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Development of parsing abilities interacts with grammar learning: Evidence from Tagalog and Kannada

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1. Introduction

1.1 Syntax and Word Learning

We explore here how a child's ability to parse sentences interacts with language learning. Does the manner in which a child recovers syntactic structure have important consequences for acquisition of the lexicon or parts of the grammar that depend on the information successfully recovered from the parse? It is now well established that the syntactic structure of a sentence contributes significantly to the learning of word meanings, in a process known as syntactic bootstrapping (Gleitman, 1990). For example, in one such study by Naigles (1990), young children heard simple sentences describing the actions of a duck and a bunny. When they heard a transitive sentence involving a novel verb, like "The duck is kradding the bunny", 25-month olds were found to spend more time looking at a video of a causal action in which the bunny was acting on the duck as compared to a video of two simple motion events. And critically, this preference was not seen when children instead heard an intransitive sentence such as "The duck and the bunny are kradding." This result suggests that learners can recover some aspects of clausal meaning even from sentences with unknown verbs, and that they can use the clausal meaning to guide hypotheses about the verb's meaning. More recently, Yuan and Fisher (2009) have found that syntactic bootstrapping can even occur in the absence of a visual referent world, simply by hearing a conversation involving a novel verb. This suggests that the inferences from clause structure to possible verb meanings can operate even without a set of candidate events provided by the visual context. We know from other work, however, that there are systematic changes that occur over development in how children parse, and hence how they recover the clause structures necessary for this kind of learning to occur. Here we are going to ask if one of these developmental changes, namely the failure to revise initial misinterpretations (Trueswell, Sekerina, Hill, & Logrip, 1999), might influence the path of learning cross-linguistically.

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1.2. The Child Sentence Parser

With the advent of visual world eyetracking methods to study child parsing (Trueswell et al., 1999), much has been learned about how children recover the structure of sentences. In many ways, children as young as three years of age appear to be just like adults, in that they assign structure to sentences incrementally in real-time, sometimes even anticipating upcoming constituents (e.g., Fernald, Zangl, Portillo, & Marchman, 2008). And, like adults, they are quite adept at using lexical cues to structure to guide syntactic ambiguity resolution. For example, for known verbs and prepositions, four-year olds show systematic parsing preferences that are quite similar to adults (e.g., Trueswell et al., 1999; Snedeker & Trueswell, 2004). Overall, the system appears to be behaving like a slowly maturing multiple-constraint parsing system, in which most developmental changes simply reflect the learning of additional syntactic contingencies, such as prosodic, discourse, and referential cues to structure (e.g., Hurewitz, 2002; Sekerina & Trueswell, in press; Snedeker & Yuan, 2008).

But children do show at least one striking parsing difference as compared to adults, in that they often fail to revise their parsing mishaps. That is, they often fail to recover from garden-path sentences. For example, in an eyetracking study by Trueswell et al. (1999), four- and five-year-old children responded to spoken instructions like the sentence in (1a) that contained a temporary ambiguity related to the first Prepositional Phrase (PP) “on the napkin”; it could link to the verb as a Goal, indicating where to put the frog, or link to the Noun Phrase (NP) “the frog”, specifying more information about the frog.

- (1) a. Put the frog on the napkin into the box.
- b. Put the frog that’s on the napkin into the box.

The visual display contained a toy horse, a toy frog on a napkin, an empty box, and an empty napkin. Upon hearing “on the napkin”, both children and adults looked to the empty napkin, suggesting they initially thought “on the napkin” was a goal phrase, i.e., where to put the frog. Upon hearing “into the box”, adults’ actions suggested that they revised this parsing commitment, in that they would correctly pick up the frog that was on the napkin and put it into the box. Children, on the other hand, showed signs that they never revised this initial misparse. On more than half the trials, they carried out incorrect actions, all involving the incorrect Goal: for instance, moving the frog to the empty napkin and then into the box. Crucially, making the sentence unambiguous, as in (1b), effectively turned children into adults, in that they hardly ever carried out an incorrect action in response to this sentence. So, hearing a linguistic cue to modification, as in the “that’s”, before hearing the prepositional phrase “on the napkin,” guided children toward the correct parse.

