Knowledge of Structural Constraints on Dative Alternation
In Children’s Pronoun Interpretation

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Abstract

Previous studies on the acquisition of English double object construction find that preschool children have more difficulty comprehending double object than *to*-dative sentences (e.g., Cook 1976; Osgood and Zehler 1981; Roeper et al. 1981). In addition, it has also been documented that children acquiring English make overgeneralization errors of dative alternation (e.g., Bowerman 1988; Mazurkewich and White 1984; White 1987). The goal of this study is to investigate whether English-speaking preschool children possess the knowledge of the structural constraints governing the pronoun interpretation in double object sentences like “The old lady threw Winnie the Pooh, his, chair” and “*The Smurf brought his, brother Tigger,”. The hypotheses are that if children adopt the linear order strategy or if they convert the double object sentences to the corresponding *to*-dative construction for interpretation, they will assign a wrong antecedent for the pronoun. The results from two truth value judgment experiments showed that 4-6 year-old children performed like adults in interpreting the two types of double object sentences. The finding clearly demonstrates that although young children at this age range make overgeneralization errors regarding dative alternation, they have an abstract understanding of the structural constraints when they are computing the interpretations of pronouns in double object sentences.

Keywords: Structural constraints; Pronoun interpretation; Dative alternation
1. **Introduction**

Many human languages have two kinds of dative constructions that can alternate with each other to convey basically the same truth condition as in (1).

\[
\begin{align*}
(1) & \quad \text{a. Mary gave the book to John.} \\
& \quad \text{b. Mary gave John the book.}
\end{align*}
\]

English sentences like (1a) are generally referred to as prepositional (or to-) datives, and sentences in (1b) are usually called double object datives. Previous linguistic studies on dative alternation have mainly focused on whether the semantic relationship between the two constructions is lexically based (e.g., Jackendoff 1990), or derived syntactically. Some linguists (e.g., Larson 1988, 1990) argue that the double object dative is derived from the underlying structure of a to-dative, while others either propose that to-datives are derived from double object datives (e.g., Aoun and Li 1989), or assume no derivational relationship between the two types of dative constructions (e.g., Pesetsky 1995). Although the sentences in (1) can be paraphrases for each other, there still exist some constraints regulating the alternation in English. On the one hand, some verbs can appear in the to-dative construction but not the double object construction (as the examples in (2)), whereas other verbs,
although very few, permit only the double object structure but not the prepositional
dative structure (as shown in (3)).

(2) a. Mary donated the book to the library.
       George reported the case to the manager.
   b. *Mary donated the library the book.
       *George reported the manager the case.

(3) a. ??I spared the details to the reporter.  (Ferreira 1996, p. 743)
       *I envied his good looks of him.  (Pinker 1994, p. 402)
   b. I spared the reporter the details.
       I envied him his good looks.

On the other hand, for verbs that can be used in both double object and to-dative
constructions, the semantic paraphrase can break down when a possessive pronoun
occurs in either of the object noun phrases, as demonstrated in (4) and (5).

(4) a. The lady brought Miss Lee, to her, brother.
   b. *The lady brought her, brother Miss Lee,.

(5) a. ??The lady brought her, book to Miss Lee,.
   b. The lady brought Miss Lee, her, book.

In (4a), when the possessive pronoun is in the indirect object NP of the to-dative

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1 Some English-speaking adults I consulted found the co-reference in (5a) not as bad as the
   unacceptability of (4b).
construction, the co-reference between the direct object and the pronoun is legitimate, but in the corresponding double object construction (4b), the two cannot co-refer. However, when the possessive pronoun is in the direct object NP of the double object structure as in (5b), it can co-refer with the indirect object, but the co-reference interpretation is not accepted by most English speakers in the corresponding to-dative sentence as in (5a).²

Since the discussion of Baker (1979) on the learnability paradox posed by the alternation of (1a) and (1b) and the ungrammaticality of (2b) and (3a), most of the acquisition research on dative alternation has been concerned with whether children make overgeneralizations to novel verbs or non-alternating verbs such as *donate*, and if they do, how they unlearn the mistakes (e.g., Bowerman 1978, 1983, 1987, 1988; Conwell and Demuth 2007; Gropen, Pinker, Hollander, Goldberg, and Wilson 1989; Mazurkewich and White 1984; Pinker 1984, 1989). The paradox arises given that previous studies have shown that negative evidence is neither consistently nor reliably available for all children to expunge a grammatical error (e.g., Brown and Hanlon 1970; Marcus 1993). Although the constraints governing the argument structures of

² One of the anonymous reviewers suggested that the asymmetry of the co-reference readings can be accounted for by simply stating that when the pronoun precedes (linearly) the antecedent, co-reference is prohibited. An obvious counterexample for this linear account is shown below, where the pronoun precedes the referential NP, but co-reference is allowed. More discussion on the relevant structural constraints and acquisition studies of co-reference is in sections 2 and 3.

(i) While he was watching TV, John wore the new glasses.
alternating vs. non-alternating verbs have been one of the major research topics for about three decades, little attention has been paid to the acquisition of constraints governing the asymmetry of pronoun interpretations in dative alternation as exhibited in the contrasts in (4) and (5). Previous acquisition studies (e.g., Cook 1976; Osgood and Zehler 1981; Roeper, Lapointe, Bing, and Tavakolian 1981) on the comprehension of the two dative constructions exclusively concern the relative comprehension difficulty of the two structures and whether children adopt any strategies (e.g., animacy or linear order of the object noun phrases) to interpret the difficult sentences. Using an act out task, the major finding of these comprehension studies is that children up to the fourth grade or ten years old have greater difficulty understanding double object datives than to-dative sentences. With respect to children’s comprehension strategies, these studies generally reveal no significant effect of animacy, although performance is usually poor when the direct object and the indirect object are both animate or both inanimate. Nevertheless, the results of Roeper et al. (1981) indicate that among kindergarteners, second-graders and fourth-graders, animacy is relied on most heavily by second-graders as an indicator of the indirect object, but kindergarteners rely more on the linear order of the object noun phrases. That is to say, kindergarteners tend to interpret a sentence like (6a) as

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3 Since Cook (1976) did not analyze the results from different age groups (5 to 10 years old) separately, and the subjects in Osgood and Zehler (1981) were only 3 to 5 years old, this may explain why they did not find significant effect of animacy.
though it were (6b).

(6)  a. The cow gave the dog the pig.
    b. The cow gave the dog to the pig.

The current study is intended to fill the gap in the acquisition literature regarding the development of constraints restraining children’s pronoun interpretation in dative alternation. Before the presentation of the experiments in section 4, I will illustrate the structures of the two dative constructions and the hypothesis of the current study in section 2, and review previous acquisition studies on structural constraints in section 3.

2. **Structures of the Dative Constructions**

The structures depicted in (7) illustrate the hierarchical relation between the two NPs proposed in previous syntactic analysis of dative constructions.

(7)  a. VP
    V
    |   
    V
    |   
    NP1
    |   
    NP2

b. VP
    V
    |   
    NP1
    |   
    NP2
c. VP
    V
    |   
    NP1
    |   
    NP2
Based on Barss and Lasnik’s (1986) observation of certain asymmetries in the English double object datives (as shown in the (a) sentences below), Larson (1988) extended the findings to the to-dative construction (shown in the (b) sentences below).

(8) Anaphor binding
   a. I showed John himself (in the mirror).
      *I showed himself John (in the mirror).
   b. I showed Mary to herself.
      *I showed herself to Mary.

(9) Quantifier binding
   a. I showed every friend of mine his photograph.
      *I showed its trainer every lion.
   b. I sent every check to its owner.
      ??I sent his paycheck to every worker.

(10) Weak crossover
    a. Who did you show his reflection in the mirror?
       *Which lion did you show its trainer?
    b. Which check did you send to its owner?
       *Which worker did you send his check to?
(11) Superiority
a. Who did you give which book?
   *Which book did you give who?
b. Which check did you send to whom?
   *Whom did you send which check to?

(12) Each…the other
a. I gave each man the other’s watch.
   *I gave the other’s trainer each lion.
b. I sent each boy to the other’s parents.
   *I sent the other’s check to each boy.

(13) Negative polarity items
a. I gave no one anything.
   *I gave anyone nothing.
b. I sent no presents to any of the children.
   *I sent any of the packages to none of the children.

Barss and Lasnik (1986) and Larson (1988) argue that the above asymmetries demonstrate that in a V-NP-NP (i.e., double object dative) or a V-NP-P-NP (i.e., to-dative) sequence, the second object NP is in the domain of the first object NP, but not vice versa. To put it another way, the first object NP asymmetrically c-commands the second object NP in the structures of the two kinds of dative constructions.\(^4\) The definition of c-command is stated as follows.

