Syntax and Semantics: Argument Mapping and Maturation in Child Passives

Susannah Kirby
University of North Carolina at Chapel Hill

1 Background

The passive has been extensively studied in first language acquisition. This construction is a marked one in many adult languages (Keenan, 85), and correspondingly, much research has indicated that the passive is late to be acquired. Naturalistic data from English (Horgan, 1978), French (Sinclair, Sinclair, and Marcellue, 1971; cited in Suzman, 1985), German (Mills, 1985), and Hebrew (Berman, 1985), among other languages, have shown that spontaneous full passives (that is, those with an agent *by*-phrase; e.g., (1)) are quite rare in child language until age 4;0 at the very earliest (English, German), if not much later (e.g., 8;0 in Hebrew).

(1) Neil was kissed by Louise

This relatively late acquisition prompted Borer and Wexler (1987, 1992) to propose the *linguistic maturation hypothesis*, according to which certain linguistic constructions in UG (including those involving A-chains, such as the passive) are not immediately available to the child, but rather mature over time, just as do secondary sex characteristics. Structures relevant to the passive are assumed to mature around the age of 4;0; before this age, the *A-Chain Deficit Hypothesis* (ACDH; e.g., Babyonyshev et al., 2001) suggests that A-chains – specifically "non-trivial," or subject-object, A-chains – are ungrammatical for the child, and predicts that passives will therefore not appear in spontaneous speech. Data from a number of other studies on the passive, both naturalistic and experimental, have been interpreted by various researchers as support for the maturation hypothesis (e.g., Horgan, 1978; Mills, 1985; Pierce, 1992).

However, other accounts of the passive in child speech take a different tack, assuming that children initially depend heavily on semantics to support their syntactic interpretations. Proponents of the *semantic bootstrapping hypothesis* (e.g., Bowerman, 1973; Grimshaw, 1981; Pinker, 1984) have suggested that children come to the language learning task with inborn knowledge and/or biases about semantics which allow them to "bootstrap" into the syntax of their language. The details of the account vary from researcher to researcher, but the two major components hypothesized to be part of this task – namely, the categorization of words into syntactic classes, and the identification of syntactic functions within an utterance – are both connected inextricably to the (linguistic and cognitive) semantics of an utterance.

Important to the current discussion is the hypothesis that children rely on canonical notions of subject and object in their interpretation of all sentences. Specifically, children are biased to associate particular syntactic positions (e.g., "subject" and "object") with particular thematic roles (e.g., "agent" and "patient/theme," respectively) in a consistent way. This default assumption should aid children when they are presented with a linguistic description of an

observable event. For instance, upon hearing *The boy is kissing the girl* in the context of a kissing event, the child will be able to determine the word order of the ambient language (in the case of English, SVO, since the agent, mentioned first, should map onto the subject, and the patient, mentioned second, should map onto the object). As with syntactic categorization, the learner must initially depend on utterances that display the canonical semantics (e.g., active-voice clauses with agentive-transitive verbs) as she builds up a basic level of knowledge; only after building this foundation can she go on to identify subjects and objects that do not conform to this general scheme.

Such a strategy generally works well, considering that syntactic roles and semantic/thematic roles often line up in adult language, resulting in prototypical agent subjects and patient/theme objects, crosslinguistically (Fillmore, 1968; Keenan, 1976; Dowty, 1991; Baker, 1997).

However, the passive construction results in a syntactic-semantic "mismatch," in which themes – and not agents – surface as subjects. As would be predicted by the semantic bootstrapping approach, children who have not yet acquired the relevant syntax interpret "reversible" passives (that is, those with two animate arguments; (2)) as if they were active sentences, taking the first NP to be the agent (3) (Bever, 1970; Maratsos, 1974; Mills, 1985).

(2) *Utterance*: Neil was kissed by Louise
(3) *Child's interpretation*: Neil kissed Louise

Taking such evidence into account, Hyams et al. (2006) have suggested that children's trouble with the passive stems from a noncanonical arrangement of theta-roles. They propose the *Canonical Alignment Hypothesis* (CAH), which states that in the earliest grammar, any external argument (for instance, typically an agent) must map onto subject position (Spec, IP). Thus, it is not A-chains *per se* that give children trouble, but rather, only A-chains that result in a violation of the CAH.