Since this initial result from Trueswell et al. (1999), many other studies have also found preschool-aged children failing to revise misinterpretations, including studies involving PP-attachment ambiguities (Hurewitz, Brown-Schmidt, Thorpe, Gleitman & Trueswell, 2001; Weighall, 2008), filler-gap dependencies (Omaki, Davidson White, Goro, Lidz, & Phillips, in prep.; Omaki, Lau, Dakan, Davidson White, & Phillips, under revision), quantifier scope assignment (Musolino & Lidz, 2006; Viau, Lidz, & Musolino, 2010) and anaphora resolution (Leddon & Lidz, 2006).

1.3. Cross-Linguistic Implications for ‘Failing to Revise’

Children’s failure to revise makes interesting predictions about parsing patterns cross-linguistically. For instance, in a recent study, Choi and Trueswell (2010) explored the hypothesis that Korean-speaking children would sometimes have trouble using verb information to make parsing decisions. This is because Korean is a verb-final language; an English sentence like “Pick up the frog on the napkin” has the translation in (2) in which the verb appears at the end of the sentence.

- (2) naypkhin-ey kaykwuli-lul cipu-sey-yo
 napkin-loc frog-acc pickup-hon-se
 napkin-on frog pick up
 ‘Pick up the frog on the napkin.’

The case marker -ey, in (2), can be interpreted as either a reduced form of a full relative, -ey issnun, or a genitive, -uy, since both markers are pronounced in the same manner, as /ay/. Thus, the phrase “naypkhin-ey kaykwuli-lul” in (2) is ambiguous between a modifier and a goal interpretation until the verb because the spoken form of -ey could be parsed as either a locative or a genitive. Since this form is much more frequently a locative than a genitive in Korean (Choi & Trueswell, 2010), it is very likely that “naypkhin-ey” is going to be parsed as a separate syntactic complement, such as a goal, rather than a modifier of ‘frog’. Upon hearing the verb “cipu-sey-yo” (“pick up”), however, listeners have to revise this initial parse, making a single complement: the frog that’s on the napkin. This predicts that such a sentence should be a garden-path sentence, and that Korean-speaking children should have trouble recovering from this misinterpretation.

Indeed, when sentence (2) is accompanied by a visual scene consisting of a frog on a napkin, a frog on a book, and an empty napkin, Korean-speaking four- and five-year-olds often made errors in their actions – actions that suggested they parsed the sentence as having two separate complements. Sometimes they interpreted napkin-/ay/ as a goal, moving a frog over to the napkin, and sometimes they treated it as an instrument phrase, using the empty napkin to pick up a frog. Adults on the other hand consistently revised their initial

misinterpretation and carried out the modifier action required by the verb: they picked up the frog on the towel.

The Choi and Trueswell (2010) findings have important implications for our understanding of child language learning. In particular, the findings suggest that not all linguistic cues are 'created equal'. Within a particular language, some cues tend to *guide* interpretation; in English the Verb in imperative sentences, or the Subject NP and the Verb in declarative sentences, often guides parsing, whereas in Korean and other verb-final languages, it's the NPs and their case-markers that tend to guide parsing commitments. Other cues in a language have the tendency to *revise* or simply augment ongoing interpretations. So, in verb-final languages, the verb and verb morphology will play this role. This would especially be the case for verb morphology that conveys information about argument structure – such as verb morphology that conveys information about causation.

If such a view of parsing is correct, we would expect that children's sensitivity to causative verb morphology would differ depending upon whether they are learning a verb-initial or verb-final language. Children learning a verb-final language ought to be less sensitive to causative verb morphology in assigning clause meaning, and if clause meaning guides verb learning, this lack of sensitivity could impact lexical acquisition.

We have some reason to suspect this might be true. In particular, a study by Lidz, Gleitman, and Gleitman (2003) found that children learning Kannada, a verb-final language spoken in certain parts of India, had trouble understanding causative verb morphology, despite the fact that this morphology is a perfect predictor of causation. In the study, children acted out simple sentences that either did or did not contain the causative morpheme on the verb. On certain trials, the sentence contained just one Noun Phrase, as in example (3a), which means "The horse rises". Adding the causative morpheme "-is-" to the verb, as in (3b), changes the meaning to "The horse lifts (something)", with an implicit Patient.

