'give', *jwetsa* 'tell'). This resulted in two ditransitive constructions per verb that differed only in the order of postverbal objects (e.g. 'I cooked the child the meat' vs. *'I cooked the meat the child'). These were constructed to be as short as possible in order to facilitate processing and production by the younger children. The stimuli therefore contained null-subject sentences with eight to eleven syllables, where the verb had no other verbal extensions (such as perfect aspect, passive, causative, or reciprocal), and the objects were typically two or three syllables long (cf. Demuth 1998, Idiata 1998).[4]

Each of the five conditions differed in the animacy characteristics of the objects (see Table 2). The first two conditions consisted of split animacy stimuli, where one object was animate and the other inanimate. In Condition 1 the animate object was human, and in Condition 2 the animate object was an animal. In both cases the animate object must be ordered immediately after the verb. If children were aware that the animacy restrictions on word order apply to both humans and animals, they should perform equally well on both conditions. If construction frequency effects play a role in deter-

DOUBLE OBJECT APPLICATIVE (DOA) CONSTRUCTIONS		
	Split animacy conditions	
	1. human	inanimate
	2. animal	inanimate
	Equal animacy conditions	
	3. human	animal
	4. inanimate (benefactive)	~ inanimate
INHERENTLY DITRANSITIVE DOUBLE OBJECT (DO) CONSTRUCTIONS		
	5. human (recipient)	inanimate

TABLE 2. Order of postverbal objects across different stimulus conditions.

[3] It was later discovered that there was a problem with one of the stimulus verbs, and it was subsequently omitted from analysis, resulting in fifty-nine stimuli sets and only eleven verbs for Condition 4.

[4] See §5 for a discussion of possible length effects on the order of postverbal objects.

mining performance, however, we should expect participants to perform better on Condition 1, since this is the DOA typically used in everyday speech.

The second set of stimuli contained sentence-pairs with equal animacy. Condition 3 contained two animate objects, one human and one an animal. In this case the human object must be ordered immediately after the verb, even though both objects are animate (e.g. 'We bought the child the dog' vs. *'We bought the dog the child'). If children have knowledge of the AH they should perform above chance on this condition. If they perform randomly, treating this as a condition where both arguments are equally animate, this would provide evidence that they do not know that the AH applies to animals. Condition 4 contained two inanimate objects, where either order of objects was permitted. We therefore expected all subjects to randomly place either object immediately after the verb. However, these stimuli were also constructed to have an obvious benefactive argument (e.g. 'We opened the door (for) the chair'). If subjects consistently place the benefactive argument first (in this case 'chair'), this would indicate that thematic role, rather than animacy, might be playing a role in determining DOA. Recall again that this is the grammatical word order for many other Bantu languages.

Condition 5 contained nonapplicative, inherently ditransitive verbs in DO constructions. These verbs take a recipient (rather than benefactive) argument, which must be ordered immediately after the verb (e.g. 'They gave the man the book' vs. *'They gave the book the man'). This condition was included to examine participants' knowledge of word-order constraints in DO constructions more generally, independent of the applicative morpheme. These verbs are much more frequent than ditransitive applicative verbs, also occurring more frequently as DO constructions (DO: 0.91/hour vs. DOA: 0.11/hour). This condition was included to determine if the high frequency of these constructions might result in better performance than on the lower-frequency DOA constructions.

The order of objects was counterbalanced across stimulus sentence-pairs (e.g. six stimuli sentence-pairs from each condition had the 'correct' order of objects mentioned first). For Condition 4, where either order of objects was grammatical, the order with the benefactive argument placed immediately after the verb was treated as 'correct'. The stimulus sentence-pairs from all five conditions were then quasi-randomized and divided into two blocks, with six sentence-pairs from each condition placed in each block. Both blocks of stimuli were then audio-recorded by the second author, resulting in thirty stimulus sentence-pairs in each block.

3.3. PROCEDURE. The experiments took place in a quiet room on the school premises for the children and at the National University of Lesotho for the adults. Participants sat at a desk with the tape recorder, stereo speakers, a recording microphone, and two or three experimenters. Participants were familiarized with two hand puppets (a sheep and a panda bear whose mouths opened) and were explained the rules of the 'game'. They were told that both puppets came from another country (e.g. Switzerland) and were learning Sesotho. Sometimes they spoke good Sesotho and sometimes not. The participants were asked to listen carefully as each puppet said a sentence. The prerecorded stimuli were then played out of speakers placed on the table in front of the participant. Each puppet was animated in turn by one of the experimenters—usually the third author—while a second experimenter played the next sentence-pair from the audiotape. Participants were asked to point to the puppet that spoke Sesotho the best. The experimenter then asked the participants *O-itseng?* 'What did it say?'. After five practice trials, the test sentence-pairs were presented. Half of the participants (balanced for gender) heard the first block of stimuli

first, and half heard the second block first. Participants were given a break between the two blocks of stimuli. The child participants were given an orange at the conclusion of the experiment. The entire procedure took approximately thirty minutes—sometimes less for the adults and longer for the younger children.

Most of the children enjoyed the task, especially the interaction with the puppets. Children who could not carry out the task (i.e. produce one of the modeled stimuli) after a repeat of the five practice trials were dismissed from the study and others were recruited to take their place. Those dismissed totaled six four-year-olds, all of whom appeared to be tired or hungry and not attending to the task.

3.4. CODING. All participant responses were audio-recorded on a second tape recorder and manually checked on a score sheet as being correct, incorrect, or inappropriate. The first author was present at a subset of the test sessions and manually coded responses to 10% of the data. These were compared with the research assistant's manual coding and were found to have a high degree of intercoder reliability at 94%. The audio recordings were consulted to determine the correct coding for the remaining 6% of the data, thus resolving all differences between the two coders. For the split animacy Conditions 1 and 2, responses were coded as correct if the animate object (either human or animal respectively) was produced immediately after the verb. For the equal animacy conditions, responses were coded as correct if the human object was ordered before the animal object in Condition 3 and if the semantically benefactive argument was ordered first in Condition 4. Condition 5 responses were coded as correct if the human/recipient argument was ordered immediately after the verb.

Occasionally participants did not repeat either of the sentence stimuli. In a few cases the sentences were left incomplete, constituting null responses. These were dropped from the analysis. If an object was changed but the animacy remained the same (e.g. *mosadi* 'woman' changed to *basadi* 'women'), the changed word was recorded and the response was analyzed for grammaticality along with the rest of the responses. However, if the animacy of the objects was changed (e.g. *ngwana* 'child' changed to either *ntja* 'dog' or *buka* 'book'), the changes were again recorded. These responses were classified as 'repairs' and were excluded from the present analysis, even though some resulted in grammatical sentences (see discussion of errors and repairs in §4.6). If participants changed the animacy of more than ten of the objects, they were dropped from the study. Three four-year-olds and two six-year-olds were classified as 'noncompliant' children and did not complete the study. Additional participants were then recruited to ensure a total of sixteen participants in each child age group.