\(^4\) For anaphor binding, reflexives and reciprocals (i.e., anaphors) must be c-commanded by their antecedents. For quantifier-pronoun binding, a quantifier must c-command a pronoun at Surface Structure if it is to bind it. For weak crossover, a wh-phrase c-commanded by an NP containing a pronoun at Deep Structure cannot be moved over that NP if the wh-phrase and the pronoun are co-referential. For superiority effects, a wh-phrase cannot be moved over another wh-phrase that c-commands it at Deep Structure. For the each…the other construction, it may have a reciprocal reading only when the each-phrase c-commands the other-phrase. For negative polarity items, they
(14) A node A \(c\)-commands a node B if A and B do not dominate each other, and the first branching node dominating A also dominates B. (Reinhart 1979)

The generalization hence casts doubts on the validity of the structures in (7a-c) frequently assumed for the double object dative construction. The structures in (7a) and (7b) must be rejected because the two NPs are symmetrical (i.e., they mutually c-command each other), and the structure in (7c) is not allowed because NP2 asymmetrically c-commands NP1, making backward predictions with respect to domains.\(^5\) In consequence, the structures in (7d) and (7e) excel the other three in allowing the representation of asymmetrical c-command of NP2 by NP1.

Given the asymmetrically c-commanding relationship between the two NPs in double object dative and \(to\)-dative constructions, the prohibition on dative alternation regarding the interpretation of a pronoun as in (4b) and (5a) can be naturally captured.\(^6\) In order to correctly interpret the pronoun in the sentences, a child must

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\(^5\) Even if we adopt a definition of c-command based on containment in maximal projections as shown below, the structure in (7c) is still not plausible, since both NP1 and NP2 are contained in the maximal projection VP, they will mutually c-command each other, predicting no asymmetries.

(i) \(X\) c-commands \(Y\) iff every maximal projection that dominates \(X\) also dominates \(Y\). (Aoun and Sportiche 1981).

\(^6\) A comprehensive account on all the co-reference possibilities for a pronoun is beyond the scope of this study (more discussion on this topic can be found in Koopman and Sportiche 1982 and Higginbotham 1983). However, it seems plausible to say that the pronoun’s being in an NP which c-commands the other object NP makes co-reference of the two unacceptable, as in the contrast of (4a) vs. (4b) and (i) vs. (ii) below. More examples from Koopman and Sportiche (1982) further support the reasoning, as the sentences shown from (iii) to (v), where the quantified noun does not c-command
be able to compute the hierarchical structure between the two NPs in his/her mental grammar, and relying on transforming a double object sentence to a to-dative sentence when the former causes processing difficulty as found in previous comprehension studies may result in picking up a wrong antecedent when the co-reference of the two object NPs is under consideration. If the structure used by English-speaking children is such that the second object NP c-commands the first object NP, or if they do not c-command each other, co-reference between the pronoun and the second object NP should be possible in (4b) and (5a). That is to say, if English-speaking children do not have the adult hierarchical structure with respect to the two object NP’s for the double object construction, they will have difficulty getting the adult interpretations for the contrasting sentences in (4) and (5). The problem now is how the constraints on dative alternation discussed above come to a child. The positive evidence children encounter in their linguistic environment will not tell them that (4b) and (5a) are unacceptable in adult English. Since negative evidence is not consistently

\begin{itemize}
  \item [(i)] Tigger hugged his brother.
  \item [(ii)] His mother washed the Smurf.
  \item [(iii)] *Whose mother likes him?
  \item [(iv)] *Everyone’s mother likes him.
  \item [(v)] *A picture of every child pleased him.
\end{itemize}

Although co-reference between his and the Smurf in a sentence like (ii) is considered acceptable because they do not c-command each other (e.g., Higginbotham 1983, p. 399; Huang 1995, p. 138), in Koopman and Sportiche (1982) it is considered unacceptable when the focal stress is on the object NP. However, English-speaking adults reported in Su (2001) rejected the co-reference in (ii) 97% of the time. There may be some dialectal differences, as indicated in footnote 25 in Koopman and Sportiche (1982).
available to inform children of their grammatical errors, a child will have to be a conservative learner in order to be able to converge to adult grammar, as proposed in Baker (1979).

Contrary to the conservatism account, in the acquisition literature, it has been documented that children acquiring English make overgeneralization errors of dative alternation (e.g., Bowerman 1988; Mazurkewich and White 1984; White 1987; and more recently Conwell and Demuth 2007). Examples of such overgeneralization errors are as follows (from Bowerman 1988).

(15) a. I said her no. (cf. I said no to her.)
     b. Shall I whisper you something? (cf. Shall I whisper something to you?)
     c. Button me the rest. (cf. Button the rest for me.)

In these examples, the utterances made by children do not exist in the adult grammar, and hence it is not likely that children learn them from positive evidence. The only way children can come up with these sentences is through the correspondence of the to- or for-dative and the double object constructions for some verbs, which occurs in the adult input, as illustrated in the following examples.

(16) a. I told her a story. (cf. I told a story to her.)
     b. Mary baked Jane a cake. (cf. Mary baked a cake for Jane.)
In addition to the evidence of overgeneralizations found in children’s speech production, Mazurkewich and White (1984), using a grammaticality judgment task for older children from 9 to 15 years old, found that a number of ungrammatical sentences containing NP-NP sequence after verbs like *donate* (i.e., Latinate verbs) were accepted by children, suggesting an overgeneralization made by them. White (1987), using an act out task and an imitation task, found that there was no significant difference in terms of various error types for alternating and non-alternating verbs for English-speaking children at the age of 3;8 to 5;8. Another interesting finding from this study in their imitation task was that in general children preferred the NP-PP sequence (i.e., the *to*-dative) to the NP-NP one (i.e., the double object dative), as exhibited in the errors which converted the latter form to the former, as in (17b) for (17a).

(17) a. The teddy is drawing the doll a house.
   b. The teddy is drawing a house for the doll.

Another relevant recent study is Su and Crain (2000), in which how English-speaking children interpret double object sentences like “Snow White gave a lady every flower” and *to*-dative sentences like “The troll sold every ring to a girl” were examined. Using a truth value judgment task, it was found that English-speaking
adults accepted the existential wide scope reading (i.e., one of the ladies receives all the flowers) and rejected the universal wide scope reading (i.e., every flower is given to a different lady) 100% of the time for the double object sentences. That is to say, the double object sentences are not ambiguous and allow only the existential wide scope reading for adults. However, English-speaking children between the ages of 4;2 and 6;4 (mean 5;3) accepted the existential wide scope reading only 45% of the time, and wrongly accepted the non-adult universal wide scope reading 72% of the time. The conspicuous discrepancy between adults and children is also manifested in their performance for the to-dative sentences. Although adults accepted the existential wide scope reading (i.e., only one of the girls gets all the rings) 97% of the time and the universal wide scope reading (i.e., each ring is sold to a different girl) 72% of the time, children accepted the former only 50% of the time and the latter 77% of the time. Children’s comparable acceptance rates of the two interpretations for the double object and to-dative sentences suggest the possibility that they may interpret the double object sentences via the corresponding to-dative ones. These studies all suggest that children are not conservative when acquiring a language, and that they overapply the dative alternation to generate double object forms or meanings that do not exist in the adult grammar. Therefore, with respect to children’s pronoun interpretation in double object sentences, the hypothesis would be that at least at an
early stage when they make overgeneralization errors, children may sometimes interpret the double object sentences via the corresponding to-dative construction and hence wrongly interpret the pronouns.\(^7\)

3. Previous Acquisition Studies on Structural Constraints of Coreference

In this section, I will review relevant acquisition studies that examine young children’s structural constraints on the interpretations of sentences with pronouns.

Most of the studies to be considered here investigated Principle C of the Binding Theory (Chomsky 1981; 1986), which is a structural constraint prohibiting co-reference.\(^8\) Principle C is defined as follows.

(18) Principle C\(^9\)

\(^7\) One of the anonymous reviewers commented that children’s overgeneralization errors and their interpretation of possessive pronouns may be totally unrelated. The reviewer stated that maybe children are free to overgeneralize because they can recover from those mistakes, but they do not make mistakes with the interpretation of possessive pronouns because they could not recover from those mistakes. It is not clear why children can recover from one type of overgeneralization errors but not the others. If what the reviewer meant is that overgeneralization errors on sentence forms as found in Bowerman (1988), Mazurkewich and White (1984), and White (1987) can be recovered more easily than overgeneralization errors on meanings, the non-adult interpretations of double object sentences reported in Su and Crain (2000) would be counterexamples for those are errors on meanings.

