

---

ARTICLE

---

**Factors facilitating implicit learning: The case of the Sesotho passive**

**Melissa Kline<sup>1</sup> and Katherine Demuth<sup>2</sup>**

*Massachusetts Institute of Technology<sup>1</sup>; Macquarie University<sup>2</sup>*

**Running title:** Implicit learning – Sesotho passive

**Contact information:**

Melissa Kline

Brain and Cognitive Sciences

Massachusetts Institute of Technology

77 Massachusetts Ave, Rm 46-3037D

*mekline@mit.edu*

## Abstract

Researchers have long debated the mechanisms underlying the learning of syntactic structure. Of significant interest has been the fact that passive constructions appear to be learned earlier in Sesotho than English. This paper provides a comprehensive, quantitative analysis of the passive input Sesotho-speaking children hear, how it differs from English input, and the implications for learning the passive. The findings indicate that the more frequent use of both the passive *and* the *by*-phrase in Sesotho child-directed speech, in conjunction with the non-ambiguous passive morpheme, may together facilitate earlier access to thematic roles (agent, patient), thereby promoting early implicit learning of the passive. The implications for the acquisition of syntactic structure more generally are discussed.

## 1. Introduction

The late acquisition of English passive constructions relative to other syntactic structures has long been a topic of theoretical interest (Maratsos, Fox, Becker, & Chalkley 1985; Horgan 1978; Pinker, Lebeaux, & Frost 1987; Borer & Wexler 1987, 1992; Gordon & Chafetz 1990; Fox & Grodzinsky 1998; see also Crain, Thornton & Murasugi, 2009). Early explanations of this phenomenon suggested that passives were derivationally complex and therefore acquired late (Brown & Hanlon 1970). Given the passive sentence in (1) these analyses proposed that the patient (*the lamp*) raises from object to subject position. The logical subject can then be optionally realized as part of a *by*-phrase (*by Sarah*).<sup>1</sup> Others have further proposed that since these are ‘non-canonical’ (infrequent) constructions, they take longer to learn than other constructions (Bever 1970).

Drawing on insights from Principles & Parameters theory (Chomsky 1981), Borer & Wexler (1987, 1992) proposed that the principle governing movement of an object to subject position (Argument or A-chain movement) only matures around the age of 5. The A-chain Deficit Hypothesis (ACDH) therefore predicted the late acquisition of syntactically complex (verbal) passives (1). It also suggested earlier acquisition of syntactically simple adjectival constructions that do not involve movement, such as the sentence in (2). However, sentences like that in (3) can be interpreted either as a truncated verbal passive (with no *by*-phrase), or as an adjectival passive describing a resultant state; their syntactic status is therefore ambiguous. Wexler and colleagues suggest that young children consider such constructions to have the

---

<sup>1</sup> See Bresnan (1982) for a non-movement, lexicalist account of the passive.

syntax and semantics of an adjective, and therefore acquire them earlier than verbal (syntactic) passives.

- (1) The lamp<sub>*t*</sub> was broken *t*<sub>*i*</sub> (by Sarah) Verbal Passive
- (2) The lamp was green Adjective
- (3) The lamp was broken Ambiguous (Verbal or Adjectival Passive)

More recently, Babyonyshev, Ganger, Pesetsky, & Wexler (2001) proposed that the challenge of learning the passive may not be one of A-chain maturation, but of the lack of external arguments (logical subjects) in the input (Chomsky 1993). That is, when the *by*-phrase is missing in (1), the logical subject can only be inferred, presenting a potential problem for learners. Babyonyshev et al. (2001) therefore offered the External Argument Requirement Hypothesis (EARH) as a possible means for understanding children's early problems with constructing verbal passives. They proposed that sentences like those in (3) are interpreted by the immature grammar as being 'syntactic homophones' (s-homophones) of the non-movement constructions in (2). That is, children would initially treat verbal passives as adjectives. Support for this proposal comes from the observation that children rarely use *by*-phrases, resulting in syntactically ambiguous surface productions that look like that in (3) (Horgan 1978).

It has therefore been of significant interest that children spontaneously use verbal passives in other languages before the age of 3 – much earlier than typically reported for English (e.g., Zulu – Suzman 1985, 1987; Sesotho – Demuth 1989, 1990; Inuktitut – Allen & Crago 1996; Mayan K'iche – Pye & Quixtan Poz 1988). For example, Demuth (1989) found that Sesotho-speaking children were spontaneously using passives by 2;8, and many of these were full passives (i.e., accompanied by a *by*-phrase). To explain this finding, Demuth (1989) proposed that this earlier acquisition of passives could be attributed to the relatively high frequency of

these constructions in the ambient language. Other studies reporting the early acquisition of passives also found that passives were frequently used in the input children hear. In contrast, those languages reporting the relatively late acquisition of passives (e.g., English – 4-5 years (Maratsos et al. 1985), German – 5 years (de Villiers 1984), Hebrew – 8 years (Berman 1985)) have few passives in the input (cf. Pinker et al. 1987; Gordon & Chafetz 1990). Thus, Demuth (1989) suggested that some of these cross-linguistic differences in the course of passive acquisition may be due to input effects. However, the initial investigation of Sesotho passive input was based on only a small, 4-hour sample of caregiver speech to one 2;1-year-old child. It has therefore been unclear exactly what the frequency of passives in the Sesotho input actually is, and how this might influence the learning of passive syntax.