3.5. PREDICTIONS. Since the experiment involved a forced choice between two options, chance performance was 50%. Performance at this level therefore shows no preference for postverbal word order in Sesotho DOAs. However, if participants performed above chance, this would indicate some preference for certain word orders. We therefore predicted that, if participants were aware of AH effects on word order in Sesotho DOAs, they would perform above chance (above 50%) on both split animacy Conditions 1 and 2. This would indicate that participants had learned the Sesotho grammatical generalization for placing the animate object immediately after the verb, independent of humanness. Demuth et al. 2003 found that four-year-olds were above chance on their performance on Condition 1. Condition 2, then, with an animal as the animate object, was the true test condition here, as was a comparison of performance between the two. If participants performed equally well on both conditions this would provide evidence that children know that animals count as animate objects. By contrast,

if there was a significant difference in performance between Conditions 1 and 2, this would indicate either that participants treat human and animal objects differently with respect to animacy and word order, or that the difference in frequency between the two constructions might have affected performance.

The equal animacy conditions provided a different measure of knowledge of the AH. Condition 3, with a human and animal object, provided the true test of knowledge of the AH. If participants were above chance at placing the human object immediately after the verb, this would provide critical evidence for knowledge of the AH and its role in determining word order in Sesotho DOAs. If, on the other hand, performance was at chance (50%), this would indicate that participants were treating animals as being animate to the same degree as humans, being unaware of the subtle distinctions in the AH and/or its effect on postverbal word order. In contrast, performance on Condition 4, with two inanimate objects, should be random, since no animacy is involved. At the same time, one of the objects is semantically the benefactive: if participants were using a 'benefactive first' thematic role strategy rather than animacy or the AH for ordering objects, this would be evident from performance on this condition. Demuth et al. 2003 found that younger child participants performed randomly on this condition, as expected. However, adults showed a tendency to place the benefactive argument immediately after the verb. This condition was therefore included partly as a control for benefactive vs. animacy issues, but also to see if the previous findings were replicated with more verbs.

Finally, Condition 5 was included to test participants' knowledge of postverbal word order on nonapplicative, inherently ditransitive DO constructions. In this condition the recipient argument (which was animate/human) must be placed immediately after the verb. Since DO constructions are much more frequent than DOA constructions and show no animacy effects on postverbal word order, we expected participants to perform better on this condition than on any of the DOA constructions.

In all of these conditions we expected consistency across lexical items within a condition if a syntactic generalization were being applied. Alternatively, if participants performed better on some lexical items than others within a condition, this might provide support for an item-based approach to learning the argument structure of verbs.

4. RESULTS AND ANALYSIS. For each test condition there were twelve items per subject, sixteen child participants, and twelve adult participants, yielding a total of 192 items per condition for each child age group and 144 items for the adults. One of the stimuli sentence-pairs for Condition 2 was subsequently omitted from the analysis, yielding only 176 items for child participants and 132 items for adult participants in this condition. If participants did not successfully repeat one of the target sentences, these errors/repair items were not counted in the total, resulting in fewer than the target number of tokens per condition. The most frequent repair was to make the argument next to the verb human and the second object inanimate, mirroring the fact that the majority of DOAs in Sesotho take a human benefactive and an inanimate theme. These repairs therefore provide additional evidence that the task was tapping children's underlying awareness of the grammatical structure of these constructions. The other 'repair' that occurred was to change a nonapplicative, inherently ditransitive verb from Condition 5 into an applicative verb by affixing an applicative morpheme. Since forty-eight of the sixty stimulus sentence-pairs in this study contained applicative verbs, we suspect that some of the younger children decided that this was an 'applicative' study, and therefore modified verbs accordingly, showing some structural priming (e.g. Bock & Loebell 1990). Such verb-change errors

were also omitted from the analysis. These errors and repairs are discussed further in §4.6 after considering performance on each condition.

As described previously, the items from all five conditions were quasi-randomized and divided into two blocks of stimuli, with the order of presentation of the two blocks counterbalanced across participants. In order to assess possible block effects, 2 × 2 contingency tables were constructed indicating the frequency of correct and incorrect responses generated within each of the two blocks of items. Tabulated across all age groups, there were no significant block effects in Conditions 1, 3, and 5 (all Yates-corrected $\chi^2(1)$'s < 0.9, all p's > 0.35). A significant difference between the two blocks did emerge for Condition 2 (Animal Benefactive Condition; 72% vs. 81% correct; $\chi^2(1) = 6.86$, $p < 0.01$) and for Condition 4 (Semantic Benefactive Condition; 60% vs. 67% correct; $\chi^2(1) = 5.60$, $p < 0.05$). However, when response frequencies were tabulated separately for each age group, a significant block effect emerged only for the eight-year-olds in Condition 2 (Animal Benefactive Condition).

The effect of order of presentation on participants' performance was also examined by constructing 2 × 2 contingency tables indicating the frequency of correct and incorrect responses generated within the first and second blocks of items presented to each subject. Tabulated across all age groups, there were no effects of presentation order on frequency of responses in any of the three test conditions ($\chi^2(1)$'s < 1.86, all p's > 0.17). Similar results were found when response frequencies were tabulated separately for each age group (all but one $\chi^2(1)$'s < 1.82, p's > 0.17), although in Condition 5 a significant order effect was observed for the six-year-olds ($\chi^2(1) = 4.02$, $p < 0.05$) such that performance was better in the first block (i.e. 86% vs. 74% correct). Taken together, these two tests indicate that there were no overall block effects in this study. That is, there is no evidence of a 'learning' effect during the experimental task.

Collapsed across block, the mean percentages of correct responses produced by the five age groups in each test condition are presented in Table 3. These percentages were analyzed by a 5 (Test condition) × 5 (Age Group) multivariate analysis of variance (MANOVA) where Age was a between-participants factor and Condition was a within-participants factor. Analysis using Pillai's trace statistic revealed significant main effects of both Test condition ($F(4,68) = 60.06$, $p < 0.001$) and Age Group ($F(4,71) = 18.53$, $p < 0.001$), but no significant Test condition by Age Group interaction ($F(16,282) = 1.23$, $p = 0.24$). In other words, there were significant differences across age groups, but participants performed very consistently across conditions. We examine the performance on each condition more closely below.