If children's failure on passive comprehension is due to problems overcoming a syntax-semantics mismatch, rather than trouble with A-chains, children should perform better on passives when prototypical theta-role mapping is not violated. Passives embedded under raising-to-object verbs (RO-EPs; shown in (4)) circumvent violations of canonical roles in argument mapping, thereby providing an utterance type with which we can test this prediction. Here, semantic objects surface as syntactic objects – for instance, in (4), *Neil* is both the patient of *kiss* and object of *want/need*.

(4) Suki wanted/needed Neil$_i$ [t_i to be kissed t_i by Louise]

On the other hand, if trouble with the passive indeed results from a

deficiency regarding non-trivial A-chains, children should perform equally poorly on RO-EPs, which involve movement from the object to the subject of the embedded clause, and secondarily to the object of the matrix clause.

2 Method

The research described below tested the hypothesis that children's difficulty with the passive construction is a result not of a pre-mature grammar which is unable to construct or interpret nontrivial A-chains, but rather of the syntax-semantics mismatch posed by this construction. I tested this hypothesis with English-speaking children (ages 4-5) using two truth-value judgment tasks.

2.1 Experiment 1: Matrix passives

In Experiment 1, children ages 4-5 were tested on their ability to interpret matrix (non-embedded) passives. 32 monolingual English-speaking children (ages 4;1.15-5;11.15) were recruited from the Chapel Hill, NC, area to take part in the study. The 4-year-old group contained 8 boys and 8 girls and had a mean age of 4;6 (range: 4;1.15-4;11.12); the 5-year-old group contained 7 boys and 9 girls, and had a mean age of 5;5 (range: 5;0.18-5;11.15). Participants had no known linguistic (speech or hearing) impairment or other cognitive or developmental delays. Children received a small token gift for their participation.

Experiment 1 comprised a truth-value judgment task (TVJ; Crain and McKee, 1985; Gordon, 1996), in which each child heard stories and saw them acted out with small figurines. After each story, the child listened to a puppet make a comment about the story. The child was asked to reward the puppet for his correct comments by "feeding" him a plastic orange, and to punish him (i.e., provide him with a less attractive reward) for his incorrect comments by "feeding" him a plastic piece of lettuce. In the latter case, children were also asked to explain why the puppet was wrong. Children received test items separated by filler items, which were included to check for answer biases and/or inattention to the task.

All test items in Experiment 1 involved full reversible passives – that is, they included an agent *by*-phrase, and both subjects and objects were animate. All arguments were full lexical NPs. An example story appears in (5), and test items appear in (6). Target answers for stimuli appear after each item.

(5) *Example story: Passive*
This woman wanted to draw a picture of someone. The nurse was busy, and she had already drawn a picture of farmer, so she decided to draw the policeman.
Experimenter: *What happened?*

Puppet: *The woman was drawn by the policeman* (F)

(6) *Passive test items*
The pig was sent by the farmer (T)
The woman was drawn by the policeman (F)
The farmer was picked by the sheep (F)

The outcome of Experiment 1 was that only 5-year-olds behaved in an adultlike manner in their interpretations of matrix passive utterances. That is, the 5-year-olds, but not the 4-year-olds, had mastered matrix passives. The results of Experiment 1 are given in Table 1.

Table 1: Performance on Matrix Passives

Age	% Correct
4	64.6
5	79.2*

*p<0.01

The data was analyzed by age group (4, 5). A series of logistic regressions (with the standard error adjusted for multiple observations within subjects) were performed to compare the number of correct (adultlike) responses per age group to a chance level of performance (namely, 50%). The test of the hypothesis that children performed at a chance level on matrix passive constructions was rejected for 5-year-olds ($z=3.08$, $p=0.0020$), but not for 4-year-olds, who did not perform above chance ($z=1.83$, $p=0.0667$).

These results are unsurprising, when we consider the existing literature on acquisition of the passive. In short, the children in Experiment 1 performed exactly as the extant literature predicted they would, given their age and native language.

However, given the predictions of the semantic bootstrapping hypothesis, it is possible that children who failed on the task in Experiment 1 may still succeed on interpreting embedded passives (RO-EPs), in which syntactic and semantic roles align. Evaluating children who fail to comprehend matrix passives on their comprehension of RO-EPs will serve as a test for Wexler's hypothesis that it is specifically the non-trivial (subject-object) A-chain in the passive construction that causes children trouble. The A-chains in RO-EPs (e.g., *Suki wanted/needed Neil$_i$ [t_i to be kissed t_i by Louise]*) are exceedingly non-trivial, in that they constitute object-subject-object A-chains. As a result, if Wexler is right, RO-EPs should prove as problematic for pre-mature children as do matrix passives. On the other hand, if children have less trouble with embedded than with matrix passives, the mismatch account would be supported.