- (3) a. Kudure eer-utt-ade.
Horse rise-npst-3sn
'The horse rises.'
- b. Kudure eer-is-utt-ade.
Horse rise-caus-npst-3sn
'The horse lifts [something].'

Adults acting out these sentences showed sensitivity to these differences in form. Children, on the other hand, carried out non-causative actions for both sentence types, regardless of morphology. That is, they had the horse get up from the ground in both cases.

It was only when the sentence contained two NPs that children acted out a causative action. That is, children preferred to use the number of noun phrases in

a sentence as a cue to causativity rather than verb morphology. This finding was predicted by Lidz et al. (2003) because the number of arguments as a predictor of causativity is a universal property of all languages of the world, whereas verb morphology is a language-specific cue that has to be learned by the child.

But Kannada is a verb-final language. Thus the causative morpheme would, in these linguistic contexts, be a *revising* cue rather than a *guiding* cue. For example, in order to correctly interpret the causative morpheme in sentence (3b) which has just one overt NP, listeners need to use the verb and its morphology to retroactively insert another argument prior to the verb, causing a revision of the initial parse. The question then is what happens in a verb-initial language, where revision isn't necessary, as compared to a verb-final language that requires revision. We address this in two experiments below, first by re-examining children's use of causative morphology in Kannada (the verb-final language), and then comparing these results to a verb-initial language, Tagalog.

2. Experiment 1: Kannada-Speaking Children

2.1. Introduction

An act-out task was conducted with native Kannada-speaking children to confirm the central findings of Lidz et al. (2003) – namely that Kannada-speaking children do not use the causative morpheme to infer the presence of an implicit argument and hence do not form a causative interpretation of the sentence.

2.2. Method

Twenty 3- and 4-year-old children (10 female; mean age 3;11) participated in the study. All were native speakers of Kannada. They resided in the city of Mysore, India, and attended the Pushkarini and Swami Vivekinanda preschools, where we were permitted to conduct the study. Fourteen adult native speakers served as controls.

The procedure was a simple act-out task like that used in Lidz et al. (2003). On critical trials, two objects were placed in front of the child, one 'animate' (a toy mouse) and one inanimate (a notebook). Using pre-recorded sentences played over a laptop computer, both objects were labeled and then a set of instructions was given for the child to act out. The first action was always an action that involved no objects (e.g., 'You should smile'). This was done to encourage participants to be 'players' in the act-out task. Then two additional sentences were heard, each referring to one of the objects, as in: 'The notebook should open' and 'The mouse should squeak.' Mentioning both objects in an action was done to permit felicitous reference to them using an implicit argument in the following target sentence. The target sentence took one of four forms, as shown in (4).

4. a. niinu illi-yannu muTT-isa-beeku
 you-nom mouse-acc touch-caus-should
 'You should make [something] touch the mouse'
- b. niinu illi-yannu muTTa-beeku
 you-nom mouse-acc touch-should
 'You should touch the mouse.'
- c. niinu illi-yinda muTT-isa-beeku
 you-nom mouse-inst touch-caus-should
 'You should make the mouse touch [something].'
- d. niinu illi-yinda muTTa-beeku *
 you-nom mouse-inst touch-should *
 'You should touch with the mouse.' *

All sentences referred to the mouse via an overt NP. When this NP receives accusative case and the verb has causative morphology (as in 4a), the sentence is intended to convey the presence of an implicit Causee for the verb "touch", and hence a causative action is expected: having the notebook touch the mouse. Removal of the causative morpheme (as in 4b) makes this a simple sentence without an implicit argument, in which the expected response is for the child to touch the mouse. When the overt NP receives instrumental case and the verb has causative morphology (as in 4c), the sentence is intended to convey the presence of an implicit Patient for the verb 'touch', and hence a causative action is again expected: having the mouse touch the notebook. Removal of the causative morpheme (as in 4d) makes this an ungrammatical sentence, roughly translated as the ungrammatical English sentence 'You should touch with the mouse', and hence the expected action is unclear.