	CONDITION				
AGE GROUP	1	2	3	4	5
4-year-olds	80 (0.04)**	66 (0.03)*	75 (0.04)**	54 (0.04)	84 (0.04)**
6-year-olds	82 (0.02)**	74 (0.03)**	69 (0.05)*	55 (0.05)	80 (0.03)**
8-year-olds	83 (0.04)**	71 (0.03)**	76 (0.04)**	58 (0.04)	86 (0.03)**
12-year-olds	94 (0.02)**	85 (0.03)**	80 (0.05)**	70 (0.03)**	87 (0.04)**
Adults	99 (0.01)**	96 (0.02)**	94 (0.02)**	84 (0.02)**	100 (0.00)***

* significantly greater than chance (.50), $p < 0.001$
** significantly greater than chance (.50), $p < 0.0001$
*** no variation—probability not calculated

TABLE 3. Mean percentage (and standard deviation) of arguments correctly placed immediately after the verb. (Conditions: 1. human–inanimate, 2. animal–inanimate, 3. human–animal, 4. inanimate (benefactive) ~ inanimate, 5. human (recipient)–inanimate.)

4.1. CONDITION 1: HUMAN–INANIMATE OBJECTS. All five age groups performed significantly better than chance (all p's < 0.002) on stimuli where the objects were a human benefactive and inanimate theme. A one-way between-participants ANOVA indicated significant differences in performance among the five age groups on this condition ($F(4,71) = 7.58$, $p < 0.001$). Post-hoc Tukey pairwise comparisons indicated that the adults performed significantly better than all child age groups except twelve-year-olds (all p's < 0.05). Twelve-year-olds performed significantly better than four-year-olds ($p = 0.007$) and six-year-olds ($p = 0.04$) and performed marginally better than the eight-year-olds ($p = 0.06$). The four-, six-, and eight-year-olds did not differ significantly from each other (all p's > 0.90), all performing very well.

Thus, all participants performed extremely well on Condition 1, as expected. Since the vast majority of ditransitive applicatives and all the DOA's found in the Sesotho Corpus involve a human benefactive and inanimate theme, this should be the easiest arrangement of objects both to process and produce. All participants therefore showed that they have knowledge of animacy effects when the benefactive is human, and four-year-olds performed exceptionally well (80%). In addition, twelve-year-olds showed that they have attained adult-like performance on this condition.

4.2. CONDITION 2: ANIMAL–INANIMATE OBJECTS. We had predicted that, if participants showed an awareness of animacy effects with humans (Condition 1), this pattern of performance would generalize to animals as well. This prediction was borne out, as all age groups again performed significantly above chance with an animal benefactive and inanimate theme (all p's < 0.001). However, a one-way ANOVA (five age groups) showed significant differences in performance between groups on this condition ($F(4,71) = 14.17$, $p < 0.001$). Post-hoc Tukey pairwise comparisons indicated that adults again performed significantly better than all child age groups except twelve-year-olds (all p's < 0.001). Twelve-year-olds performed significantly better than four-year-olds ($p < 0.001$) and eight-year-olds ($p = 0.02$) and performed marginally better than the six-year-olds ($p = 0.08$). Thus, although twelve-year-olds showed adult-like performance, overall performance, especially with the younger age groups, was not as good as when the benefactive argument was human.

This was confirmed in a two-way repeated-measures ANOVA performed in order to compare the patterns of performance of the five age groups across Conditions 1 and 2. There was a significant main effect of condition ($F(1,71) = 27.13$, $p < 0.001$), where participants performed better overall on Condition 1 than on Condition 2. Follow-up matched-pairs t-tests confirmed that this difference was significant for all child age-groups (all p's < 0.05) and was marginally significant in the adult group ($p = 0.07$). There was also a significant main effect of Age Group ($F(4,71) = 18.03$, $p < 0.001$), with the three younger age groups performing similarly and significantly worse than the two older age groups (Tukey comparisons; p's < 0.01). No significant Condition $\times$ Age Group interaction emerged ($F(4,71) = 1.14$, $p = 0.34$), however, indicating that the pattern of performance across the two conditions was similar in the five age groups.

Thus, although participants performed above chance on Condition 2, they did not perform as well as in Condition 1. As discussed in §3.5, poorer performance on the animal–inanimate condition could be due either to the lower frequency of this construction in the input children hear, or to an incomplete understanding that animals are animate, and the implications this has for DOA word order. Either might adversely affect the processing and production of this construction.

4.3. CONDITION 3: HUMAN–ANIMAL OBJECTS. We have already seen that participants performed significantly above chance at placing both human and animal objects imme-

diately after the verb in Conditions 1 and 2. This shows that children know that animals as well as humans count as animate for the purposes of DOA word order. The true test of knowledge of the AH lies in putting human and animal objects together in the same sentence, as in Condition 3. The results once again showed that all age groups performed significantly above chance on this condition. However, a one-way ANOVA (five age groups) still showed significant differences in performance between age groups on this condition ($F(4,71) = 4.73, p = 0.002$). Post-hoc Tukey pairwise comparisons indicated that adults performed significantly better than four-, six-, and eight-year-olds ($p < 0.05$ for four- and eight-year-olds, $p < 0.01$ for six-year-olds). Although adults performed better than twelve-year-olds, the difference was not significant, again showing that twelve-year-olds are approximating adult levels of performance. There were no significant differences among the child age groups, with four-year-olds performing exceptionally well (75% correct). These results demonstrate that even four-year-old Sesotho-speaking children have access to the AH and apply their knowledge of the AH to postverbal word order in DOA constructions.

Performance on Condition 3 was generally worse than on Condition 1 but was similar to performance on Condition 2. Only four-year-olds showed no difference in performance between Condition 3 and Condition 1 ($p = 0.32$) and performed significantly better on Condition 3 than on Condition 2 ($p = 0.05$). Note that both Conditions 1 and 3 contain a human object, which must be placed immediately after the verb. This suggests that DOAs containing a human object, like those in Condition 1, may be easier for young children to process and produce.

Thus, performance on Condition 1 was much better than performance on Conditions 2 and 3, but performance on both of the latter conditions was significantly above chance for all participants. This shows that young Sesotho speakers are aware that not only animacy, but also the AH, is involved in determining postverbal word order in DOA constructions. It also suggests that the relative frequency of these constructions plays an important role in determining the level of performance, with better performance on the higher-frequency Condition 1 than on the lower-frequency Conditions 2 and 3. Given that this was a challenging task, which taxed children's processing and production abilities, it is not surprising that performance should be best on Condition 1, the construction that is typically heard and used in everyday speech.