2.2 Experiment 2: Embedded Passives

In Experiment 2, children were tested on their ability to interpret passives embedded under raising-to-object verbs. The participants and methods in Experiment 2 were identical to those in Experiment 1.

In Experiment 2, all test items had a pronoun matrix subject (to reduce processing load) and a lexical NP embedded subject and object. Each child received either *want* items, or *need* items. An example story appears in (7) and test items (with target answers) appear in (8).

(7) *Example story: Embedded passive*
Winnie the Pooh said to Tigger, "Somebody should call Elmo and invite him over to play with us. Do you have his telephone number? Can you call him up?" Tigger said, "Yes, I can call Elmo," and he went to call him and invite him over.
Experimenter: *What did Winnie the Pooh do?*
Puppet: *He needed Tigger to be called by Elmo* (F)

(8) *Embedded passive test items*
She wanted the tiger to be tickled by the bear (T)
She wanted Clifford to be drawn by Patrick (T)
He wanted the horse to be seen by the farmer (F)
He needed Clifford to be fed by Shrek (T)
He needed Tigger to be called by Elmo (F)
She needed Cookie Monster to be photographed by Elmo (T)

It should be explicitly noted that if children were to interpret the embedded passives as if they were actives, they would fail on the task (9).

(9) He needed [Tigger to be called by Elmo] ≠ He needed [Tigger to call Elmo]

The outcome of Experiment 2 was that both 4- and 5-year-olds performed significantly above chance in their interpretations of passives embedded under RO verbs. The results of Experiment 2 are given in Table 2.

Table 2: Performance on Embedded Passives

Age	% Correct
4	75.0*
5	79.2*

*$p<0.01$

As in Experiment 1, the data was analyzed by age group, with logistic regressions performed to compare the number of correct responses per age group to a chance level of performance. The test of the hypothesis that children performed at a chance level on RO-EP utterances was rejected for both age groups: both 4- and 5-year-olds' performance was significantly above chance (4: $z=3.30$, $p=0.0010$; 5: $z=4.41$, $p<0.0001$).

Thus, contrary to the maturation account, but as predicted by the mismatch account, both groups – even 4-year-olds, who had failed to comprehend matrix passives – performed above chance in their interpretation of RO-EPs.

Table 3: Comparative Performance on Passives (Percent Correct)

Age	Matrix	Embedded
4	64.6	75*
5	79.2*	79.2*

*$p<0.01$

Moreover, success on two tasks was not significantly correlated ($r^2=0.076$, $p=0.1273$); thus, it was not the case that those children who succeeded on the RO-EP task were simply those who also succeeded on the matrix passive task.

These data dovetail with independent evidence that children have no trouble with A-chain formation (e.g., in subject raising, Köppe, 1994; *get*-passives, Fox and Grodzinsky, 1998; and unaccusatives, Guasti, 2002), as well as with adult aphasia studies indicating that processing load increases with non-canonical theta-role ordering (Caplan and Hildebrandt, 1988).

3 Conclusion

In the experiments presented here, English-speaking 4- and 5-year-olds were tested on their comprehension of matrix and embedded passives. Although 4-year-olds failed to comprehend matrix passives in an adultlike way, instead interpreting them as active-voice utterances, both age groups performed significantly above chance in interpreting passives embedded under raising-to-object verbs. These results are especially striking considering the greater syntactic complexity and length (both traditionally considered to be correlated with processing load) of RO-EPs, in comparison to matrix passives.

I propose that children's pattern of performance in these two experiments are part of a larger cluster of strategies that I will refer to as *semantic scaffolding* (for more detail, see Kirby, in prep). Specifically, I submit that children rely strongly on the semantics of the utterances – including, but not limited to, canonical syntax-semantics matches, as claimed by the CAH – to aid in

interpretation, until syntactic representations and processing power reach adult levels.