\(^8\) There are more studies on the acquisition of Principle C than those included here (e.g., Tavakolian 1978; Lust 1981; Solan 1983). However, due to the problems with the task used, the results from those studies showed more of the children’s preference than competence. For a discussion regarding this, see Crain and Thornton (1998) chapter 26.

\(^9\) For ease of illustration, we adopt the statement for Principle C used in Crain and Thornton (1998, p. 216). Chomsky (1986, p. 166) defines the principle as in (i).

(i) An r-expression is free (in the domain of the head of its chain).
An r-expression R (i.e., a referring expression) cannot be co-referential with a pronoun P that c-commands it.

Principle C is employed to explain why co-reference between the pronoun and the NP is allowed in (19b) and (19d), but prohibited in (19a) and (19c). The principle does not rule out co-reference in (19b) and (19d) because in (19b) the NP c-commands the pronoun, while in (19d) they do not c-command each other. The principle has an effect on (19a) and (19c) in consequence of the pronoun’s c-commanding the NP. Note that the prohibition cannot be attributed to the linear order of the pronoun and the NP, as the pronoun precedes the NP in (19a), (19c) and (19d).

(19) a. *He, thinks the Troll, is the best jumper.
    b. The Troll, thinks he, is the best jumper.
    c. *He, was reading the paper, while the Troll, was eating a bagel.
    d. While he, was reading the paper, the Troll, ate a bagel.

Since Principle C is a negative statement that excludes one of the possible meanings for the relevant sentences due to the structural constraint, and given that negative evidence do not exist consistently nor reliably for all children to unlearn a grammatical error (e.g., Brown and Hanlon 1970; Marcus 1993), it is plausible to consider Principle C as a part of innately specified linguistic knowledge. Therefore,

\footnote{In all the four sentences, a deictic reading that co-refers the pronoun with someone not mentioned in the sentence is always allowed.}
it should be expected to appear early in the course of language development.

Using a truth value judgment task, Crain and McKee (1985) examined the acquisition of Principle C by young English-speaking children (mean age 4;2) using the sentences in (19). The results showed that for ambiguous sentences like (19d), children accepted the backward anaphora reading (i.e., the co-reference reading) 73% of the time, and the deictic reading 81% of the time. For unambiguous sentences like (19a) and (19c) where Principle C is effective, children rejected the co-reference reading 84% of the time for (19a) and 88% of the time for (19c). The findings suggest that the structural constraints prohibiting co-reference appear as early as children can participate in relevant experiments.

Kazaniza and Phillips (2000) used the corresponding Russian sentences in (19) to test Russian-speaking children’s knowledge of Principle C. With respect to adult interpretations, Russian differs from English in that co-reference between the pronoun and the NP for a sentence like (19d) is unacceptable in Russian, but acceptable in English. It was argued that co-reference for (19d) in Russian is ruled out by a non-syntactic constraint which is effective when the first subject (i.e., the pronoun) is an agent. The results from Russian-speaking children were very similar to the findings from English-speaking children in Crain and McKee (1985). For control sentences like (19b) where co-reference is possible, children accepted the co-reference
reading around 85% of the time. For the Russian sentences that correspond to (19a), children rejected the co-reference reading 83% of the time. Although adults do not allow the co-reference reading for (19d), Russian-speaking children rejected the co-reference reading only 42% of the time. There was a correlation between the percentage of rejection and children’s age for (19d), ranging from 10% for the 3-year-olds, to around 50% for the 3-5 year-old kids, and 80% for the 5-year-olds. It was concluded that syntactic constraints like Principle C appear at an early age, while non-syntactic (i.e., pragmatic) constraints are acquired later.

Thornton (1990) tested children’s knowledge of Principle C in strong crossover\textsuperscript{11} sentences such as those in (20).

\begin{align*}
(20) \ a. \ & *I \ know \ who \_i \ he/they \_i \ scratched \_i . \\
& *I \ know \ who \_i \ he/they \_i \ said \_i \ has \ the \ best \ drink .
\end{align*}

For both sentences in (20), the pronoun and the wh-phrase ‘who’ cannot co-refer, i.e., the bound variable interpretation is not allowed. The prohibition can be explained based on the trace theory of movement and Principle C. Since the trace left by the wh-phrase after movement is c-commanded by the pronoun, co-reference is ruled out according to Principle C. The results from this study showed that English-speaking

\textsuperscript{11} “Strong crossover” refers to sentences in which a referential expression has moved across a c-commanding co-indexed pronoun (Huang 1995, p. 139). In the two sentences in (20), the wh-phrase moves from its original position indicated with \( t \) to its surface position, crossing a c-commanding pronoun, and hence the co-reference between the pronoun and the wh-phrase is prohibited.
children (mean age 4;2) rejected the bound variable reading for the one-clause crossover question (20a) 97% of the time in trials with a singular pronoun, 96% of the time in trials with plural pronouns, and 92% of the time for the two-clause crossover question in (20b). Children’s knowledge of the structural constraint on strong crossover was validated by their 100% acceptance rate of the deictic reading for the crossover control as in (21a), and 95% rejection rate for the non-movement control sentences as in (21b). In comparison with the crossover questions, it was also tested whether children allow the bound variable interpretation for sentences like (22).

(21) a. I know who, he, thinks ti has the best smile.
   b. *Theyi scratched [Bert and Grover],.

(22) I know who, ti said he, has the best food.

In (22), since the trace left by the wh-phrase is in a position c-commanding the pronoun, Principle C does not apply, and hence the bound variable reading is possible. For these sentences, children accepted the bound variable interpretation 87% of the time. The findings from this study also demonstrate the early emergence of the structural constraint on the interpretation of sentences with pronouns for children.

Guasti and Chierchia (1999) tested Italian-speaking children’s knowledge of Principle C in standard sentences as in (23) and cases of “reconstruction” as in (24).
(23) a. Mentre (pro), ballava, un pagliaccio, suonava la chitarra
While (pro) was dancing, a clown was playing the guitar
“While he was dancing, a clown was playing the guitar.”

b. *(pro), andava sul cavallo a dondolo, mentre un musicista,
(pro) was riding the rocking horse while a musician
suonava la tromba
was playing the trumpet
“He was riding the rocking horse, while a musician was playing the trumpet.”

(24) a. *Nel barile di ciascun pirata, con cura (pro), ha messo una pistola
In the barrel of each pirate with care (pro) has put a gun
“In the barrel of each pirate with care he put a gun.”

b. Le scimmie hanno nascosto il tesoro di ciascun bambino,
The monkeys have hidden the treasure of each child
mentre (pro), dormiva
while (pro) was sleeping
“The monkeys have hidden the treasure of each child while he was sleeping.”

c. Il tesoro di ciascun bambino, le scimmie lo hanno nascosto,
The treasure of each child, the monkeys it have hidden
mentre (pro), dormiva
while (pro) was sleeping
“The monkeys have hidden the treasure of each child while he was sleeping.”

In (24a), the pronoun cannot be anaphorically dependent (i.e., bound by) ‘each pirate’,
but in (24b) and (24c) both the bound variable reading and the deictic reading are
allowed. The reconstruction effects occur when a phrase is displaced from its
canonical base position but still retains certain properties associated with the base position, rather than with its surface position. In (24a), the quantifier NP ‘each pirate’ is contained in a PP which is preposed from its base position within the VP headed by the verb ‘put’. Since the subject pronoun c-commands the PP in its base position, Principle C prohibits the pronoun’s being bound by the quantifier NP. In (24c), although the quantifier NP is contained in an object NP which is fronted from a position after the verb ‘hide’, since the null subject pronoun of the while-clause does not c-command the quantifier NP in its base position, Principle C does not apply.

Three experiments were conducted in Guasti and Chierchia (1999). In Experiment 1, an elicited imitation task was used to assess whether children could distinguish sentences that allow the co-reference reading (as in (23a)) from sentences that preclude the reading (as in (23b)) in backward anaphora contexts. The results showed that the 12 Italian-speaking children (mean age 4;7) tested changed the ungrammatical sentences 84% of the time, and the grammatical sentences 54% of the time. The difference between the two types of sentences was statistically significant. In Experiment 2, a truth value judgment task was used to test whether Italian-speaking children allow the backward anaphora reading of pronouns for the sentences in (23). The results of this experiment showed that Italian-speaking children rejected the anaphoric reading for sentences like (23b) 89% of the time, and accepted the
anaphoric reading as well as the deictic reading for sentences like (23a) 92% of the time. Experiment 3 tested whether children who responded to Principle C in standard cases are also sensitive to it in reconstruction contexts like (24). Children rejected sentences like (24a), where the bound variable reading is prohibited, about 90% of the time. For ambiguous sentences like (24b) and (24c), they accepted the bound variable reading 86% of the time and the deictic reading 89% of the time. The authors hence concluded that Principle C is part of the initial state of language development, and that there is no rule of reconstruction that needs to be separately learned by children.