4.4. CONDITION 4: INANIMATE (BENEFACTIVE) ~ INANIMATE OBJECTS. We have shown above that four-year-olds have an awareness of the AH and its role in determining postverbal word order in DOAs. In all three conditions examined so far, however, the learner might simply be placing the object most likely to be the benefactive argument immediately after the verb. Condition 4, with two inanimate objects, was therefore included as a control to test for this possibility. Since the objects in this condition did not differ in animacy, either order of objects was permitted. We therefore expected participants to randomly place either object immediately after the verb if they were using the AH as a means for determining postverbal word order in DOAs. However, one of the objects was semantically benefactive. If participants were appealing to thematic roles, using a 'benefactive first' strategy, we would expect the benefactive object to be placed immediately after the verb. Recall that these items were coded as 'correct' if the benefactive argument was placed immediately after the verb, even though either order of objects was grammatical.

A one-way ANOVA (five age groups) showed significant differences in performance between age groups on this condition ($F(4,71) = 10.21, p < 0.001$), with four-,

six-, and eight-year-olds performing at chance (i.e. randomly placing either object after the verb). Post-hoc Tukey pairwise comparisons indicated that adults were significantly more likely than all child age groups except twelve-year-olds to place the benefactive argument first ($p < 0.001$ for all groups), and that twelve-year-olds were significantly more likely than four- and six-year-olds to place the benefactive argument immediately after the verb ($p < 0.05$ for both groups). Once again, twelve-year-olds did not differ significantly from adults. Most interesting is the fact that the three younger age groups all performed at chance in placing the benefactive argument immediately after the verb, showing no preference for placing the benefactive argument first.

As expected, performance on Condition 4 differed significantly from performance on Conditions 1 and 2 for all age groups. A two-way repeated-measures ANOVA comparing the patterns of performance of the five age groups across Conditions 3 and 4 also revealed a significant main effect of condition ($F(1,71) = 39.07$, $p < 0.001$) but no significant group-by-condition interaction ($F(4,71) = 0.82$, $p = 0.52$). Planned matched-pairs *t*-tests confirmed that this difference was significant for the four-year-olds, eight-year-olds, and adults (all p's < 0.01), and approached significance for the six-year-olds ($p = 0.06$) but not the twelve-year-olds ($p = 0.12$).

The results from Condition 4 are interesting for several reasons. First, these patterns of performance demonstrate that young Sesotho-speakers use animacy, and not thematic role, in determining postverbal word order in DOA constructions. Second, these results show that adults and twelve-year-olds have a tendency to place the benefactive argument first when both objects are inanimate. The real puzzle, then, is why adults (and twelve-year-olds) tend to use a 'benefactive first' strategy, even when they know that either order of objects is permitted.

There are several possible explanations for the adult pattern of behavior. First, the adult results could be due to task effects, possibly the result of benefactive-first 'priming'. Since the correct response on Conditions 1, 2, and 3 was to place the most animate object first, and arguments higher on the animacy hierarchy are more likely to be benefactive, it is possible that the task may have primed adults to place the benefactive argument first even when there was no animacy difference between the objects. Thus, the adult tendency to place the benefactive argument first in Condition 4 may be due to construction priming (cf. Chang et al. 2003). Further support for this possibility comes from the fact that a similar pattern was found in Demuth et al. 2003, where adults placed the benefactive argument first 78% of the time. In the present study, where there were twelve stimuli per condition (rather than only five), the effect was even stronger (84%). This suggests that the increased number of items in the present task may have led to a stronger priming effect.

A possible alternative explanation for the Condition 4 results is that older speakers may have a tendency to place the benefactive argument first when the objects are of equal animacy, even in natural discourse. That is, if animacy is not available as a cue to word order, they may (unconsciously) resort to thematic roles. Such a strategy could facilitate both processing and production of these constructions, since most DOAs have a (human) benefactive argument which is placed immediately after the verb. Since there are no examples of equal animacy DOA constructions in the Sesotho Corpus, it is difficult to know what word order adults actually use in spontaneous speech. If adult speakers do have the tendency to place the benefactive argument first when the animacy of the objects is equal, this could represent either a 'default' strategy or the beginnings of anological change. That the locus of such historical change might occur on these relatively low-frequency constructions is not surprising (cf. Bybee & Hopper 2001 for

discussion of similar phenomona in other languages). This would have the effect of making Sesotho grammar more like that of other Bantu languages, where DOA word order is based on the thematic hierarchy (e.g. Jackendoff 1972, Givón 1976, 1984, Hyman & Duranti 1982, Bresnan & Kanerva 1989).

In sum, the results from Condition 4 indicate that the three younger groups of children appear to determine postverbal word order in Sesotho DOA constructions on the basis of animacy, not thematic role. In contrast, twelve-year-olds and adults have a tendency to place the benefactive argument first. This could be due either to task effects such as construction priming, or to the use of thematic role strategy when animacy is not available, possibly implicating the beginning of grammatical change.

4.5. CONDITION 5: HUMAN (RECIPIENT)–INANIMATE OBJECTS. The results on Conditions 1–3 showed that all age groups exhibit an awareness that animacy and the AH play a role in determining postverbal word order in Sesotho DOAs. Results on Condition 4 furthermore showed that twelve-year-olds and adults have a noncategorical preference for placing the benefactive argument immediately after the verb when both arguments were inanimate. This raises the question of what speakers know about word-order restrictions on nonapplicative DO constructions, where the thematic roles are recipient and theme. In Condition 5 the recipient, which is human, must be ordered immediately after the verb. All groups performed extremely well on this condition, with adults at 100% correct. However, a one-way ANOVA (five age groups) still showed significant differences in performance between age groups on this condition ($F(4,71) = 4.75$, $p = 0.002$). Post-hoc Tukey pairwise comparisons showed that adults performed significantly better than four-, six-, and eight-year-olds ($p < 0.05$ for all groups) but only marginally better than the twelve-year-olds ($p = 0.06$). Once again, twelve-year-olds' performance was not significantly different from adults. In addition, there were no significant differences between child age groups (all p's > 0.55), indicating that performance was very high. Performance on Condition 5 was not statistically different from that on Condition 1 and was generally better than performance on Conditions 2 and 3.

These results therefore show that performance on Condition 5 was extremely good for all age groups. We had anticipated that this would be the case given the high frequency with which these constructions occur in everyday speech. One of the original reasons for including Condition 5 in the study was to address the possibility that good performance on Condition 5 might transfer to good performance on Condition 1. However, since performance on both conditions was very good, there were no significant differences between the two. But performance on Condition 5 was much better than performance on Conditions 2 and 3 which involved animals. This raises the question of how participants might have performed if the recipient objects in Condition 5 had been animals rather than humans, or if both the recipient and the theme objects had been inanimate. This goes beyond the scope of the present article, but is obviously an area for further research.