The purpose of the present study was therefore to provide a more complete investigation of the passive input Sesotho-speaking-children hear, examining all 98 hours of the Demuth Sesotho Corpus (Demuth 1992). Only with a better understanding of both the quantity and quality of language-specific input is it possible to understand how this might influence the course of acquisition across languages. We first outline the structure of the Sesotho passive.

### 1.1 The structure of the Sesotho passive

Like most other Bantu languages (and English), Sesotho has SVO (Subject Verb Object) word order. Assuming a traditional movement analysis (Chomsky 1981), both Sesotho and English exhibit raising of the object to subject position, followed by an optional *by*-phrase (e.g., *The woman bought the potatoes* > *The potatoes were bought (by the woman)*). Sesotho also has an extensive system of noun-class prefixes and agreement markers that provide evidence that the

subject agrees with the verb (Doke & Mofokeng 1985; Demuth & Harford 1999). Example (4a) shows that the lexical subject *basadi* ‘women’ triggers noun-class 2 subject agreement (AGR) on the verb.<sup>2</sup> In the passive in (4b), the object *ditapole* ‘potatoes’ has raised to subject position, again triggering subject-verb agreement – this time class 10. In addition, the passive morpheme (-w-) is infixes before the final vowel of the verb, and the logical subject *basadi* ‘women’ can optionally appear as the object of a *by*-phrase (*ke basadi* ‘by the women’). In contrast, adjectives in Sesotho are realized with an entirely different morphology and syntax, as shown in (4c).

- (4) a. Ba-sadi ba-rek-il-e di-tapole Active  
 2-women 2AGR-buy-PERF-FV 10-potatoes  
 ‘The women bought some potatoes’
- b. Di-tapole<sub>i</sub> di-rek-il-w-e *t<sub>i</sub>* (ke ba-sadi) Passive  
 10-potatoes 10AGR-buy-PERF-PASS-FV (by 2-women)  
 ‘The potatoes were bought (by the women)’
- c. Di-tapole di-ne di-le di-mpe Adjective  
 10-potatoes 10-CP 10-PST 10ADJ-bad  
 ‘The potatoes were bad’

---

<sup>2</sup> Glosses are as follows: ADJ = adjective, AGR = subject-verb agreement, CAU = causative, CP = copula, DEM = Demonstrative, FUT = future, FV = final vowel (mood marker), INF = infinitive marker, NEG = negation, OBJ = object marker, PASS = passive, PERF = perfect aspect, PR = preposition, PST = past, REL = relative complementizer, RL = relative marker. WH = question marker, Numbers = noun class, 17 = expletive marker. A more phonetically transparent version of Lesotho orthography is used.

Thus, the syntactic formation of the verbal passive is the same for both English and Sesotho. Critically, however, the syntax and morphology of the Sesotho passive are unique, and cannot be understood as an adjectival passive, as in English (see further discussion below). Forms with no *by*-phrase in Sesotho are therefore never ambiguous with respect to their syntactic or semantic status; they are always clearly verbal, and an agent is always implied. This lack of ambiguity in Sesotho may make the syntax of passives more transparent, facilitating earlier acquisition.

The present study therefore provides a comprehensive examination of the language environment that leads to the earlier acquisition of Sesotho passive compared to English. This was done by conducting an exhaustive analysis of the Sesotho Corpus (Demuth 1992) and comparing this to what is known about English passive input. In particular, we develop a more detailed profile of Sesotho passive input, including the overall frequency of passives, the distribution of passives as a function of verb semantics, *by*-phrases, tense/aspect, and discourse context. This provides a context for better understanding the mechanisms underlying the acquisition of syntactic structures more generally.

## 2. Subjects and Data Preparation (Method)

The Sesotho Corpus was collected over a 2-year period in rural Lesotho from approximately 98 hours of spontaneous child conversations with peers, older siblings, and adults (Demuth 1992; see CHILDES database: MacWhinney 2000). The four child subjects included one boy (Hlobohang, 2;1-3;0) and three girls (Lithhare, 2;1-3;2; 'Neuoe, 2;4-3;3; and Tsebo, 3;8-4;7). The adult data are drawn from conversations between the children and their mothers and

grandmothers. The utterances analyzed for this study were selected by searching the entire corpus to identify all those that contained full verbs. Thus, copulas, deficient verbs, high-frequency frozen/routinized passives and coalesced expressions were excluded from the analysis. Identical consecutive utterances by the same speaker were counted only once. The resulting data analyzed contained 8,540 adult utterances (10,021 verbs) and 16,666 child utterances (18,174 verbs). All adult and child Sesotho passive verbs were then extracted and classified with respect to the factors of interest (verb semantics, *by*-phrases, tense/aspect, discourse contexts).

### 3. Results

#### 3.1 The frequency of passive structures in adult and child speech

Using the morphological tagging tools available through CLAN (Sagae, Davis, Lavie, MacWhinney & Wintner 2007), we identified 33,125 non-copular verbs in the Brown corpus of English child-directed speech (Brown 1973). Gordon & Chafetz (1990) found only 91 examples of verbal passive constructions in this corpus. Thus, only 0.27% of the verbs these English-speaking children heard were passives. In contrast, the child-directed utterances in the Sesotho Corpus contained a total of 269 passive verbs out of 10,021 non-copular verbs, or 2.7%. Thus, Sesotho-speaking children hear passive verbs 10 times more often than their English-speaking peers. Even more impressively, 1.6% of Sesotho-speaking children's utterances were passives (297 passive verbs out of 18,174 non-copular verbs). This is a higher percentage of passive verbs than that of English-speaking adults. As shown in Figure 1, Sesotho-speaking children's use of passive verbs falls into roughly three developmental stages. Before 2;6 years, about 1% of

children's verbs occurred in a passive construction. This rose to 2% between 2;7 and 4;1, approaching the average passive frequency of the adults' speech (2.7%). From 4;2-4;7 older Tsebo used passives 4% of the time, more frequently than the adults in the Sesotho Corpus.