Another recent study pertaining to this issue is Kiguchi and Thornton (2004), which probe children’s interpretation of pronouns in ACD (antecedent-contained deletion) constructions. Two experiments were conducted in this study, using a truth value judgment task. In the first experiment, they investigated whether English-speaking children apply Principle C at Surface Structure (S-structure) or Logical Form (LF) in ACD constructions, and whether they apply Principle B (as in (25)) in the ellipsis of ACD constructions. Two types of ACD sentences as shown in (26) were used in this experiment.\textsuperscript{12}

\textsuperscript{12} Although the two types of sentences tested in the first experiment of Kiguchi and Thornton (2004) were also double object sentences, they differ from those used in the current study in that the sentences in Kiguchi and Thornton (2004) involve VP ellipsis and the computation of the structures after QR, whereas the sentences in the current study do not. Consider (26b) and (4b) as a contrast. Although in both sentences the pronoun is in an NP (i.e., the first NP) c-commanding the NP with the name (i.e., the second NP) at S-Structure, since (26b) requires QR, the name \textit{the Smurf} is not in a c-command
(25) Principle B\textsuperscript{13}

If an NP c-commands a pronoun within the same clause, they cannot be coindexed; hence, they cannot be anaphorically linked.

(26) a. *The Mermaid baked him, the same food that Cookie Monster, did.

b. Dora gave him, the same color paint the Smurf, ’s father did.

Since in an ACD construction, ellipsis of the VP occurs within a relative clause, the resolution of VP ellipsis generates a filling procedure in the elided site that is never ending, as depicted in (27a) for sentence (26a). To solve the problem of infinite regression, May (1985) proposed that the noun phrase containing the VP ellipsis is raised out of the matrix VP at LF via Quantifier Raising (QR). This yields the LF representation of (26a) as in (27b).

(27) a. The Mermaid \[VP \text{ baked him}, \text{ the same food that Cookie Monster}, \text{ did} \<[VP \text{ baked him}, \text{ the same food that Cookie Monster}, \text{ did} \[VP \text{ baked him}, \text{ the same food that Cookie Monster}, \text{ did} \[VP \ldots]]]>\]

b. *[the same food that Cookie Monster, \(t\) baked him, \(t\)]\text{, the Mermaid baked him,} \(t\).

Since in (27b), after QR, the name (i.e., \textit{Cookie Monster}) c-commands the pronoun

\textsuperscript{13} The statement of Principle B used here is from Crain and Thornton (1998, p. 265). Principle B is also defined as stating that a (non-reflexive) pronoun is free in its binding/local domain, i.e., a pronoun cannot take an element of its domain as its antecedent (Chomsky 1981, p. 220; 1986, p. 60, 166).
him in the ellipsis within the same relative clause, the sentence cannot mean that the Mermaid baked Cookie Monster the same food that he baked for himself, which violates Principle B. As for the ACD sentence (26b), it differs from (26a) in that the name inside the relative clause is inside a possessive phrase such as the Smurf’s father. After QR, the name the Smurf is not in a c-command relation with the pronoun as the LF representation in (28), and hence co-reference between the Smurf and the pronoun is possible. A crucial contrast between (26a) and (26b) resides in that if binding principles are computed using the surface structure, both ACD sentences should violate principle C, since as discussed in section 2, in double object structures, the indirect object c-commands the direct object. However, if they are computed at LF, after QR has taken place, co-reference will be legitimate for (26b) but not for (26a).

(28) [the same color paint that the Smurf’s father did <gave him, t>] Dora gave him, 

The 15 English-speaking children (between 4;1 and 5;10, mean age 4;8) rejected the co-reference reading for (26a) 85% of the time, and the 32 adults also rejected the reading about 95.3% of the time. Children’s high rate of rejection for (26a) contrasted with their 93.3% acceptance of the co-reference reading for (26b). The results in this experiment demonstrate that children respond to the two types of ACD
sentences like adults, i.e., they apply Principle B in the ellipsis of ACD constructions, and they do not compute Principle C based on the surface structures.

Their second experiment examined the landing site of QR in children’s grammars. Although the results in the first experiment showed that children as well as adults compute binding principles after QR has been applied, it is not clear whether they raise the relative clause above the matrix sentence (following Fiengo and May 1994), or above the VP (as argued by Fox 1995, 2000). For the two types of ACD sentences in (26), both analyses can account for the co-referential possibilities between the pronoun and the name. However, for the ACD sentence in (29a), if the relative clause is raised above the matrix sentence (as shown in (29b)), it will wrongly predict the co-reference reading to be possible, contrary to the adult judgment. Therefore, the landing site for QR should be a position above the VP but below the matrix subject (as illustrated in (29c)).

(29) a. *Hei rode every horse that Berti tried to.
   b. [every horse that Berti tried to <ride $t_1$>]i hei rode $t_1$.
   c. *Hei [every horse that Berti tried to <ride $t_1$>]i rode $t_1$.

The 13 English-speaking children (between 4;2 and 5;1, mean age 4;9) participated in this experiment rejected the illicit co-reference reading for (29a) 94.2% of the time, suggesting that children apply Principle C and execute QR in exactly the same way as
adults do.

To summarize, these studies demonstrate the early emergence of children’s knowledge of the relevant structural (or syntactic) constraints in different languages and different constructions. Since constraints are negative statements, and negative evidence is not reliably available in the linguistic input for children to learn constraints, by logic the structural constraints ought to be innately specified.

4. Experiments

Two experiments were conducted to investigate English-speaking children’s interpretation of pronouns in double object sentences. The first experiment examined whether children allow co-reference between the recipient NP (i.e., the indirect object) and the possessive pronoun in the theme NP (i.e., the direct object) as the sentence in (30a), and the second experiment probed whether children have the knowledge of the constraint to prohibit co-reference between the theme NP and the possessive pronoun in the recipient NP as in (30b).

(30) a. The old lady threw Winnie the Pooh, his, chair.
    b. *The Smurf brought his, brother Tigger,
The task used in the two experiments was a truth value judgment task, which requires subjects to judge the truth or falsity of sentences presented in contexts acted out as stories with toys and props by one of the two experimenters. Since specific contexts are provided, the acceptance of the target sentence uttered by the puppet manipulated by the other experimenter is taken as indicating the child’s grammar warrants the interpretation. By contrast, the rejection of the target sentence in the context under consideration is interpreted as suggesting that the meaning violates a specific constraint in the child’s grammar. Therefore, when testing whether children have the knowledge of a constraint, the story is designed to incorporate both the meaning that is allowed in the adult grammar and the meaning that is prohibited by the constraint. The illicit meaning that violates the constraint is designed to be true (i.e., what really happens) at the end of the story, and hence, if the constraint is not operative in the child’s grammar, they would accept the target sentence. On the other hand, the meaning that is associated with the adult grammar, although under consideration in the middle of the story, does not happen at the end (i.e., the meaning is false given the context), and thus children should reject the target sentence if they respond as adults. When the subjects think the puppet’s statement is wrong, they have to provide an explanation to justify their answers in order to ensure that the judgment is based on relevant reasons, not lack of attention. For the details
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regarding the justification of the task and the fundamentals of experimental design, see Crain and Thornton (1998).

4.1. Experiment 1: Possessive Pronoun in the Theme Noun Phrase

In this experiment, double object sentences similar to “The old lady threw Winnie the Pooh his chair” were used to see if children allow co-reference between the possessive pronoun in the theme NP and the preceding recipient NP. As aforementioned, the co-reference reading is allowed for this type of double object sentences in the adult grammar of English. However, if English-speaking children do not assign the correct hierarchical structure to the double object sentences, or if they have difficulty processing double object sentences and hence interpret them via the corresponding to-dative construction, the co-reference reading may thus not be allowed. Therefore, the null hypothesis of this experiment is that children have adult-like structure for double object construction, and hence allow the co-reference reading for the target sentences, and the experimental hypothesis is that children differ from adults in that sometimes they may interpret the target sentences through the corresponding to-dative sentences or assign a non-adult structure to the sentences, resulting in prohibition against the co-reference reading.
4.1.1. Subjects

Seventeen English-speaking preschool children (seven girls and ten boys) between the ages of 4:4 to 6:6 (mean 5:6) participated in this experiment. All the preschool children were from the Center for Young Children, the preschool of the University of Maryland, College Park. The child subjects were tested individually in a research room of the preschool with their agreement during play time, and they all had written permission from their parents to take part in the research, in accord with Internal Research Board guidelines at the university. All the child subjects also participated in some other experiments carried out in the preschool using the truth value judgment task, and so they were familiar with the procedures. In addition, seventeen English-speaking undergraduate students from the same university also participated in the experiment. Unlike the child subjects, the adult subjects were shown a videotaped version of all the stories and were given an answer sheet to indicate, for each story, whether they thought the puppet’s statement was right or wrong and also to provide a justification for the answer.