In sum, all child age groups showed an awareness of the AH and the role it plays in determining postverbal word order in Sesotho DOAs. This finding is extremely interesting given that many of these constructions are not abundant in everyday speech. Possible explanations for these findings are discussed in §5. But first, we examine participants' errors/repairs, shedding further light on the younger children's underlying grammatical system.

4.6. ANALYSIS OF ERRORS AND REPAIRS. As mentioned previously, this was a challenging task for four-year-olds, requiring careful attention to the two stimulus sentences

given and taxing participants' sentence processing and production abilities. This resulted in a few responses that did not match either of the stimulus sentences. These responses were counted as errors. Out of a total of 1,652 stimulus items there were 147 errors, or errors on 8.9% of the stimuli. The breakdown of errors by age group and condition is provided in Table 4.

	CONDITION					
AGE GROUP	1	2	3	4	5	TOTAL
4-year-olds	6	10	11	14	18	59 (40)
6-year-olds	4	7	9	11	13	44 (30)
8-year-olds	3	4	7	10	3	27 (18)
12-year-olds	1	1	2	4	3	11 (7.5)
Adults	0	1	1	2	2	6 (4)
TOTAL	14 (9.5)	23 (16)	30 (20)	41 (28)	39 (36.5)	

TABLE 4. Number (and percentage) of errors by age group and condition.

The fewest number of errors occurred on Condition 1 with human–inanimate arguments. Not only is this animacy configuration of objects the most frequent of the ditransitive applicatives used in everyday speech, but it is also the only one where DOAs are actually attested in the Sesotho Corpus. It is therefore not surprising that Condition 1 should exhibit the fewest errors, probably being the easiest for participants to process and produce. Conditions 2 and 3, both with animal objects, had a higher level of errors. This is probably due to the fact that animals rarely occur in these constructions in everyday speech. In half of the Condition 2 errors animals were changed to humans, resulting in grammatical repairs, but not the ones being tested. In half of the Condition 3 errors the animal was changed to an inanimate argument, resulting in the higher-frequency human–inanimate configuration of arguments in Condition 1. Again, these repairs were grammatical, but differed from the test sentence-pairs. Condition 4 had the highest number of errors. As found previously (Demuth et al. 2003), participants had a tendency to change one of the inanimate objects into a human, again resulting in a grammatical human–inanimate order of objects. This accounted for over half of the errors on Condition 4. Finally, Condition 5 exhibited a large number of errors, despite the fact that participants performed most accurately on this condition. Two-thirds of these errors were due to changing the stimulus verb into an applicative verb, probably due to the high occurrence of applicative verbs in the experiment.

As might be expected, the younger children accounted for the majority of errors. The percentage of grammatical repairs ranged from 42% to 45% for all child age groups and was 83% for adults. Thus, although child participants did not always perform according to what was asked for in the task, they nonetheless produced grammatical sentences in almost half of their errors, overwhelmingly resulting in repairs that contained a human argument followed by an inanimate argument. The four- and six-year-olds had by far the most errors, the number dropping significantly for eight-year-olds and again for twelve-year-olds and adults. This may be a function of increased processing ability as older children become more familiar with DOAs.

It therefore appears that the optimal form of the DOA takes a human benefactive and an inanimate theme (i.e. Condition 1). Of the 989 ditransitive applicatives that take a benefactive argument in the Sesotho Corpus (the majority of which surfaced as a preverbal incorporated pronoun), only two benefactives were inanimate, and both took an inanimate theme. Furthermore, of the twelve examples that had an animate theme, all took an animate benefactive as well. That is, there were no cases in the Sesotho

Corpus of an inanimate benefactive cooccurring with an animate theme.[5] Thus, young Sesotho speakers are highly sensitive to the robust semantic properties of the input and seem to require that the objects in DOAs adhere to the high-frequency argument characteristics found in the ambient language (cf. Osgood & Zehler 1981). Even more importantly, four-year-olds used appropriate word order when changing the animacy of the objects, placing the human argument immediately after the verb.

In sum, the findings from this study show that Sesotho-speaking four-year-olds have extracted the syntactic generalization that the AH determines postverbal word order in DOA constructions. They also exhibit better performance on the highest-frequency human–inanimate conditions, and many of their grammatical repairs take this form. Why, then, does adult-like performance on the lower-frequency constructions take several years to achieve? In the next section we explore possible explanations for these findings, as well as alternative analyses of the data.

5. DISCUSSION. At the beginning of this article we predicted that the order of objects in Bantu DOA constructions would be learned early and easily. Our prediction was based on the fact that, unlike in English dative-shift constructions, the lexical semantics of verb classes does not interact with the order of objects in Bantu DOAs. Furthermore, these constructions are morphologically marked in Bantu languages, overtly distinguishing them from inherently ditransitive verbs. Thus, we expected that as soon as children determined the language-specific word-order parameter of these DOAs (thematic role is relevant for Kiswahili, the AH is relevant for Sesotho), they would apply it to all verbs they encounter. However, we also predicted that performance would be best on the high-frequency constructions (Conditions 1 and 5) and not as good on the other conditions. The results from the present study show that these predictions were upheld. Although the findings show that Sesotho-speaking children have extracted the generalization that the AH (and not thematic role) determines postverbal word order in Sesotho, performance on the high-frequency Conditions 1 and 5 was significantly better than on the low-frequency Conditions 2 and 3.

There are several possible explanations for this variability in performance across conditions. First, it could be that task effects, such as problems with processing, memory, or production, may have masked children's underlying knowledge of the lower-frequency constructions. If this were the case, however, we might have expected random results. The fact that all child age groups performed significantly above chance on all conditions (except Condition 4, where either order of objects was permitted) points to the fact that differences in underlying grammatical representations were being tapped during the elicited production task. Alternatively, it could be that some of the variable performance found was merely an artifact of grouped data, where individuals show categorical behavior, some having set the appropriate word-order parameter and others not. However, an examination of the data indicates that this is not the case. Among four-year-olds there was only one child who performed at 100% correct on both Conditions 1 and 3, but not on any other conditions. There were also three participants who performed at 100% correct on Condition 5, but not on any of the other conditions. There were only two cases of

[5] Of the sixteen cases in the Sesotho Corpus where the animacy of objects differs from the high-frequency human–inanimate case, only two had animal–inanimate objects (Condition 2), four had human–animal objects (Condition 3), two had inanimate–inanimate objects (Condition 4), and eight had human–human objects (the animate equivalent of Condition 4). In the Condition 2 and 3 cases, the object highest on the animacy hierarchy was pronominalized. But all of these pronominalized objects were benefactive, providing no additional evidence for animacy effects on postverbal word order.

100% performance for six-year-olds—one on Condition 1 and one on Condition 5—but these were not the same children. Thus, although some participants performed better overall than others, there is no evidence of a bimodal distribution within the data. This indicates that achieving adult-like performance on the word order of Sesotho DOAs takes several years, even for high-frequency, inherently ditransitive verbs in Condition 5.