→ INSERT FIGURE 1 ABOUT HERE

Both adults and children produced Sesotho passive verbs using a wide range of verb types. Out of 429 total verb types used by adults in the Sesotho Corpus, 74 verbs (17%) were used in at least one passive construction. For the children, out of 525 distinct verb types, 90 verb types appeared at least once as a passive (17%). Since the corpus of child utterances was larger than that of adult utterances, the child speech contains a number of verb types that were not attested in the adult input. This is not surprising given the Zipfian (power-law) distribution of natural language vocabularies.

These comparisons between Sesotho-speaking adults and children, as well as between English and Sesotho, are striking for several reasons. First, Sesotho-speaking children under the age of three already use more passive constructions than do English-speaking adults when talking to children. Second, this exhaustive analysis of the Sesotho Corpus confirms previous

### 3.1.1 The relative frequency of actional and nonactional passive verbs

Previous studies have found that young English-speaking children have particular difficulty comprehending nonactional verbs in passive constructions (Gordon & Chafetz 1990; Maratsos et al. 1985). That is, concrete picturable actions like *hug* or *wash* are easier to comprehend in the passive than are non-action verbs such as *see* or *know*. This difficulty has been presented as one source of evidence that 4-year-old English-speaking children do not yet

have adultlike passive representations (Fox & Grodzinsky 1998; Maratsos et al., 1985; though see O'Brien, Grolla & Lillo-Martin 2006, for an alternative view). Drawing again on the Brown Corpus, Gordon & Chafetz (1990) found that only 7% of passives occurred with nonactional verbs in English child-directed speech. Given that verbs with similar semantics are likely to appear as passives cross-linguistically, we expected that Sesotho-speaking adults might show a similar distribution of passive verbs. If Sesotho-speaking children have robust representations for the passive, we would expect them to show a distribution of passive verb use similar to that of the adults, using more passives with actional than nonactional verbs.

We therefore performed an analysis of the verb types that children use in their passive constructions and compared this with their caregivers' speech. Using various lists in the literature as a guide, we divided all Sesotho adult and child verbs in the corpus into actional and nonactional verbs. Classification of the verbs was carried out by both authors with extensive cross-checking for validation. The actional verbs included all verb types reflecting observable, pictureable actions: verbs in this group tended to take agent arguments for subject (rather than experiencer). The nonactional verbs consisted of all verb types that did not fall into this class. The ten most frequent verbs in each class are listed in order of frequency in Table 1.

→ INSERT TABLE 1 ABOUT HERE

We then calculated the percent of nonactional verbs used in the passive, and found that the results for both the adults and children were similar to those reported for adult English: 4% of the adults' passive verbs were nonactional, as were 5% of the children's passives. This is a small amount compared to the use of nonactional verbs used in active constructions - 22% for adults and 24% for children, a significant difference for both groups (Adults:  $\chi^2(1, N=10021) = 48.29, p < .001$ ; Children:  $\chi^2(1, N=18171) = 61.40, p < .001$ ). Thus, for both English- and Sesotho-

speaking children, nonactional passives constitute only a small percentage of the passive verb input they hear. Nonetheless, Sesotho-speaking children use nonactional verbs in the passive in spontaneous speech at the same rate as adults. In addition, recent experimental results show that Sesotho-speaking 3-year-olds are above chance in their comprehension of nonactional passives (Demuth, Moloji & Machobane, 2010). Overall lower performance on nonactional compared to actional passives appeared to be due to difficulties with interpreting static pictures of nonactional events, rather than difficulties with passive comprehension. This was determined by the fact that child performance was worse on nonactional actives as well, and that adults showed similar effects.

The fact that young children use nonactional passives in an adultlike way (i.e., at an equal rate) may seem surprising, given their low frequency in the input. If children must hear many passives in order to acquire this structure quickly, how do they also learn the passive for a class of verbs that is not often attested in the input? Sesotho-speaking children's ability to use the more infrequent nonactional passives may stem from their ability to generalize syntactic structures between verb types. Mounting evidence has shown that by three years of age, children show evidence of such phenomena as syntactic priming which depend on abstract syntactic representations (Messenger, Branigan, McLean & Sorace, 2009; Thothathiri & Snedeker 2008.) If children are able to form an abstract representation of the passive from the models they hear, this may support their extension of the passive to different classes of verbs. Experimental results with Sesotho-speaking 3-year-olds suggest that this is, in fact, the case (Demuth et al., 2010).

The foregoing discussion suggests that the overall frequency of passives in the input may play an important role in explaining the different rates of passive acquisition across languages. It is also possible that specific types of passive input may influence the acquisition process,

particularly as it involves establishing the appropriate mappings between syntax and thematic roles (cf. Pinker 1989). We turn to this issue below.