4.1.2. Experimental stimuli

In this experiment, subjects were presented with three trials of the double object
sentences with co-reference between the possessive pronoun in the theme NP and the preceding recipient NP as in (31a) and two trials of control sentences in which co-reference between the possessive pronoun in the subject NP and the object NP with the universal quantifier every was disallowed, as shown in (31b). For children, the five stories were randomized, but for adults, they were presented with the same order due to the fact that the stories were videotaped. The sentences (as presented by the puppet) were uttered by a native speaker of English with natural intonation and without stress on the pronoun in any of the test sentences.

(31) a. The old lady threw Winnie the Pooh, his, chair.
   b. *His, dog licked every dwarf.

The sentences used in this experiment are listed in Table 1. For the double object sentences, the possessive pronoun in the theme NP is potentially ambiguous. It can refer to someone not mentioned in the sentence (i.e., the deictic reading), to the recipient NP, or to the subject NP (if the gender matches with the pronoun). In this experiment, since the goal was mainly concerned with the structural relationship between the two object noun phrases in child grammar, I manipulated the co-reference possibilities only between the pronoun and the recipient NP. For the double object sentences, co-reference between the possessive pronoun and the recipient NP is
allowed and is what really happens at the end of the story, hence the correct response to the target double object sentences should be YES. The control stories were designed to ensure that children do not always allow co-reference between the pronoun and a noun phrase in the same sentence due to lack of attention. For the control sentences in Table 1, they do not have the potential to be ambiguous, i.e., the pronoun can only refer to someone not mentioned in the sentences. The control sentences were all false for adults in the given story context, because the stories were designed in such a way that at the end of the story every dwarf’s dog (but not the boy’s dog) licked its own master for (iv), and every troll girl’s brother (but not Minnie’s brother) carried his own sister for (v).

As aforementioned, the possessive pronoun of the double object target sentences can have the deictic reading, or refer to either the subject or the recipient noun phrases. In the double object target stories, both the deictic reading and the reading in which the pronoun was co-referential with the recipient NP were under consideration. The co-referential reading was true in the context, but the deictic reading was not what happened at the end of the story. If children interpret these sentences based on the
hierarchical structure of the two object noun phrases, they will be expected to accept
the three double object sentences. If children interpret them via the corresponding
to-dative sentences or non-adult hierarchical structures, the prediction is that they may
reject the sentences. To illustrate the design of the stories, take a target sentence like
(31a) (which is (iii) in Table 1) as an example. Donald Duck and Winnie the Pooh
come to the lakeside for picnic. Since they want to go to the other side of the lake to
see the flowers, they ask an old lady to watch their chairs and other stuff. After a
while, Winnie the Pooh feels tired, and asks the old lady to throw his chair to him so
that he can sit down. The old lady says Winnie the Pooh’s chair is too big and heavy,
and suggests he should get Donald Duck’s small chair. However, since Winnie the
Pooh still wants his own big chair with soft cushion, at the end, the old lady throws
Winnie the Pooh’s chair to Winnie the Pooh. The story is followed by the puppet’s
statement with a linguistic antecedent for the target sentence, “This story is about an
old lady, Donald Duck and Winnie the Pooh on the lakeside. I know what happened.
The old lady threw Winnie the Pooh his chair.” Note that the deictic reading is under
consideration when the old lady suggests that Winnie the Pooh gets Donald Duck’s
chair, but this is not what happens at the end.¹⁴ The position of the toys at the end of
the story (i.e., Winnie the Pooh with his big chair) reminds subjects of the possible

¹⁴ Note that it has been observed that children show a preference for deictic readings of pronouns over
bound readings (Thornton and Wexler 1999, p. 156), and hence the double object sentences tested in
Experiment 1 can serve as a comparison with those in Experiment 2 to ensure that children do not
disallow co-reference because of their preference for deictic readings.
interpretations of the sentence. Since the co-reference reading is true and is the last event happened in the story, it should be salient enough for subjects to accept the puppet’s statement, if the reading is legitimate in their grammar. Figure 1 illustrates the scenario of the sample story, and the detailed plots for the three target stories can be found in Appendix A.

4.1.3. Results

The dependent measure used in this experiment was the proportion of YES responses to the puppet’s statements. The seventeen English-speaking children overwhelmingly accepted the co-reference reading of the double object sentences 100% (51 trials totally) of the time, which did not differ significantly from adults’ 96% (49 out of 51 trials) acceptance rate ($t(32)=1.478, p > 0.05$). For the control sentences which were false given the contexts, children accepted them only 6% (2 out of 34 trials) of the time, which was not significantly different from adults’ 3% (1 out of 34 trials) acceptance rate ($t(32)=0.59, p > 0.05$) (Figure 2). Responses for each test and control sentence from the seventeen children are shown in Appendix C.
All the seventeen children and fifteen out of the seventeen adults accepted the three target double object sentences given the contexts in the stories, i.e., they allowed the possessive pronoun in the theme NP to refer to the recipient NP, and the other two adults accepted two of the three double object sentences. For control sentences, only two children and one adult accepted one of the two sentences given the contexts, i.e., children and adults predominantly disallowed the possessive pronoun in the subject noun phrase to co-refer with the object noun phrase with the universal quantifier every.\textsuperscript{15} Hence, the main finding in Experiment 1 is that English-speaking children around 4 to 6 years old and adults allow co-reference between the possessive pronoun in the theme NP and the recipient NP for double object sentences, and their acceptance of the co-referential reading cannot be attributed to a general tendency to allow the pronoun to refer to an antecedent in the same sentence, as evinced in their adult-like rejection of the control sentences.

4.2. Experiment 2: Possessive Pronoun in the Recipient Noun Phrase

\textsuperscript{15} When children and adults were asked why the puppet’s statements were wrong for the control trials, the justifications they provided were because the dwarf’s dogs licked them, not the boy’s dog, or because the boy’s dog only licked him (i.e., the boy) for (iv), and because her (Minnie’s) brother didn’t carry them (i.e., the troll girls), or their (the troll girls’) brothers did for (v).
In Experiment 2, double object sentences similar to “The Smurf brought his brother Tigger” were utilized to test whether English-speaking preschool children have the knowledge of the structural constraint to prohibit co-reference between the theme NP and the possessive pronoun in the recipient NP. Owing to the hierarchical structure between the two object noun phrases (i.e., the recipient NP asymmetrically c-commands the theme NP), the possessive pronoun in the recipient NP can only refer to the subject noun phrase or someone not mentioned in the sentence, but not the theme NP, in parallel with the ban on co-reference between the object noun phrase and the possessive pronoun in the subject noun phrase as in “His brother hugged Tigger”. If English-speaking children interpret this type of double object sentences via a non-adult hierarchical structure, or by converting them into the corresponding to-dative sentences, the co-reference reading will be wrongly allowed. Accordingly, the null hypothesis of this experiment is that children have the knowledge of the structural constraint to exclude the co-reference reading from the possible interpretations of the target sentences, and the experimental hypothesis is that they may wrongly interpret the double object sentences via a non-adult hierarchical structure or the corresponding to-dative sentences, and hence allow the co-reference reading.
4.2.1. *Subjects*

Nineteen English-speaking preschool children (nine girls and ten boys) between the ages of 4;3 to 6;7 (mean 5;6) and nineteen adults participated in this experiment. All the preschool children were from the Center for Young Children, the preschool of the University of Maryland, College Park, and the adult subjects were all undergraduate students from the same university. Among the nineteen child subjects, thirteen of them also took part in Experiment 1. The procedures of testing the child and adult subjects were the same as Experiment 1.

4.2.2. *Experimental stimuli*

In this experiment, subjects were presented with three trials of double object sentences with the possessive pronoun in the recipient NP as in (32a), and two control sentences with the possessive pronoun in the object noun phrase and the universal quantifier *every* in the subject noun phrase as in (32b). For the double object target sentences, co-reference between the theme NP and the possessive pronoun in the recipient NP is prohibited by the structural constraint, whereas for the control sentences, the possessive pronoun in the object noun phrase can take the subject as its antecedent. As Experiment 1, the five stories were randomized for children, but for
adults, they were presented with the same order because the stories were videotaped, and the sentences (as presented by the puppet) were uttered by a native speaker of English with natural intonation and without stress on the pronoun in any of the test sentences.