Demuth et al. 2003 found that, despite evidence of generalization, there were also lexical item effects for three-year-olds on Condition 1, and four-year-olds showed a (nonsignificant) tendency in that direction. In fact, the more frequently a verb was used in the applicative (in the Sesotho Corpus), the worse participants performed, showing a NEGATIVE frequency effect, with worse performance on verbs that most frequently occur in surface syntactic frames other than SVOO. This was attributed to competition from the much higher-frequency S Obj-V (O) syntactic frame with a preverbal incorporated pronominal and an optionally realized lexical theme (cf. examples in 8). With only five stimulus verbs per condition, however, it is difficult to evaluate how robust this lexical/construction effect might be. One of the purposes of the present study, then, was to determine if item-based construction effects would persist once more stimulus verbs were considered. If so, this might help account for participants' less than perfect performance on these tasks.

The stimuli used in the present study were selected to include commonly used verb roots. This was done to ensure that the ability to generalize, if present, would emerge independent of lexical frequency effects. However, we also wanted to vary the frequency with which different verbs occurred in the applicative in order to examine the possibility of a frequency-based construction effect. To investigate the possible effects of verb frequency on participants' performance, two types of verb frequency were calculated. Verb-root frequency was calculated by counting each verb's occurrence in all of its inflected and derived forms in the Sesotho Corpus (e.g. tense, causative, applicative, reciprocal, etc.). Applicative-verb frequency was calculated by counting only instances of each verb as it occurred with the applicative morpheme. Verb-root frequencies ranged from 7 to 2,150 and applicative-verb frequencies ranged from 0 to 53. Thus, although all verb roots used in the stimuli were attested in the Sesotho Corpus, not all appeared in the applicative, and the frequency with which each verb root and applicative verb occurred varied for stimulus verbs within a particular test condition.

We then examined the association between verb frequency and performance using Pearson's correlation coefficient. In this way we could determine which type of frequency effects language learners might be sensitive to, if any. Although performance on different verbs within conditions varied, none of these differences correlate significantly with either verb-root frequency or applicative-verb frequency for any age group in any of the five conditions: Across all age groups and conditions, r values for correlation coefficients ranged from -0.006 to -0.477, with p values ranging from 0.96 to 0.12. That is, none of the variability on individual verbs was due to lexical frequency effects.

The results from the present study therefore show that robust generalization processes have taken place with respect to the AH by the age of four. The lack of lexical frequency effects indicates that four-year-olds are generalizing their knowledge of word-order restrictions on Sesotho DOA constructions, even though these constructions are still somewhat novel. These findings corroborate the Demuth et al. 2003 evidence of early abilities to generalize verb-argument structure. The present findings also show that, by the age of four, there is better performance on higher-frequency constructions (Condition 1), even while performance on individual verbs did not differ. Thus, by four years,

the Sesotho-speaking children in this study showed construction effects (performing best on the highest-frequency constructions), but no lexical frequency effects.

Those familiar with English dative-shift constructions might wonder if the results presented here could be accounted for by other factors. English double object constructions exhibit a tendency for shorter objects (such as pronouns) to be placed immediately after the verb, and longer (heavier) objects to be placed second (e.g. *I gave her the table*) (e.g. Bresnan & Nikitina 2003), and similar phenomena are reported for English verb-particle constructions (e.g. Wasow 2002, Lohse et al. 2004), at least in terms of the number of words per object NP. Could the results reported in this study be merely an artifact of object length, where there was a tendency to place the shorter object first? That is, was the benefactive object typically shorter than the theme in this study, and could this have biased our results?

To test for this possibility we re-coded the data according to the relative length of the object. Recall that all objects contained only one word, so our measure was in terms of the number of syllables per object (see the appendix). Since the original study was not designed to investigate the role of object length effects, many of the objects had the same number of syllables. However, in some cases the benefactive object was longer, and in other cases the theme object was longer. All three types of objects (SameLength, BenefactiveLonger, ThemeLonger) were found in all five conditions. If participants were ordering objects according to length (in terms of number of syllables), we would make the following predictions: on the SameLength conditions we would expect performance to be around 50%, randomly assigning either object to first position. On the BenefactiveLonger condition we would predict the shorter theme object to be placed first, resulting in below-chance performance on placing the benefactive object first. On the ThemeLonger condition we would expect the opposite, with above-chance performance at placing the shorter, benefactive object first.

We explored the interactions in a 5 (Test condition) $\times$ 5 (Age Group) $\times$ 3 (Length) multivariate analysis of variants (MANOVA) where Age was a between-participants factor and Condition and Length were within-participants factors. Analysis using Pillai's trace statistic revealed significant main effects of Test condition ($F(4,284 = 36.77$, $p = 0.9\times10^{-25}$) and Age Group ($F(4,71) = 23.554$, $p = 0.2\times10^{-12}$), as well as a significant interaction between Test condition, Age Group, and Length ($F(32,586) = 1.84$, $p = 0.004$). There was also a significant difference on Test condition by Length ($F(8,284) = 2.54$, $p = 0.01$), showing that differences in object length were more relevant for some conditions than others. This was probably due to the fact that the number of sentence test pairs where the benefactive object was longer than the theme object varied greatly across conditions. However, there was no significant effect of Age Group by Length ($F(8,71) = 0.95$, $p = 0.48$) nor of Test condition by Age Group ($F(16,71) = 1.6$, $p = 0.07$). In other words, children were no more likely to show length effects than adults.

A closer look at the data showed the length effect was in the OPPOSITE DIRECTION to that predicted. That is, the first object was typically longer (in number of syllables) than the second object. In both Condition 1 (human–inanimate) and Condition 3 (human–animal) the benefactive argument was longer in six out of eight items, yet all participants were above chance at placing the longer, benefactive argument first, counter to the length prediction. In Condition 5 (recipient–theme) three out of six recipient objects were longer, yet participants performed extremely well on this condition, again placing the recipient object first, showing little effect of object length. The prediction was upheld in Condition 2 (animal–inanimate), where only one out of six benefactive

objects was longer, and where participants significantly placed the benefactive argument first. Performance on this condition, however, was not significantly different from performance on Condition 3 where the length effect would predict the opposite results. Finally, Condition 4 (inanimate–inanimate) contained longer benefactive objects in only three out of eight conditions, suggesting a weak bias toward ordering the shorter, benefactive object first, but only for twelve-year-olds and adults. Note, however, that this tendency is also consistent with a word-order analysis biased toward thematic role.