### 3.2 The frequency and discourse use of *by*-phrases with passive verbs

It has been proposed that English-speaking children have difficulty learning the passive because they rarely hear *by*-phrases (Fox & Grodzinsky 1998). That is, they hear many sentences like *The lamp was broken* and few sentences like *The lamp was broken by Sarah*. In fact, only 4% of the passives in Brown corpus of English child-directed speech contain a *by*-phrase (Gordon & Chafetz 1990). This is especially problematic because truncated English passives are syntactically and morphologically homophonous with adjectival sentences like *The lamp was green* (Fox & Grodzinsky 1998). Thus, English-speaking children may identify such sentences as stative descriptions, failing to construct the appropriate syntactic and thematic structures. The prevalence of truncated passives may thus contribute to a delay in the correct analysis of English passive, resulting in a protracted course of acquisition. Conversely, the reported higher use of *by*-phrases with Sesotho passives (Demuth 1989) may facilitate earlier acquisition of the Sesotho passive by providing overt surface evidence of the full range of thematic roles (e.g., agent, patient) associated with the passive, and by helping children to process sentences more easily.

An examination of adult passives in the Sesotho Corpus found that 60% contained a *by*-phrase, confirming previous reports of high *by*-phrase use in Sesotho child-directed speech. Interestingly, only 21% of the children's passives contained a *by*-phrase, significantly fewer than the adults ( $\chi^2(1, N=566) = 88.13, p < .001$ ), but far more than English-speaking adults. This raises several questions. First, why do English and Sesotho behave so differently with respect to

*by*-phrase use? And second, is the difference in *by*-phrase use between Sesotho-speaking adults and children due to developmental progression or to discourse factors? To investigate these issues we examined the discourse contexts in which the Sesotho *by*-phrases were used.

Like many other Bantu languages, Sesotho is a topic-oriented language (Demuth 1990). This means there is a strong preference to place topical, old information in subject position (Bresnan & Mchombo 1987). Since *wh*-questions contain new, non-topical information, they cannot appear in subject position (5a). Instead, subject questions must be realized using either a cleft/relative structure (5b), or a passive (5c).<sup>3</sup> Note that the passive in (5c) contains the questioned entity as part of the *by*-phrase (*ke mang?* ‘by whom?’).

- (5) a. \*Mang o-pheh-il-e di-jo?  
 1who 1AGR-cook-PERF-FV 8-food  
 ‘Who cooked the food?’
- b. Ke mang ea-pheh-il-e-ng di-jo?  
 CP 1who 1REL/AGR-cook-PERF-FV-RL 8-food  
 ‘It is who that cooked the food?’
- c. Di-jo di-pheh-il-w-e ke mang?  
 8-food 8AGR-cook-PERF-PASS-FV CP who  
 ‘The food was cooked by whom?’

Thus, a possible explanation for the prevalence of *by*-phrases in Sesotho child-directed-speech is the high frequency of subject questions. In fact, we find that adults asked many more questions in this corpus than did children: 39% of all adult verbs occurred in the context of a question, compared to only 8% for children ( $\chi^2(1, N=28,195)=4023.68, p < .001$ ). In addition,

---

<sup>3</sup> Cleft and relative constructions are also learned quite early in Sesotho (cf. Demuth, 1995).

adults ask proportionally more subject questions than children do (6% vs. 4%,  $\chi^2(1, N=4,869)=10.09, p = .0015$ ). At a discourse level, child and adult speech thus vary significantly from one another – adults ask many more questions, and many more subject questions, than children do.

In order to explain the high number of *by*-phrases in adult speech, we next predicted that a large proportion of the adult passives would occur in these subject questions, where a *by*-phrase is required (see (5c)). This was the case: 50% of all adult Sesotho passives occurred in the context of a subject question. Thus, half of the passives used in Sesotho child-directed speech were structurally guaranteed to include a *by*-phrase. In contrast, only 3% of children's passives occurred in a subject question. The lower rate of *by*-phrases in children's passives therefore appears to be due largely to the discourse context in which passives are used, rather than to an incomplete acquisition of the passive. Interestingly, within declarative utterances, adults and children use *by*-phrases with passive constructions at the same rate - 22% and 20% respectively. The fact that children's *by*-phrase use is similar to that of adults' when discourse effects are controlled provides further evidence that the children's use of the passive is not affected by a limitation on syntactic representations.

Recall that truncated passives in English are homophonous with adjectival passives, as shown in example (3): *broken* can be analyzed as either a passive verb or an adjective in a sentence like *The lamp was broken*. Recall also that this ambiguity is not present in Sesotho since adjectives and verbs are morphological and syntactically distinct (compare (4b) and (4c)). Consider the Sesotho adjective in (6a), where there is double agreement on the adjective. Unlike English, this construction cannot be extended to use with a passive construction, since the adjective *se-se-holo*, big, does not have a verbal form. Thus, the hypothetical example in (6b) is not grammatical in Sesotho. To express the idea *I want the lamp that was broken* it is necessary





learning the passive because it provides the context for learning the mapping between meaning and form. The full passives that Sesotho-speaking children hear provide overt access to *both* thematic roles present in passive constructions, rather than just the patient/undergoer. Frequent exposure to such constructions may facilitate learning to link semantic roles to syntactic structure (Pinker 1989, Fox & Grodzinsky 1998). Furthermore, the prevalent alternation between full and truncated passives in the Sesotho input may be valuable in helping children learn how these two forms are semantically and syntactically related. This is consistent with Gomez's (2002) finding that learning is facilitated under conditions of variable frames. This improved mapping ability should in turn make it easier to comprehend the meaning of truncated passives.