There were 14 critical trials which were preceded by one practice trial. Causativity (Causative or Non-Causative) was manipulated within subject, and Case (Accusative or Instrumental) was manipulated between subjects, resulting in four unique lists. Each list had the same fixed pseudorandom order, with the constraint that no more than two Causative or Non-Causative items could appear consecutively.

2.3. Predictions

Kannada-speaking children were predicted to carry out very few causative actions for any of the target sentences. That is, the presence of the causative morpheme ought not to increase the likelihood of children using the other object (the notebook) in their actions. This could be due to a dispreference to use verb morphology to compute argument structure (Lidz et al., 2003) or because the morphology is being used here to revise an initial parse.

2.4. Results and Discussion

As expected, Kannada-speaking children rarely interpreted the target sentences as containing an implicit argument, resulting in only 11% causative actions overall. And as shown in Figure 1A below, the proportion of causative actions was largely unaffected by the presence/absence of the causative morpheme or the type of case marking on the NP. Indeed, multi-level mixed logit modeling of the trial-level data revealed no reliable effects of Causativity or Case.

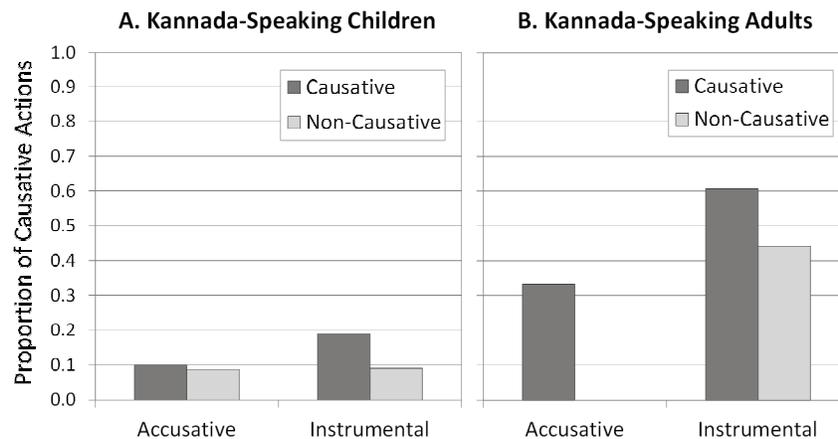


Figure 1. Proportion of Causative Actions for Kannada Speakers.

A. Children ($N = 20$); B. Adults ($N = 14$)

Adults on the other hand, showed more causative actions when the verb morphology was causative (Figure 1B). They also showed a greater preference to infer an implicit Patient than an implicit Causee, as shown by the greater proportion of causative actions when the NP received instrumental rather than accusative case.

Overall the results replicate the findings of Lidz et al. (2003); adults but not children showed sensitivity to the causative morphology. This could be due to children's dispreference to use anything other than the number of NPs to infer clausal argument structure. However, given that Kannada is a verb-final language, the findings are also consistent with the hypothesis that when causative morphology cannot guide parsing, young children cannot use it to revise their initial parsing preference. It is interesting to note that a similar insensitivity to the causative morpheme has been observed in Turkish (Göksun, Küntay, & Naigles, 2008), and Turkish, like Kannada, is a verb-final language.

The question therefore becomes: what happens in a verb-initial language that has productive causative morphology? If the failure-to-revise account is correct, children learning such a language should show an ability to use the

morphology to infer the presence of an implicit argument. We explore this in Experiment 2 by examining Tagalog.

3. Experiment 2: Tagalog-Speaking Children

3.1. Introduction

Tagalog is a verb-initial language spoken in the Philippines. Like Kannada it too employs verb morphology to convey causation. In particular the verbal morpheme “pa” is used to contrast verbal predicates such as “touch” (‘hipu-in’) from “cause to touch” (‘i-pa-hipo’).¹ However, unlike Kannada, listeners of Tagalog encounter this morpheme prior to most, if not all, constituents in canonical constructions. Thus, the morpheme may be used to guide rather than revise computation of clausal argument structure.