In sum, there was a tendency in this study for the longer object to be placed first, demonstrating that our results cannot be explained by a tendency to place longer objects last. It thus appears that the length effect reported for English double object and verb-particle constructions may be specific to certain languages rather than universal, and that animacy and thematic role are the organizational principles for determining postverbal word order in Sesotho DOAs. Note, however, that all objects in this study contained only one lexical item, whereas many of the length effects reported in the literature are based on a tendency for multiword NPs to be placed last (e.g. Wasow 2002, Lohse et al. 2004). Hawkins (1994:424) suggests that there may be a probabilistic tendency for animate objects in Sesotho to be shorter than inanimate objects, and that restrictions on postverbal word order may have been grammaticized in terms of animacy rather than length. This is obviously an area for further research. However, we suggest that the length effect in Sesotho, a highly agglutinative language, may be realized by different means, such as reducing objects that are salient in the discourse context to a preverbal incorporated pronominal (cf. 8a,b) or null argument (cf. 8a′,b′). Both reduction processes are the norm for Sesotho, accounting for most of the ditranstive applicative surface syntactic frames. The DOA, with two postverbal NPs, is actually the marked exception, being used only when both arguments are new information. This is one of the reasons that DOAs are relatively rare in the input children hear, rendering these constructions challenging to process, produce, and learn.

6. CONCLUSION. This study investigated four- to twelve-year-old children's and adults' knowledge of syntactic constraints on Sesotho double object applicative constructions, specifically focusing on how animacy hierarchy effects on postverbal word order are learned. Since no semantic verb class learning was required, early generalization across verbs was predicted. It was also expected that performance would be better on the higher-frequency constructions. Both predictions were upheld. Using a forced-choice elicited production task, this study found that four-year-old Sesotho-speaking children performed significantly above chance (50%) in correctly placing the object highest on the animacy hierarchy immediately after the verb, but performed at chance when there was no animacy difference between the two objects. This shows that young Sesotho-learners have knowledge of the language-specific word-order constraints on DOA constructions, making early syntactic generalizations regarding the role of the AH in determining postverbal word order.

All subjects also performed better on the higher-frequency constructions. The highest levels of performance were on the high-frequency constructions in Condition 1, which contained human–inanimate objects, and Condition 5, containing recipient–inanimate DO constructions on verbs like *fa* 'give'. Performance on the lower-frequency constructions in Conditions 2 and 3, both involving animal objects, was not as good. Children also had a strong tendency for their occasional repairs to take the form of the high-frequency human–inanimate objects, correctly placing the human object immediately

after the verb. This was especially true for Condition 4, which contained two inanimate objects. The fact that most of the ditransitive applicatives children hear contain a human benefactive and an inanimate theme seems to influence both children's level of performance and the nature of their repairs. It is therefore not surprising that the acquisition of the lower-frequency argument structure takes some time to master. Again, this is consistent with the findings from early English, where children's use of verbs mirrors the argument structures used in child-directed speech (Naigles & Hoff-Ginsberg 1995).

Another finding from this study was that twelve-year-olds and adults had a tendency to place the benefactive argument first in Condition 4 (with two inanimate objects). This could have been due to priming effects or to a tendency for adults to appeal to thematic roles when animacy is not available. If the latter is the case, four-, six-, and eight-year-olds perform significantly differently from the statistics of the ambient language. This then provides some evidence of the deeper organizational principles of children's developing grammars. It would appear that children first become aware that animacy plays a role in determining postverbal word order in Sesotho DOA constructions, and only somewhat later begin to determine that the AH, not simply animacy itself, is involved. Finally, they become aware of the overlap with thematic roles, beginning to place the benefactive argument immediately after the verb when both objects are inanimate. The younger children are therefore picking up on the higher-frequency information in the input they hear, and are immediately incorporating this into their grammars. It takes somewhat longer to do the same for information that is less frequently encountered. Importantly, however, this appears to happen in a probabilistic fashion, with little evidence of lexical effects. First animacy and then the animacy hierarchy begin to play a role, and then finally thematic role. This learning path is outlined in Figure 1.

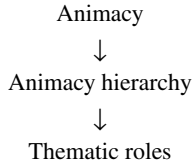

FIGURE 1. Learning path in determining word order in Sesotho double object applicatives.

The results of this study provide robust evidence that four-year-olds show generalized syntactic behavior. At the same time, young language learners appear to be extremely sensitive to the frequency of surface syntactic frames and to the animacy characteristics of objects (e.g. indirect objects are usually animate; Fillmore 1968). Results from previous studies of English dative shift have shown that participants prefer inanimate direct objects to be followed by animate indirect objects when both are full lexical NPs (e.g. *I gave the book to Sally* vs. *I gave Sally the book*; e.g. Osgood & Zehler 1981). In English, the latter order is typically used when the indirect object is a pronoun (e.g. *I gave her the book*), and young learners are sensitive to the discourse conditions (and/or length effects) of these alternative surface syntactic frames (cf. Waryas & Stremel 1974). Even two-year-olds are reported to show discourse awareness of appropriate use of lexical, pronominal, and null objects (cf. Clancy 1996, 1997, Demuth et al. 2000). This suggests that language learners may be statistical learners to a much greater extent than initially thought, and that the linguistic units over which they are computing their statistics include the argument structure frame or construction (see also Bloom et

al. 1975). This may help explain why children's grammars show strong evidence of generalization on high-frequency argument structures but also take time to attain adult levels of performance on lower-frequency constructions.

Bantu languages, with their morphologically marked verb classes, provide an ideal context for testing theories regarding acquisition of argument structure. Since the syntactic restrictions on Sesotho DOA word order differ from those found in many other Bantu languages, a comparative study of these issues would be most illuminating. Do children learning Kiswahili, for example, show any evidence of animacy or AH effects on DOA word order? Or do they quickly determine that benefactive–theme word order is correct for this language, applying it regardless of the animacy of these thematic roles? In either case, we would expect children to perform best when the benefactive is animate and the theme inanimate, since this probably accounts for the majority of DOAs they hear. The findings from this study therefore point to the importance of understanding the nature of the input and the possible effects this may have on children's construction of their early grammars.

APPENDIX: STIMULI.