In sum, Sesotho truncated passives are clearly verbal; they cannot be construed as adjectival. In contrast, English learners must discover that the same surface form can correspond to two very different syntactic structures. If English-speaking children begin by interpreting truncated passives as adjectives, this would mean that the English passive is even more impoverished in the input (or in the uptake) than is typically assumed. Thus, although the overall frequency of a construction may enhance the rate of acquisition, other aspects of the form/meaning mapping, and how these are realized in child-directed speech, may also play an important role in determining how and when syntactic structures are acquired.

#### 4. Discussion

The findings presented above establish that Sesotho-speaking adults use many more passive verbs than do English-speakers, and that the young children in this corpus respond in kind. Furthermore, Sesotho-speaking children do not appear to be limited in the semantic range

of passives they produce: although neither adults nor children used many nonactional passives, children were just as likely to use them as adults. It therefore appears that the overall higher frequency of passive constructions in Sesotho may facilitate the early acquisition of passive syntax. This is confirmed by recent results showing that Sesotho-speaking 3-year-olds are able to generalize the passive to novel verbs (Demuth et al., 2010). However, little is known about the learning mechanisms that underlie this process.

A growing number of studies support the notion that environmental (input) factors can influence the course and rate of acquisition. Results from both perception and production experiments show that language learners are extremely sensitive to the frequency of various phonological structures in the input they hear, including segments, syllable structures, and prosodic word structures (e.g., Anderson, Morgan & White 2003; Levelt, Schiller & Levelt 2000; Roark & Demuth 2000). Artificial grammar learning studies also show that both infants and adults easily learn the transitional probabilities of the syllable patterns they are exposed to, and can use this information in both low-level word-segmentation tasks (Saffran, Aslin & Newport 1996) and in higher-level syntactic categorization tasks (Thompson & Newport 2007; Wonnacott, Newport, & Tanenhaus 2008). Finally, several recent studies demonstrate that both adults and children are sensitive to syntactic (structural) priming, where speakers tend to reuse syntactic constructions previously heard in a discourse (Bock 1986; Bock & Griffin 2000; Huttenlocher, Vasilyeva, & Shimpi 2004; Thothathiri & Snedeker 2008). While structural priming is often thought of as a transient effect, there is evidence that it also represents a form of implicit learning, reflecting the development of language through experience (Chang, Dell, Bock, & Griffin 2000). Structural priming has been attested even when no function or content words are repeated from prime to target (Bock 1989; Pickering & Branigan 1998). For passive

constructions in particular, de Villiers (1984) found that 3- and 4-year-olds were more likely to use both actional and nonactional passives when describing events if they had previously repeated these verbs in a passive syntactic frame. A study of passives by Gordon & Chafetz (1990) also found better overall performance on later test trials, suggesting a possible priming effect, and Bencini & Valian (2008) found passive priming effects with 3-year-olds similar to that with older children and adults. Additionally, Brooks & Tomasello (1999) showed that English-speaking 3;5-year-olds could generalize passive syntax to novel verbs after extensive exposure to that construction. This suggests that, in a language where the passive is used quite frequently, priming effects from the input may facilitate more frequent use of the passive in children's own spontaneous speech, and lead to faster acquisition through implicit learning.

## 5. Conclusion

A key challenge for the field of language development is explaining the different rates at which similar syntactic constructions are acquired across languages. These studies are often carried out in a vacuum, with little attention paid to the environment of the learner. The present analysis of the Sesotho Corpus has revealed several factors that appear to facilitate the earlier acquisition of Sesotho compared to English passives. First, the higher overall frequency of Sesotho passive verbs in child-directed speech appears to aid the acquisition of the passive, through a process of implicit learning. Sesotho-speaking children's use of the passive in spontaneous speech may then be enhanced through structural priming, which strengthens developing syntactic representations, and makes it possible for learners to formulate abstract patterns from the individual exemplars they hear (Bock & Griffin 2000; Ferreira & Bock 2006;

Huttenlocher et al. 2004). Second, Sesotho-speaking caregivers use many more *by*-phrases with their passives than do English-speaking parents. This may help learners more easily identify thematic roles (Piinker 1989, Fox & Grodzinsky 1998), further facilitating the comprehension and learning of these structures. Finally, Sesotho does not have the English syntactic and morphological homophony between adjectival and verbal passives (e.g., *The lamp was broken*). Thus, the syntax, semantics, *and* morphology of Sesotho passives are transparent, providing an ideal situation for learning the mapping between meaning and form. Given these findings, it is not surprising that the learning of passives in a language like Sesotho should be given a boost, whereas the learning of passives in a language like English, with few (often truncated and syntactically ambiguous) passive exemplars, would be much more protracted.

Of course, corpus results alone cannot determine the exact nature of children's underlying syntactic representations. In particular, there is controversy over whether children's syntactic representations are as flexible and abstract as their parents' (Fisher 2002; Tomasello 2000). This can be tested in comprehension and production tasks. Results from our recent experimental studies indicate that Sesotho-speaking 3-year-olds can comprehend, produce, and generalize the passive to novel verbs (Demuth, et al., 2010). The present results provide the basis for understanding how and why this is possible.

Understanding the nature of the linguistic input children hear is critical for constructing a theory of language acquisition, providing a more realistic profile of the information that is present or absent in the environment, and how this may facilitate or hinder the learning process. Predictions can then be formulated and tested, using behavioral experiments and/or computational modeling to further explore the nature of the learning process. In this way we can

learn more about constraints on the language learning mechanism, and how to enhance learning for those experiencing challenges in this domain.