(32) a. *The Smurf brought his, brother Tigger,.
    b. Every dwarf, rode their, horse.

The sentences used in this experiment are listed in Table 2. For the double object sentences, the possessive pronoun in the recipient NP can take either the subject noun phrase or someone not mentioned in the sentence as its antecedent, but not the theme NP. Since the goal of this experiment is to probe whether English-speaking children have the knowledge of the structural constraint to prohibit the co-reference reading between the possessive pronoun and the theme NP, I make this as what really happens at the end of the story. If children do have the adult-like structural constraint for double object sentences, they should reject the target double object sentences, but if they convert the sentences into corresponding to-dative sentences or assign a non-adult structure to the sentences, they may accept the co-reference reading. Two control sentences were also included in which the possessive pronoun in the object noun phrase could take either someone not
mentioned in the story or the subject noun phrase with the universal quantifier every as its antecedent. The control stories were designed to ensure that children could allow the co-reference reading when it was one of the legitimate interpretations of the sentence, i.e., to make sure that children reject the target double object sentences not because they only assign the deictic reading to the possessive pronoun. The two control sentences were all true for adults in the given story context, as the stories were designed in such a way that at the end of the story the dwarfs rode their own horses for (iv), and the trolls lifted their own suitcases for (v).

In the stories for the target double object sentences, the interpretations in which the possessive pronoun in the recipient NP was co-referential with either the subject noun phrase (i.e., the legitimate interpretation) or the theme NP (i.e., the illegitimate interpretation) were both under consideration. The co-reference between the pronoun and the subject noun phrase was false in the given context, but the co-reference between the pronoun and the theme NP was what actually happened at the end of the story. Take a target sentence like (32a) (which is (i) in Table 2) as an example to illustrate the design of the stories. Tigger and a Smurf are good friends.
They just finish their work at school and are ready to go home. The Smurf asks Tigger if he can help the Smurf’s brother with the homework. Tigger is willing to help but he has to go swimming with his brother at 4 o’clock. Since there is still time, Tigger gets onto the Smurf’s car and they head toward the Smurf’s home. However, the car breaks down on the way, and it takes the Smurf quite a while to fix it. As it is about 4 o’clock, Tigger has to meet with his brother by the swimming pool, and hence tells the Smurf he would prefer helping the Smurf’s brother on another day. Therefore, at the end, the Smurf brought Tigger to Tigger’s brother by the pool, and the Smurf goes home alone. After the story, the puppet makes a statement about what happens, “This story is about a Smurf, his brother, Tigger and his brother. I know what happened. The Smurf brought his brother Tigger.” The legitimate interpretation in which the pronoun takes the subject noun phrase as its antecedent is under consideration in the story when the Smurf tries to give Tigger ride to help the Smurf’s brother, but at the end that is not what really happens. The illegitimate interpretation in which the pronoun co-refers with the theme NP turns out to be what happens in the story, i.e., the Smurf brings Tigger to Tigger’s brother. The position of the characters (i.e., Tigger with his brother, and the Smurf with his brother) at the end of the story also serves to remind the children of the scenario of the story. Since the illegitimate interpretation is true and is the last event in the story, if that is the
reading that children allow, they would accept the puppet’s statement, but if children have the knowledge of the relevant structural constraint, they should reject the statement. Figure 3 depicts the scenario of the sample story, and the detailed plots for the three target stories can be found in Appendix B.

4.2.3. Results

The dependent measure used in this experiment was the proportion of NO responses to the puppet’s statements. The nineteen children in Experiment 2 rejected the puppet’s statement 82% (47 out of 57 trials) of the time, which differed significantly from adults’ 98% (56 out of 57 trials) rejection rate ($t(36)=3.18$, $p < .05$). However, a closer inspection of the double object trials showed that 7 out of the 10 children’s non-adult responses came from the sentence with the verb *throw*, 2 from the sentence with the verb *bring*, and 1 from the sentence with the verb *give*. Gropen et al. (1989) examined the use of the two types of dative forms in the spontaneous speech of five children (i.e., Adam 2;3-5;2; Eve 1;6-2;3; Sarah 2;3-5;1; Ross 2;7-6;6; Mark 1;5-4;7), and found that verbs of “ballistic motion” (e.g., *throw, kick, toss*) were never used in the double object form, and only rarely used in the prepositional dative
form.\textsuperscript{16} This indicated that children at this age range do not necessarily consider double object construction acceptable for verbs of “ballistic motion” such as \textit{throw}, and hence change it into the \textit{to}-dative sentences for interpretation.\textsuperscript{17} Similar spontaneous conversions are often found in studies using an elicited imitation task where children may reconstruct the model sentences in repetition, especially when they do not have the full grammatical competence for the structure (e.g., Lust et al. 1998). Since this study was concerned with children’s interpretation of sentences with pronouns in double object construction, not whether they allow a certain verb in both double object and \textit{to}-dative constructions, the sentence with the verb \textit{throw} was removed for further analysis. Without the sentence with the verb \textit{throw}, the nineteen children rejected the puppet’s statement 92% (35 out of 38 trials) of the time, which did not significantly differ from adults’ 100% rejection rate (t(36)=2.02, \(p > .05\)). For the control sentences in which the co-reference reading was legitimate, children’s rejection rate was 13% (5 out of 38 trials), which was not significantly different from

\textsuperscript{16} Only the verb \textit{throw} used in the prepositional dative form was found in the corpus of Adam (3 times), Sarah (once), and Ross (3 times), and all emerged when the children were around age 3;0 to 3;5.

\textsuperscript{17} This explanation will lead to a question as why these children did not reject the co-reference reading for the double object sentences tested in Experiment 1 if they also converted them into \textit{to}-dative sentences (thanks to one of the anonymous reviewers for pointing out this to me). A possibility is that for those children who did not consider double object construction acceptable for the verb \textit{throw}, they gave YES responses because a non-adult representation with the two object NPs mutually c-commanding each other was assigned to the sentences, or because the sentences sounded odd to them and hence were confused (i.e., a YES bias commonly observed for children and adults, e.g., Crain and Thornton 1998, p. 222). Since relevant findings were also reported in other studies (detailed discussion in section 5), it is plausible that the trial effect found in Experiment 2 resulted from some children’s distinction between verbs of “ballistic motion” such as \textit{throw} and prototypical double object verbs like \textit{give} and \textit{bring}. However, future research with more different types of verbs is certainly necessary to further investigate the verbs’ acceptability in double object construction by children.
adults’ 16% (6 out of 38 trials) rejection rate ($t(36)=0.247$, $p > .05$) (Figure 4). Responses for each test and control sentence from the child subjects are shown in Appendix D.\(^\text{18}\)

All the nineteen adults and sixteen out of the nineteen children rejected the two target double object sentences with the verbs *give* and *bring* given the contexts in the stories, and the other three children rejected one of the two trials.\(^\text{19}\) The results demonstrate that English-speaking children and adults do not allow the possessive pronoun in the recipient NP to co-refer with the theme NP. For control sentences, fifteen children and sixteen adults accepted both statements made by the puppet, three children rejected one of the statements, and one child and three adults rejected both sentences. This indicates that although occasionally English-speaking children and adults prefer the pronoun to refer to someone not mentioned in the sentence (i.e., the

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\(^{18}\) In Appendix C and D, subjects 1 to 13 are the children who participated in both experiments. It is clear from the within-subject comparison of these thirteen children that a contrast exists with respect to the co-reference possibilities between the two types of sentences tested. These thirteen children accepted the co-reference reading 100% of the time in Experiment 1, but only 20% in Experiment 2 (7% if the sentence with the verb *throw* is not included).

\(^{19}\) The reasons children and adults offered when they rejected the double object test trials were because the Smurf brought Tigger to his (Tigger’s) brother, or Tigger didn’t come to the Smurf’s house for (i), and because Winnie the Pooh didn’t give the bunny to his (Winnie the Pooh’s) father, or the bunny found his daddy for (ii).
deictic reading), they still predominantly allow the possessive pronoun in the object noun phrase to co-refer with the subject noun phrase with the universal quantifier every. The results in Experiment 2 exhibit English-speaking 4-6 year-old children’s knowledge of the structural constraints on co-reference between the possessive pronoun in the recipient NP and the theme NP, and the prohibition does not result from their preference to the deictic interpretation for the pronoun, as displayed in their acceptance of the control sentences.

5. General Discussion and Conclusions

This study sets out to examine if English-speaking preschool children possess the knowledge of the asymmetry of pronoun interpretations in double object sentences as exhibited in the contrasts in (33a) and (33b).