3.2. Method

Forty-seven 3- and 4-year-old children (26 female; mean age 4;1) participated in the study. All were native speakers of Tagalog. They resided in the city of Manila and all attended the Child Development Center at the College of Home Economics at the University of the Philippines, Diliman, where we were permitted to conduct the study. Four adult native speakers served as controls.

The procedure was the same as Experiment 1, except that the target sentence took one of four forms, as shown in (5).

5. a. dapat i-pa-hipo-mo ang libro
 should cv-caus-touch-2s.gen nom-book
 ‘You should make [something] touch the book.’
- b. dapat hipu-in-mo ang libro
 should touch-pv-2s.gen nom-book
 ‘You should touch the book.’
- c. dapat i-pa-hipo-mo sa daga
 should cv-caus-touch-2s.gen obl-mouse
 ‘You should make the mouse touch [something].’

¹ Transitive clauses with definite objects in Tagalog require one of the undergoer voices: patient voice “-in”, locative voice “-an”, or conveyance voice “i-”, depending on the verb and the semantic relation of the object. In such constructions, the definite objects are marked with nominative / absolutive case “ang” (glossed here as nom) and Agents are expressed in the genitive case (glossed gen). Causative verbs with definite objects are typically found in the conveyance voice (glossed here as cv), which was employed with all the causative stimuli in the experiment. Here, the objects are marked with nominative case, the causer with genitive case, and the causee with oblique case (glossed obl).

- d. dapat hipu-in-mo sa daga *
 Should touch-pv-2s.gen obl-mouse *
 'You should touch to the mouse.' *

In sentences of this sort, nominative case marking combined with causative morphology (as in 5a) is intended to convey the presence of an implicit Causee for the verb “touch”. Hence a causative action is expected: having the mouse touch the notebook. Removal of the causative morpheme (as in 5b) makes this a simple sentence without an implicit argument, in which the expected response is for the child to touch the notebook. When this NP receives oblique case and the verb has causative morphology (as in 5c), the sentence is intended to convey the presence of an implicit Patient, and hence a causative action is again expected: having the mouse touch the notebook. Removal of the causative morpheme (as in 5d) makes this an ungrammatical sentence, roughly translated as the ungrammatical English sentence ‘You should touch to the mouse’, and hence the expected action is unclear.

Lists were identical to those in Experiment 1, except that Case was either Nominative or Oblique rather than Accusative or Instrumental.

3.3. Predictions

If children have an innate tendency to assume that the number of syntactic arguments conveys information about clausal argument structure and predicate meaning, we would expect that Tagalog-speaking children, like Kannada-speaking children, should tend not to compute an implicit argument for sentences of the type used in these experiments. And if this bias completely blocks the use of morphology as a cue to argument structure, we should expect Tagalog-speaking children at this age to be completely insensitive to the productive causative morphology of the language. If on the other hand, the insensitivity to causative morphology in Kannada arose because of the verb-final nature of the language, we should expect Tagalog-speaking children to be sensitive to causative morphology, precisely because this cue can be used to guide the computation of argument structure rather than to revise such structure.

3.4. Results and Discussion

The proportion of causative actions generated by children in response to the target sentences appears in Figure 2A. Overall, Tagalog-speaking children prefer the non-causative interpretation of such sentences, producing causative actions only 31% of the time when averaging across all four conditions. This value however is much higher than that observed above for Kannada-speaking children (11%). Indeed, this difference is in part due to the fact that Tagalog-speaking children, unlike Kannada-speaking children, show sensitivity to the causative morpheme, producing more causative actions for sentences with the

causative morpheme (mean of 36%) than for sentences without the causative morpheme (mean of 24%). This effect was significant in multi-level mixed logit modeling of the trial-level data ($p < .05$) and was found not to interact with Case marking – i.e., the effect was present for both Nominative and Oblique Case. Also, as can be seen in Figure 2A, children showed an effect of Case, such that Oblique Case sentences generated substantially more causative actions than Nominative Case sentences. Thus, children are better at inferring an implicit Patient than an implicit Causee. This finding may be related to the general patterns of pro-drop in Tagalog, where the -ang phrase (the nominative / absolutive) is more commonly omitted. So one might wish to draw the alternative, but related, conclusion that children are better able to infer an implicit nominative / absolutive argument than an oblique phrase.