*Acknowledgments* Funding for this work was provided by NSF Grant #BCS-0544121 to the second author, and a Brown University UTRA fellowship to the first author. We would like to thank Peter Gordon, William Snyder, the Brown University Child Language Lab, and anonymous reviewers for their valuable feedback.

## References

- Anderson, Jennifer, James Morgan & Katherine White. 2003. A statistical basis for speech sound discrimination. *Language and Speech* 46(2-3). 155-182.
- Allen, Shanley & Martha Crago. 1996. Early passive acquisition in Inuktitut. *Journal of Child Language* 23(1). 129-155.
- Babyonyshev, Maria, Jennifer Ganger, David Pesetsky & Kenneth Wexler. 2001. The maturation of grammatical principles: Evidence from Russian unaccusatives. *Linguistic Inquiry* 32(1). 1-44.
- Bencini, Guilia M. L. & Valian, Virginia. 2008. Abstract sentence representation in 3-year-olds: Evidence from comprehension and production. *Journal of Memory and Language*. 59, 97-133.
- Berman, Ruth. 1985. The acquisition of Hebrew. In Dan Slobin (ed.) *The Cross-linguistic Study of Language Acquisition* 1, 255-371. Hillsdale NJ: Erlbaum.
- Bever, Thomas. 1970. The cognitive basis for linguistic structures. In John Hayes (ed.), *Cognition and the Development of Language*. New York: Wiley.
- Bock, Kathryn. 1986. Syntactic persistence in language production. *Cognitive Psychology* 18(3). 355-387.
- Bock, Kathryn. 1989. Closed-class immanence in sentence production. *Cognition* 31. 163-186.
- Bock, Kathryn & Zenzi Griffin. 2000. The persistence of structural priming: Transient activation or implicit learning? *Journal of Experimental Psychology* 129(2). 177-192.

- Borer, Hagit & Kenneth Wexler. 1987. The maturation of syntax. In Thomas Roeper and Edwin Williams (eds.), *Parameter setting and language acquisition*, 123-172. Dordrecht: Reidel.
- Borer, Hagit & Kenneth Wexler. 1992. Bi-unique relations and the maturation of grammatical principles. *Natural Language and Linguistic Theory* 10. 147-189.
- Bresnan, Joan. (ed.) 1982. *The Mental Representation of Grammatical Relations*. Cambridge, MA: MIT Press.
- Bresnan, Joan & Sam Mchombo. 1987. Topic, pronoun, and agreement in Chichewa. *Language* 63. 741-782.
- Brooks, Patricia & Michael Tomasello. 1999. Young children learn to produce passives with nonce verbs. *Developmental Psychology* 35(1). 29-44.
- Brown, Roger. 1973. *A first language: The early stages*. Cambridge, MA: Harvard University Press.
- Brown, Roger & Camille Hanlon. 1970. Derivational complexity and order of acquisition in child speech. In John Hayes (ed.), *Cognition and the Development of Language*. New York: Wiley.
- Chang, Franklin, Gary Dell, Kathryn Bock, & Zenzi Griffin. 2000. Structural priming as implicit learning: A comparison of models of sentence production. *Journal of Psycholinguistic Research* 29(2). 217-229.
- Chomsky, Noam. 1981. *Lectures on government and binding*. Dordrecht: Foris.
- Chomsky, Noam. 1993. A Minimalist program for linguistic theory. In Kenneth Hale & Samuel Keyser (eds.) *The View from Building 20*. Cambridge: MIT Press.

- Crain, Stephen, Rosalind Thornton, & Keiko Murasugi. 2009. Capturing the Evasive Passive. *Language Acquisition* 16. 123–133.
- De Villiers, Jill. 1984. Limited input? Limited structure. *Monographs of the Society for Research in Child Development* 49.
- Demuth, Katherine. 1989. Maturation and the acquisition of the Sesotho passive. *Language* 65(1). 56-80.
- Demuth, Katherine. 1990. Subject, topic, and Sesotho passive. *Journal of Child Language* 17. 67-84.
- Demuth, Katherine. 1992. Acquisition of Sesotho. In Dan Slobin (ed.), *The Cross-linguistic Study of Language Acquisition* 3, 557-638. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Demuth, Katherine. 1995. Questions, relatives, and minimal projection. *Language Acquisition* 4. 49-71.
- Demuth, Katherine & Carolyn Harford. 1999. Verb raising and subject inversion in comparative Bantu. *Journal of African Languages and Linguistics* 20(1). 41-61.
- Demuth, Katherine & Melissa Kline. 2006. The distribution of passives in spoken Sesotho. *Southern African Linguistics and Applied Language Studies* 24(3). 377-388.
- Demuth, Katherine, Francina Moloji & Malillo Machobane. 2010. Three-year-olds' comprehension, production, and generalization of Sesotho passives. *Cognition*, 115 (2), 238-251.
- Doke, Clement, & Machabe Mofokeng. 1985. *Textbook of Southern Sotho grammar*. Cape Town: Longman.
- Ferreira, Victor, & Kathryn Bock. 2006. The functions of structural priming. *Language and Cognitive Processes* 21(7). 1011-1029.