(33) a. The old lady threw Winnie the Pooh, his, chair.
    b. *The Smurf brought his, brother Tigger,.

The results from two truth value judgment experiments demonstrated that like adults, English-speaking 4-6 year-old children allowed the possessive pronoun in the theme NP to co-refer with the recipient NP in (33a), but prohibited the co-reference reading
between the pronoun in the recipient NP and the theme NP in (33b). The finding clearly manifests that young children at this age range have an abstract understanding of the structural constraints when they are computing the interpretations of these sentences.

Although children’s adult-like patterns found here are in accord with previous acquisition studies investigating their knowledge of structural constraints on pronoun interpretation discussed in section 3, they are incongruous with the overgeneralization errors of dative alternation documented in the literature. On the one hand, recall that previous comprehension studies (e.g., Cook 1976; Osgood and Zehler 1981; Roeper, Lapointe, Bing, and Tavakolian 1981) using an act out task generally found children up to ten years old had greater difficulty understanding double object datives than to-dative sentences, and Roeper et al. (1981) showed kindergarteners relied more on the linear order of the object noun phrases for interpretation. Therefore, a sentence like (34a) would be interpreted as though it were (34b).

(34) a. The cow gave the dog the pig.
   b. The cow gave the dog to the pig.

If children in the current study adopted the linear order strategy, the test sentences in (33a) and (33b) from Experiments 1 and 2 would be interpreted as though they were
(35) a. The old lady threw Winnie the Pooh to his chair.
   b. *The Smurf brought his brother to Tigger.

According to the story presented to the subjects in Experiment 1, (35a) was not an appropriate description of the scenario because in the story the old lady threw Winnie the Pooh’s chair to Winnie the Pooh, not vice versa, and thus children adopting the linear order strategy should have rejected the sentence rather than accepting it. In the story of Experiment 2, the Smurf brought Tigger to Tigger’s brother, and hence (35b) is not a correct description of the scenario, either. If children employed the linear order strategy and interpreted (33b) as (35b), the justification reason for rejecting this sentence should be either because the Smurf did not bring Tigger’s brother to Tigger (if they allowed the pronoun to co-refer with Tigger), or because the Smurf did not bring the Smurf’s brother to Tigger (if they only allowed the pronoun to refer to the subject noun phrase). Neither was found among the reasons the child subjects provided when they rejected this test sentence, and accordingly children in this study showed no evidence of utilizing the linear order strategy. As for the effect of animacy, although Roeper et al. (1981) found its impact only among second-graders, performance was usually poor when the direct object and the indirect
object were both animate or both inanimate. If this also influenced how children in this study processed the test sentences, we would find their performance in Experiment 2 to be poorer, as both the direct and the indirect objects were animate. Contrary to expectation, the results of Experiment 2 indicated that children were not confused by the animacy of the object noun phrases, as evinced by their adult-like rejection rate of the test sentences.

On the other hand, almost all English-speaking children spontaneously produce both forms of the dative alternation before the age of 3 (Campbell and Tomasello 2001; Snyder and Stromswold 1997), and as afore-mentioned in section 2, numerous acquisition studies have exhibited that children make syntactic generalizations of the dative alternation to non-alternating or novel verbs. However, the generalization does not seem to be symmetrical. Both White (1987) and Conwell and Demuth (2007) found that in an imitation task and an elicited repetition task, children tended to convert double object model sentences to to-dative sentences, but not so much to transform the to-dative model sentences to double object sentences (52% for the former and only 8.9% for the latter in Conwell and Demuth’s study). As indicated in the two experiments reported here, if children at least sometimes convert the double object sentences to their corresponding to-dative sentences for interpretation, the test sentences in (33) would become (36).
(36) a. ??The old lady threw his chair to Winnie the Pooh.
b. The Smurf brought Tigger to his brother.

Since the possible interpretations of the pronoun in the to-dative sentences differ from the double object sentences, such conversion would lead to a consequence that children would not perform adult-like, which did not turn out to be true in the results of the current study. The fact that in the two experiments of this study, children accepted the sentences as in (33a) and rejected the sentences as in (33b) similar to the adult subjects clearly demonstrated that with an appropriate task that do not require much processing load (e.g., a truth value judgment task), children do exhibit the effects of relevant constraints operating while computing the meanings of the sentences.

Although English-speaking preschool children in this study in general performed like adults in their interpretations of pronouns in double object sentences, it is still noteworthy that in Experiment 2 the sentence with the verb throw did elicit more errors (7 out of the 19 children) than sentences with the verbs give and bring (1 and 2 out of 19, respectively). The discrepancy between verbs like throw and verbs like give and bring may be attributed to their different frequencies as used in double object forms in children’s linguistic experience. Snyder and Stromswold (1997) and
Campbell and Tomasello (2001) both showed that the most frequent dative verbs (e.g., *give*) are used more frequently in the double object form,\(^20\) and Gropen et al. (1989) revealed a majority of lower frequency verbs occur in the prepositional dative forms. It was also observed in Gropen et al. (1989) that among the 5 children they examined, verbs of long-distance transfer (e.g., *throw*) were never used in the double object forms but both *give* and *bring* were at least by the age of 4.\(^21\) The imbalance of frequency distribution may be the reason why Wilson et al. (1981) could elicit prepositional datives, but not double object datives with novel verbs. In addition, by using novel actions involving long-distance transfer in an elicited repetition task, Conwell and Demuth (2007) also found children preferred the prepositional form to the double object forms for the novel verbs, perhaps because they considered it to be more felicitous with this type of verbs. What this manifests is that children may be aware that some verbs, especially verbs with ballistic motion like *throw*, are not often used in the double object form, and hence interpret the sentences through the more natural *to*-dative construction, or assign the sentences a non-adult hierarchical

\(^{20}\) Snyder and Stromswold (1997) found that for the verb *give*, 73.2% of adult utterances (range between 33% and 85%) were double object datives. Also as shown in Table 2 of Campbell and Tomasello (2001), the use of double object datives obviously outnumbered *to*-datives for the verbs *give* and *bring* by both adults and children, with the contrast for the verb *give* more dramatic.

\(^{21}\) One of the anonymous reviewers mentioned the studies cited here seem to focus on younger children and hence questioned the appropriateness of comparison. However, four of the seven children in Campbell and Tomasello (2001) (i.e., Adam 2;3-4;10; Sarah 2;3-5;1; Abe 2;4-5;0; Naomi 1;2-4;9), and four of the five children in Gropen et al. (1989) (i.e., Adam 2;3-5;2; Sarah 2;3-5;1; Ross 2;7-6;6; Mark 1;5-4;7) included transcripts above 4;6, which were comparable to the age range of the children in the current study.
structure. For verbs that children have no doubt about the validity of their taking two internal arguments, the interpretation of these sentences will be governed by the relevant structural constraints. It is worth further exploration whether those verbs that do not appear as prototypical in the double object construction of children’s spontaneous speech (e.g., verbs of ballistic motion like *throw*, verbs of manner of accompanied motion like *drive*, and some benefactive verbs) are indeed more vulnerable regarding the constraints of pronoun interpretation as examined in the present study.

**Acknowledgment**

I am grateful to all the children and adult subjects participated in the current study, and the teachers at the Center for Young Children at the University of Maryland, College Park. Special thanks go to Stephen Crain, Rosalind Thornton, Amy Weinberg, and the anonymous reviewers for valuable discussion or suggestions, and to Nadia Shihab and Shani Abada for playing the puppet for the experiments.
References


14 (3), 395-420.


Structural Constraints on Dative Alternation

Chicago, IL: Chicago Linguistic Society.


Appendix A
Target stories for Experiment 1 (Possessive Pronoun in the Theme Noun Phrase)

A.1. Target story 1

Plot: One Smurf and Donald Duck are going to a movie, but they cannot bring their bikes into the theater, so they need someone to watch their bikes. A Mermaid, who is sitting outside the theater to enjoy the sunshine, agrees to watch the bikes for them. When they go to the Mermaid to get their bikes after the movie, the Mermaid suggests that they exchange the bikes, because the green color of Donald Duck’s bike looks better with the Smurf, and the Smurf’s colorful bike matches better with Donald Duck’s outfit. However, since the Smurf got his bike as a gift from his grandmother, he does not want to exchange it with Donald Duck, and Donald Duck does not like that suggestion either. Therefore, at the end, the Mermaid brings the Smurf’s bike to the Smurf.

Puppet’s statement: This is a story about a Mermaid, Donald Duck, and a Smurf. I know what happened. The Mermaid brought the Smurf his bike.