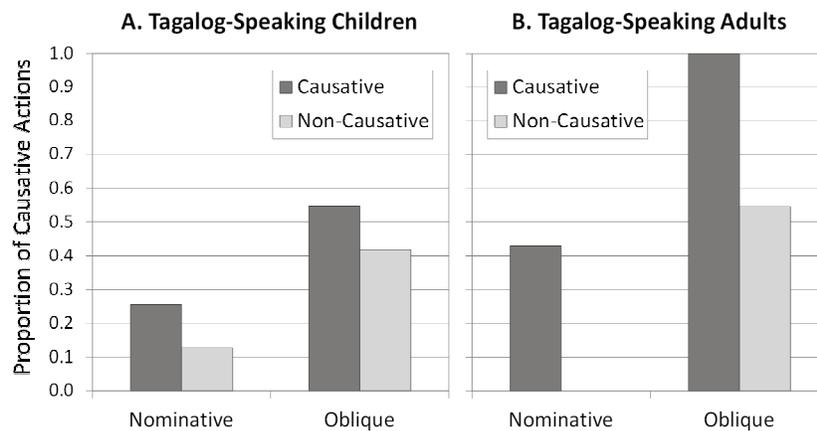


Figure 2. Proportion of Causative Actions for Tagalog Speakers.
A: Children ($N = 20$); B: Adults ($N = 4$)

The results from adults (Figure 2B) showed a pattern similar to children, except that adults showed more causative actions generally and numerically larger effects of Case and Causative Morphology.

Thus the results are consistent with the predictions made by the failure-to-revise parsing account. Children who use causative verb morphology to guide parsing (as in the verb-initial language Tagalog) show developmentally earlier sensitivity to this cue to structure.

4. General Discussion

There are two important observations to report from this work. Firstly, both Kannada-speaking children and Tagalog-speaking children show a bias to interpret one-argument clauses as conveying non-causative events, even when the causative verb morphology is present. This is consistent with the findings of Lidz et al. (2003) and their conclusion that children prefer to use the number of

NPs in syntactic argument positions as a universal cue to clausal event structure. Secondly, and quite importantly, Tagalog-speaking children, unlike Kannada-speaking children of the same age, are sensitive (to some degree) to causative morphology as a cue to structure/meaning. Tagalog-speaking children were more likely to infer the presence of an implicit argument when the causative morpheme was present, reflecting the fact that these children had assigned a causative interpretation to the sentence.

Although there are many differences between Kannada and Tagalog, the observed difference in children's sensitivity to causative morphology across these two languages is likely to arise because Tagalog is a verb-initial language whereas Kannada is a verb-final language. As mentioned above, children in this age range show difficulty using the linguistic cues within a sentence to revise initial parsing and interpretive commitments (e.g., Hurewitz et al., 2001; Omaki et al., in prep.; Trueswell et al., 1999; Weighall, 2008), with this difficulty being attributed to delays in executive functioning (e.g., Choi & Trueswell, 2010; Novick, Trueswell, & Thompson-Schill, 2005). Kannada-speaking children were being asked to use causative morphology to revise parsing commitments, taxing their executive function abilities, whereas Tagalog-speaking children were being asked to use this same cue to guide parsing commitments, resulting in less processing difficulty.

If this account is correct, it suggests that the mechanics of parsing can shape children's sensitivity to certain features of the input, which may, in turn, impact how they interpret clauses, learn word meanings, and possibly learn the grammar of their language. However, the latter claim, that parsing mechanics influence how grammar is learned, must be drawn with great caution from the current findings. We have demonstrated here that Kannada-speaking children have difficulty using causative morphology in comprehension for the sentences of the sort used here, but we have not yet demonstrated that Kannada-speaking children show a delay in overall acquisition of this morphological feature as compared to children learning a verb-initial language. This is a topic for future research; it would be quite interesting to establish that production of causative morphology is also delayed in Kannada. Such a finding would allow for greater confidence in concluding that processes pertaining to the extraction of structure and meaning from sentences (i.e., parsing) shape the acquisition profile of the grammatical system.

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