- Fisher, Cynthia. 2002. The role of abstract syntactic knowledge in language acquisition: a reply to Tomasello (2000). *Cognition* 82. 259-278.
- Fox, Danny & Yosef Grodzinsky. 1998. Children's passives: A view from the by-phrase. *Linguistic Inquiry* 29(2). 311-332.
- Gómez, Rebecca. 2002. Variability and detection of invariant structure. *Psychological Science* 13. 431- 436.
- Gordon, Peter & Jill Chafetz. 1990. Verb-based versus class-based accounts of actionality effects in children's comprehension of passives. *Cognition* 36(3). 227-254.
- Horgan, Dianne. 1978. The development of the full passive. *Journal of Child Language* 5. 65-80.
- Huttenlocher, Janellen, Marina Vasilyeva & Priya Shimpi. 2004. Syntactic priming in young children. *Journal of Memory and Language* 50. 182-195.
- Levelt, Clara, Niels Schiller & Willem Levelt. 2000. The acquisition of syllable types. *Language Acquisition* 8(3). 234-264.
- MacWhinney, Brian. 2000. *The CHILDES Project: Tools for Analyzing Talk*. Mahwah NJ: Erlbaum.
- Maratsos, Michael, Dana Fox, Judith Becker & Mary Anne Chalkley. 1985. Semantic restrictions on children's passives. *Cognition* 19. 167-191.
- Messenger, K., Branigan, H., McLean, J. & Sorace, A. (2009). Semantic factors in young children's comprehension and production of passives. In J. Chandlee, M. Francini, S. Lord & G. M. Rheiner (eds.) BUCLD 33: Proceedings of the 33<sup>rd</sup> Annual Boston University Conference on Language Development. Boston, MA: Cascadilla Press.
- O'Brien, Karen, Elaine Grolla & Diane Lillo-Martin. 2006. Long passives are understood by young children. In David Bamman, Tatiana Magnitskaia, & Colleen Saller (eds.)

- Proceedings of the 30<sup>th</sup> Boston University Conference on Language Development*, 441-451. Somerville, MA: Cascadilla Press.
- Pickering, Martin & Holly Branigan. 1998. The representation of verbs: Evidence from syntactic priming in language production. *Journal of Memory and Language* 39. 633-651.
- Pinker, Steven. 1989. *Learnability and Cognition*. MIT Press, Cambridge, Mass.,
- Pinker, Steven, David Lebeaux & Linda Frost. 1987. Productivity and constraints in the acquisition of the passive. *Cognition* 26. 195-267.
- Pye, Clifton, & Pedro Quixtan Poz. 1988. Precocious passives (and antipassives) in Quiché Mayan. *Papers and Reports on Child Language Development* 27. 71-80.
- Roark, Brian & Katherine Demuth. 2000. Prosodic constraints and the learner's environment: A corpus study. In Catherine Howell, Sarah Fish, and Thea Keith-Lucas (eds.) *Proceedings of the 24<sup>th</sup> Boston University Conference on Language Development*, 597-608. Somerville, MA: Cascadilla Press.
- Saffran, Jenny, Richard Aslin & Elissa Newport. 1996. Statistical learning by 8-month-old infants. *Sciences* 274. 1926-1928.
- Sagae, Kenji, Eric Davis, Alon Lavie, Brian MacWhinney, & Shuly Wintner. 2007. High-accuracy annotation and parsing of CHILDES transcripts. *Proceedings of the ACL-2007 Workshop on Cognitive Aspects of Computational Language Acquisition*. Prague, Czech Republic.
- Suzman, Susan. 1985. Learning the passive in Zulu. *Papers and Reports on Child Language Development* 24. 131-37.
- Suzman, Susan. 1987. Passives and prototypes in Zulu children's speech. *African Studies* 46(2). 241-254.

- Thompson, Susan & Elissa Newport. 2007. Statistical learning of syntax: The role of transitional probability. *Language Learning and Development* 3. 1-42.
- Thothathiri, Malathi & Jesse Snedeker. 2008. Syntactic priming during language comprehension in three- and four-year-old children. *Journal of Memory and Language* 58. 188-213.
- Tomasello, Michael. 2000. Do young children have adult syntactic competence? *Cognition* 74. 209-253.
- Wonnacott, Elizabeth, Elissa Newport & Michael Tanenhaus. 2008. Acquiring and processing verb argument structure: Distributional learning in a miniature language. *Cognitive Psychology* 56. 165-209.

*Originally submitted 01 June 2009*

*Final version accepted 28 June 2010*

Table 1. The ten most frequent actional and nonactional verbs used in the Sesotho Corpus.

	Adults		Children	
Actional Verbs	<i>etsa</i>	make	<i>nka</i>	take
	<i>ya</i>	go	<i>tla</i>	come
	<i>tla</i>	come	<i>etsa</i>	make
	<i>fa</i>	give	<i>ya</i>	go
	<i>nka</i>	take	<i>fa</i>	give
	<i>ja</i>	eat	<i>ja</i>	eat
	<i>dula</i>	sit	<i>dula</i>	sit
	<i>bua</i>	speak	<i>reka</i>	buy
	<i>tswa</i>	come from/leave	<i>kena</i>	enter
	<i>hwetsa</i>	tell	<i>tSela</i>	pour
Nonactional Verbs	<i>bona</i>	see	<i>bona</i>	see
	<i>utlwa</i>	feel/hear/taste	<i>tseba</i>	know
	<i>tseba</i>	know	<i>batla</i>	seek/want/like
	<i>tloha</i>	leave/remove	<i>sheba</i>	look
	<i>batla</i>	seek/want/like	<i>tloha</i>	leave/remove
	<i>sheba</i>	look	<i>hana</i>	refuse
	<i>robala</i>	sleep	<i>utlwa</i>	feel/hear/taste
	<i>rata</i>	like	<i>robala</i>	sleep
	<i>thola</i>	become silent	<i>hlaha</i>	appear
<i>hana</i>	refuse	<i>siya</i>	leave behind	