Taken together, children's performance on matrix passives and on RO-EPs provide strong support for the semantic scaffolding hypothesis, and specifically for the proposal made by the CAH that interpretation of the passive by young children hinges on the match between syntactic and thematic roles, rather than on the ability to form A-chains. In RO-EPs like those tested in Experiment 2, D-structure objects surface as S-structure objects, even though they pass through an external argument position between the two levels of representation. The results of Experiment 2 would then indicate that the CAH acts as a kind of filter, only looking at the head and the tail of the chain, and not at the intermediate traces, which – in the case of RO-EPs – *would* result in a violation of canonical alignment.

However, interpretation of the passive is not the only domain in which the effects of semantic scaffolding can be seen. A number of other researchers (Maratsos, 1974; Chapman and Kohn, 1977; Lempert, 1989; Hyams et al., 2006) have observed the effects of children's initial assumptions about theta-structuring in numerous arenas, and have linked children's non-adultlike behaviors to these default assumptions about the appearance of agents and themes. For instance, Chapman and Kohn (1977) presented evidence that children performed better on interpreting sentences with animate (agent) subjects and inanimate (theme) objects than on sentences with inanimate subjects and animate themes – that is, they performed best with Dowty-style "proto-agent" subjects and "proto-theme" objects. Similarly, Maratsos (1974) found that children appear to use a default "behavioral" strategy when confronted with NVN sequences; this processing shortcut leads them to interpret such sequences (regardless of syntax) as actor-action-object utterances. In related work, Lempert (1989) found that children (ages 2;6-5;3) produced more novel passive sentences when they had been trained on items with animate (rather than inanimate) patients – which, recall, surface as subjects in a passive utterance. All these results are consistent with the hypothesis that for children, the "concept" of *subject* is a category that includes animacy as a component.

The semantic scaffolding analysis of children's performance here, which relates to the prototypicality of agent-subjects, is moreover attractive in that it may bear on the distinction seen in children's patterns of competence on *get*-passives versus *be*-passives: namely, that children who fail on tests of full matrix *be*-passives still sometimes perform in an adultlike way on *get*-passives (Crain et al., 1987; Crain and Fodor, 1989; Crain, 1991; Fox and Grodzinsky, 1998). Although Fox and Grodzinsky (1998) present a cogent argument that the syntax of *get*- and *be*-passives is identical, it could be contended that the comparison is not an entirely fair one, since there is a subtle semantic difference between the two. Specifically, the patient-subjects in *get*-passives are more "active" in terms of the semantic role they play.

For instance, compare *Louise was kissed* with *Louise got kissed*. In the *be*-version, it is possible that all that the patient-subject *Louise* did was to hold still for the kissing event. However, in the *get*-version, *Louise* may have played a much more active role in bringing the kiss about: namely, she may have flirted, tried to look cute, or even asked someone to kiss her (cf. *Louise got herself kissed*). This divergence between the two passives may relate to the fact that *be* is stative and *get* is eventive; thus, a *get*-passive will more closely match children's default expectations that the verb in a NVN sequence represents an action (see Bowerman, 1973; Maratsos, 1974; Grimshaw, 1981; Pinker, 1984). In short, there is something much less "passive-y" about the *get*-passives, and it may be exactly this semantic distinction that allows children to master them before they master their *be*-passive counterparts.

A second benefit to the semantic scaffolding analysis is that it provides a better, more refined definition for the concept of "processing load" than has previously existed – and furthermore, that it makes use of the concept of cognitive load without giving up on a grammatical account of acquisition. As seen in the results on matrix and embedded passives detailed above, processing load does not appear to be monotonically correlated with sentence length or transformational complexity, considering that some children who succeeded on interpretation of the longer RO-EPs (with their longer A-chains) failed to interpret the shorter matrix passives. Instead, the semantic scaffolding approach equates processing load with "novelty of construction," including the noncanonical assignment or appearance of theta-roles, and predicts that utterances which violate children's default assumptions about the syntax-semantics interface will result in a greater cognitive load than utterances which match those assumptions. Such a mismatch results in the pattern observed above: children deal with various types of syntactic "strangeness" in ways that are non-adultlike, but still governed by the grammar. In short, the semantic scaffolding hypothesis explains how UG may still constrain and guide non-adultlike performance, even in the face of processing limitations.

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Susannah Kirby
University of North Carolina at Chapel Hill
Linguistics Department, CB #3155
Chapel Hill, NC 27599-3155
suki@ibiblio.org