CONDITION 1: HUMAN–INANIMATE

1.	Ba binela ntate dipina.	'They're singing the songs for father.'
	*Ba binela dipina ntate.	
2.	Re bulela basadi lemati.	'We're opening the door for the women.'
	*Re bulela lemati basadi.	
3.	O ebolela mme apole.	'He's peeling the apple for mother.'
	*O ebolela apole mme.	
4.	Ke khella nkhono metsi.	'I'm drawing the water for grandmother.'
	*Ke khella metsi nkhono.	
5.	Ba patela ausi buka.	'They're hiding the book from/for sister.'
	*Ba patela buka ausi.	
6.	Ke ts'ella banana lebese.	'I'm pouring milk for the girls.'
	*Ke ts'ella lebese banana.	
7.	Re ngwathela bashanyana dijo.	'We're feeding the food to the boys.'
	*Re ngwathela dijo bashanyana.	
8.	O robela malome thupa.	'She's breaking the stick for uncle.'
	*O robela thupa malome.	
9.	Re etsetsa baeti matlo.	'We're making houses for the guests.'
	*Re etsetsa matlo baeti.	
10.	Ba nkela bana dibuka.	'They're taking the books for the children.'
	*Ba nkela dibuka bana.	
11.	Ke sehela ngwana nama.	'I'm cutting the meat for the child.'
	*Ke sehela nama ngwana.	
12.	O batlela tichere lengolo.	'He's looking for the letter for the teacher.'
	*O batlela lengolo tichere.	

CONDITION 2: ANIMAL–INANIMATE

1.	O bulela ntja lemati.	'He's opening the door for the dog.'
	*O bulela lemati ntja.	
2.	Ba ebolela khomo mokopu.	'They're peeling the pumpkin for the cow.'
	*Ba ebolela mokopu khomo.	
3.	Ke khella dipere metsi.	'I'm drawing the water for the horses.'
	*Ke khella metsi dipere.	
4.	Ba patela dintja nama.	'They're hiding the meat from the dogs.'
	*Ba patela nama dintja.	
5.	Ke ts'ella katse lebese.	'I'm pouring milk for the cat.'
	*Ke ts'ella lebese katse.	

6.	Ba ngwathela ntja dijo.	'They're feeding food to the dog.'
	*Ba ngwathela dijo ntja.	
7.	Ke khabella pere furu.	'I'm chopping the hay for the horse.'
	*Ke khabella furu pere.	
8.	Ba etsetsa khomo lesaka.	'They're making a kraal for the cattle.'
	*Ba etsetsa lesaka khomo.	
9.	Ba nkela khoho poone.	'They're taking some corn for the chicken.'
	*Ba nkela poone khoho.	
10.	Ba sehela ntja nama.	'They're cutting some meat for the dog.'
	*Ba sehela nama ntja.	
11.	Ba phehela fariki moroko.	'They're cooking the sludge for the pig.'
	*Ba phehela moroko fariki.	

CONDITION 3: HUMAN–ANIMAL

1.	Ba batlela monna ntja.	'They're looking for the dog for the man.'
	*Ba batlela ntja monna.	
2.	Re patela ngaka pere.	'We're hiding the horse from the doctor.'
	*Re patela pere ngaka.	
3.	Re phehela moeti khoho.	'We're cooking the chicken for the guest.'
	*Re phehela khoho moeti.	
4.	O rekela bana dintja.	'She's buying dogs for the children.'
	*O rekela dintja bana.	
5.	Ba khethela mosadi fariki.	'They're choosing a pig for the woman.'
	*Ba khethela fariki mosadi.	
6.	O tlisetsa morena nku.	'He's bringing a sheep for the chief.'
	*O tlisetsa nku morena.	
7.	Ba balla banana dikhoho.	'They're counting the chickens for the girls.'
	*Ba balla dikhoho banana.	
8.	Re besetsa banna nonyana.	'We're roasting the bird for the men.'
	*Re besetsa nonyana banna.	
9.	O siela tichere khomo.	'He's leaving the cow for the teacher.'
	*O siela khomo tichere.	
10.	Ba nkela batho dikhomo.	'They're taking the cows for the people.'
	*Ba nkela dikhomo batho.	
11.	Ba shebela malome pere.	'They're looking for the horse for uncle.'
	*Ba shebela pere malome.	
12.	Ke bitsetsa morena ntja.	'I'm calling the dog for the chief.'
	*Ke bitsetsa ntja morena.	

CONDITION 4: INANIMATE (BENEFACTIVE) ~ INANIMATE

1.	Ba batlela koloi mabidi.	'They're looking for wheels for the car.'
	Ba batlela mabidi koloi.	
2.	Ba khella moroho metsi.	'They're drawing water for the greens.'
	Ba khella metsi moroho.	
3.	Re phehela phathi dikuku.	'We're baking cookies for the party.'
	Re phehela dikuku phathi.	
4.	Re nkela dijalo mobu.	'We're taking some dirt for the seeds.'
	Re nkela mobu dijalo.	
5.	O rekela dieta pholeche.	'She's buying some polish for the shoes.'
	O rekela pholeche dieta.	
6.	Ke besetsa pitsa mollo.	'I'm turning on the fire for the pot.'
	Ke besetsa mollo pitsa.	
7.	Ba ts'ella lebone parafini.	'They're pouring kerosene for the lamp.'
	Ba ts'ella parafini lebone.	
8.	O tabolela mosamo lesela.	'He's tearing the cloth for the pillow.'
	O tabolela lesela mosamo.	
9.	Re ebolela nama eiye.	'We're peeling onions for the meat.'
	Re ebolela eiye nama.	
10.	O bulela koloi tsela.	'He's opening the road for the car.'
	O bulela tsela koloi.	

11.	Ba sehela tafole lesela. Ba sehela lesela tafole.	'They're cutting the cloth for the table.'
12.	Ba etsetsa ntlo lebala. Ba etsetsa lebala ntlo.	'They're making a yard for the house.'

CONDITION 5: HUMAN (RECIPIENT)–INANIMATE

1.	Ba ruta batho sekhooa. *Ba ruta sekhooa batho.	'They're teaching people English.'
2.	Ke fa ngoanana setulo. *Ke fa setulo ngoanana.	'I'm giving the girl the stool.'
3.	Re fepa bana motoho. *Re fepa motoho bana.	'We're feeding the children corn drink.'
4.	Ke kadima morena diphahlo. *Ke kadima diphahlo morena.	'I'm lending the chief some clothes.'
5.	Ba neha tichere lengolo. *Ba neha lengolo tichere.	'They're giving the teacher the letter.'
6.	Ba joetsa moruti leshano. *Ba joetsa leshano moruti.	'They're telling the priest a lie.'
7.	Re amoha bana baesekele. *Re amoha baesekele bana.	'We're taking the bicycle from the children.'
8.	Re tima basadi dijo. *Re tima dijo basadi.	'We're refusing the women some food.'
9.	Ke kolota baruti chelete. *Ke kolota chelete baruti.	'I owe the priests the money.'
10.	Ke reha moshanyana lebitso. *Ke reha lebitso moshanyana.	'I'm giving the boy a name.'
11.	Re joents'a basadi ditaba. *Re joents'a ditaba basadi.	'We're showing the women the news.'
12.	Re botsa banana nako. *Re botsa nako banana.	'We're asking the girls the time.'

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