A.2. Target story 2

Plot: A woman and a lady Smurf are going to a party, but they cannot bring anything with them, and so they need someone to watch their brushes. They find a man standing by the door watching things for the guests, and hence leave their brushes with the man. When they go to the man to get their brushes after the party, the man suggests that the woman should have the lady Smurf’s small brush, and the lady Smurf have the woman’s big brush. However, since the woman really likes her own big brush, she does not want to give it to anyone. Therefore, at the end, the man gives the woman’s brush back to the woman.

Puppet’s statement: This story is about a man, a lady Smurf and a woman going to a party. I know what happened. The man gave the woman her brush.

A.3. Target story 3

Plot: see section 3.1.2.

Puppet’s statement: This story is about an old lady, Donald Duck and Winnie the Pooh on the lakeside. I know what happened. The old lady threw Winnie the Pooh his chair.
Appendix B
Target stories for Experiment 2 (Possessive Pronoun in the Recipient Noun Phrase)

B.1. Target story 1
Plot: see section 3.2.2.
Puppet’s statement: This story is about a Smurf, his brother, Tigger and his brother. I know what happened. The Smurf brought his brother Tigger.

B.2. Target story 2
Plot: Winnie the Pooh with some honey is on his way to visit his father. He hears someone crying. It is a bunny who gets lost and is hungry. Winnie the Pooh thinks that maybe he can give the bunny to Winnie the Pooh’s father to take care of, so he asks the bunny to go with him. A while later, the bunny’s father, who is looking for his child desperately, asks Winnie the Pooh if he sees the bunny. Winnie the Pooh says yes and gives the bunny to the bunny’s father. At the end, Winnie the Pooh goes to his father alone with only the honey.
Puppet’s statement: This is a story about Winnie the Pooh, his father, a bunny and his father. I know what happened. Winnie the Pooh gave his father the bunny.

B.3. Target story 3
Plot: A Mermaid is washing clothes, and her sister is playing on the other side of the hill. The Mermaid’s sister is bored, so the Mermaid asks Daisy Duck, who is fooling around, to play with the Mermaid’s sister. Daisy Duck agrees, but she does not want to climb the hill, and hence the Mermaid suggests that she throw Daisy Duck over the hill to the Mermaid’s sister. When the Mermaid is ready to throw Daisy Duck, Daisy Duck’s sister on the other side of the hill protests that her sister should play with her. Therefore, at the end of the story, the Mermaid throws Daisy Duck to Daisy Duck’s sister.
Puppet’s statement: This is a story about a Mermaid, her sister, Daisy Duck and her sister. I know what happened. The Mermaid threw her sister Daisy Duck.
### Appendix C
Responses for each test and control sentence from the child subjects in Experiment 1

<table>
<thead>
<tr>
<th>Test sentences</th>
<th>Control sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Mermaid brought the Smurf, his bike.</td>
<td>His, dog licked every dwarf, Her, brother carried every troll girl.</td>
</tr>
<tr>
<td>The man gave the woman, her, brush.</td>
<td></td>
</tr>
<tr>
<td>The old lady threw Winnie the Pooh, his, chair.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subject</th>
<th>Test Sentence 1</th>
<th>Test Sentence 2</th>
<th>Control Sentence 1</th>
<th>Control Sentence 2</th>
<th>Control Sentence 3</th>
<th>Control Sentence 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (6;6)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>2 (6;5)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>3 (6;0)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>4 (5;11)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>5 (5;8)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>6 (5;7)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>7 (5;7)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>8 (5;6)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>9 (5;6)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>10 (5;4)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>11 (4;9)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>12 (4;6)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>13 (4;4)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>14 (5;6)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>15 (5;5)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>16 (5;1)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>17 (6;2)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>
Appendix D
Responses for each test and control sentence from the child subjects in Experiment 2

<table>
<thead>
<tr>
<th>Test sentences</th>
<th>Control sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Smurf brought his brother Tigger, Winnie the Pooh gave his father the bunny, The Mermaid threw her sister Daisy Duck, Every dwarf, rode their horse, Every troll, lifted their suitcase</td>
<td></td>
</tr>
<tr>
<td>1 (6;7) no no no yes no yes</td>
<td></td>
</tr>
<tr>
<td>2 (6;5) no no yes yes yes no</td>
<td></td>
</tr>
<tr>
<td>3 (6;1) no no yes yes yes yes</td>
<td></td>
</tr>
<tr>
<td>4 (6;0) no no yes yes yes yes</td>
<td></td>
</tr>
<tr>
<td>5 (5;9) no no no yes yes yes</td>
<td></td>
</tr>
<tr>
<td>6 (5;8) no no yes yes yes yes</td>
<td></td>
</tr>
<tr>
<td>7 (5;8) no yes yes yes yes yes</td>
<td></td>
</tr>
<tr>
<td>8 (5;7) no no no yes yes yes</td>
<td></td>
</tr>
<tr>
<td>9 (5;8) yes no no yes yes yes</td>
<td></td>
</tr>
<tr>
<td>10 (5;5) no no no yes yes yes</td>
<td></td>
</tr>
<tr>
<td>11 (4;9) no no yes yes yes yes</td>
<td></td>
</tr>
<tr>
<td>12 (4;7) no no no yes yes yes</td>
<td></td>
</tr>
<tr>
<td>13 (4;3) no no yes yes yes yes</td>
<td></td>
</tr>
<tr>
<td>14 (6;4) no no yes yes no no</td>
<td></td>
</tr>
<tr>
<td>15 (5;5) yes no no yes yes yes</td>
<td></td>
</tr>
<tr>
<td>16 (5;2) no no no yes yes yes</td>
<td></td>
</tr>
<tr>
<td>17 (5;1) no no no yes yes yes</td>
<td></td>
</tr>
<tr>
<td>18 (5;0) no no no yes yes yes</td>
<td></td>
</tr>
<tr>
<td>19 (4;6) no no no yes yes yes</td>
<td></td>
</tr>
</tbody>
</table>
Table 1.
Test Sentences for Experiment 1

<table>
<thead>
<tr>
<th>Double Object Sentences</th>
<th>Adult judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. The Mermaid brought the Smurf, his, bike.</td>
<td>YES</td>
</tr>
<tr>
<td>ii. The man gave the woman, her, brush.</td>
<td>YES</td>
</tr>
<tr>
<td>iii. The old lady threw Winnie the Pooh, his, chair.</td>
<td>YES</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Sentences</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>iv. His, dog licked every dwarf.</td>
<td>NO</td>
</tr>
<tr>
<td>v. Her, brother carried every troll girl.</td>
<td>NO</td>
</tr>
</tbody>
</table>
Table 2.
Test Sentences for Experiment 2

<table>
<thead>
<tr>
<th>Double Object Sentences</th>
<th>Adult judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. The Smurf brought his brother Tigger.</td>
<td>NO</td>
</tr>
<tr>
<td>ii. Winnie the Pooh gave his father the bunny.</td>
<td>NO</td>
</tr>
<tr>
<td>iii. The Mermaid threw her sister Daisy Duck.</td>
<td>NO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Sentences</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>iv. Every dwarf rode their horse.</td>
<td>YES</td>
</tr>
<tr>
<td>v. Every troll lifted their suitcase.</td>
<td>YES</td>
</tr>
</tbody>
</table>
Figure 1.
The scenario for the test sentence “The old lady threw Winnie the Pooh his chair”

1. Winnie the Pooh and Donald Duck come to the lakeside for picnic.
2. They ask an old lady to watch their chairs and other stuff before they go to the other side of the lake to see the flowers.
3. Winnie the Pooh feels tired, and asks the old lady to throw his big chair to him, but the old lady suggests he should get Donald Duck’s small chair.
4. Since Winnie the Pooh still wants his big chair with soft cushion, the old lady throws Winnie the Pooh’s big chair to him.
Figure 2.
Proportion of YES responses to double object and control sentences for children and adults in Experiment 1
**Figure 3**
The scenario for the test sentence “The Smurf brought his brother Tigger”

<table>
<thead>
<tr>
<th>Image 1</th>
<th>Image 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Smurf asks Tigger if he can help the Smurf’s brother with the homework. Tigger agrees and gets onto the Smurf’s car to head toward the Smurf’s home.</td>
<td>Suddenly, the car breaks down, and it takes the Smurf a while to fix it.</td>
</tr>
<tr>
<td>Since Tigger has to meet with his brother, and it is getting late, the Smurf brings Tigger to Tigger’s brother.</td>
<td>At the end, the Smurf goes home alone and explains to his brother what happens.</td>
</tr>
</tbody>
</table>
Figure 4.
Proportion of NO responses to double object and control sentences for children and adults in Experiment 2