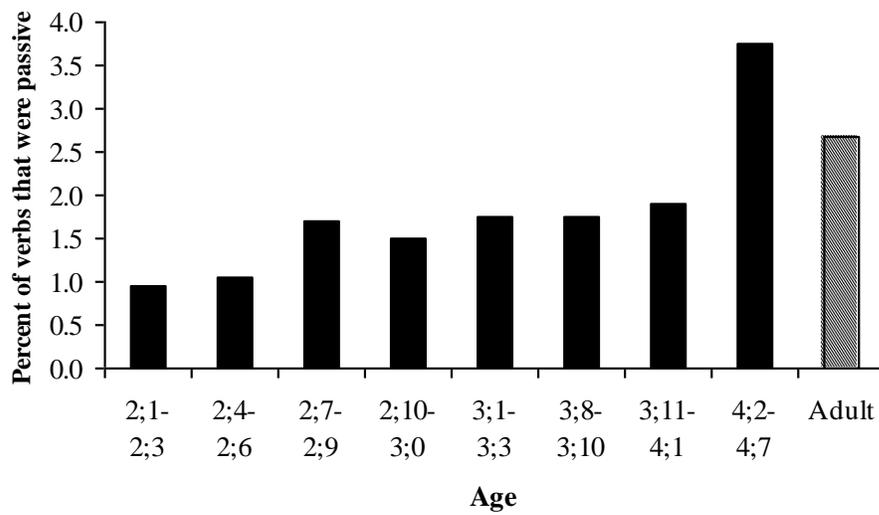


Figure 1. Percentage of verbs that were passives in Sesotho child and adult speech.

findings showing that passives are an order of magnitude more common in Sesotho child-directed speech than English child-directed speech (Demuth 1989; Demuth & Kline 2006).

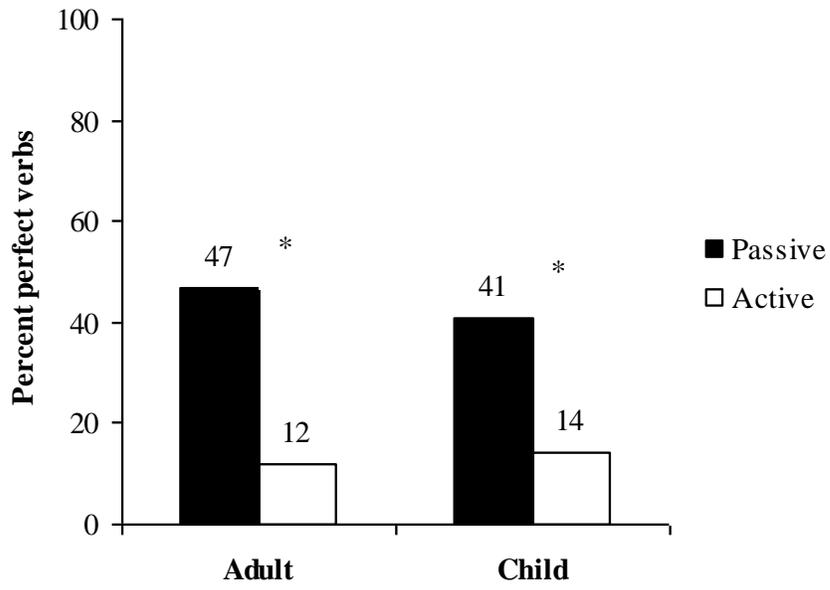


Figure 2. Percent of passive and active verbs with perfect tense/aspect.

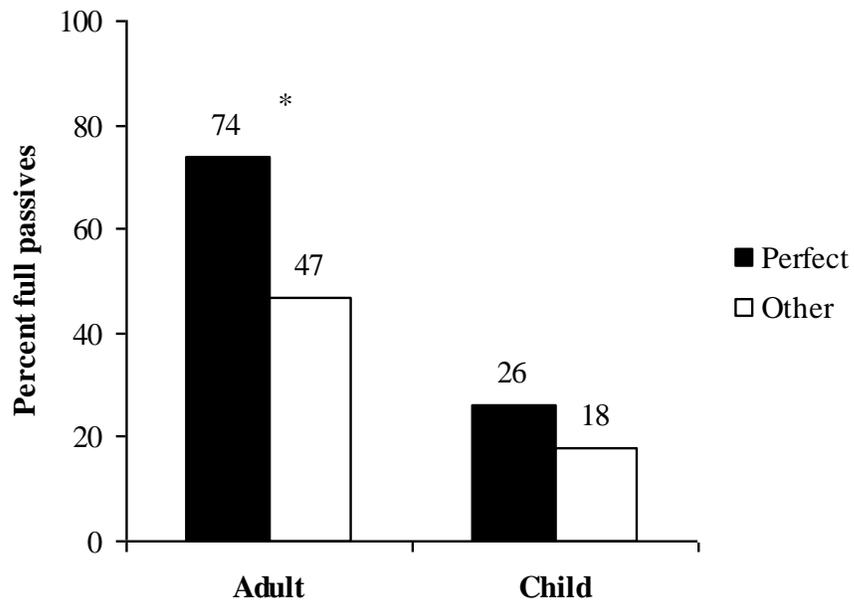


Figure 3. Percent of passives with perfect vs. other tense/aspect that occurred with a *by*-phrase.