Speaker Choice in Children’s Spontaneous Relative Clauses

Gabriel Doyle

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1 Introduction

One of the subtler features of a language is the occurrence of syntactic alternations. Syntactic alternations, such as the passive (Carl punched the man \(\sim\) The man was punched by Carl) or dative (Carl gave the man a black eye \(\sim\) Carl gave a black eye to the man), are situations where there are two or more constructions with basically the same meaning. The constructions, or alternants, have significant structural commonality and truth-conditional equivalence, and in a variety of situations, both will be acceptable. The choice in a syntactic alternation is driven by a series of gradient factors that affect the probability that a speaker will choose one alternant over the other. (Weiner & Labov, 1983; Bresnan, Cueni, Nikitina, & Baayen, 2007) These gradient factors are often subtle, so the acquisition of an alternation requires a child to pick up on many little cues in the input. How do children do it?

In the present study, I look at the acquisition of a common alternation: the choice of relative pronoun in a relative clause. Relative clauses are one of the earlier complex structures that children acquire, and so they present a useful testing area for the acquisition of a syntactic alternation at an early age. We consider three main questions in this study:

1. When do children learn the different pronoun choices?
2. How do children use the different pronouns?
3. When do children exhibit adult-like speaker choice?

2 Background

2.1 Relative clauses

At least four possible relative pronouns can be used to introduce a relative clause: who, that, where, and which. In certain situations, the relative pronoun can be omitted as well. The choice between these pronouns are valid for a given relative clause. For instance, where and which are not possible with a subject-extracted relative clause, and the relative pronoun may not be omitted either:

\[
\text{We saw the man that/who/\*\(\emptyset\) held the trophy.}
\]

In the current study, I restrict the data to a well-constrained situation: the choice between that and who. This is the choice facing a speaker who is extracting a human or human-like noun phrase. There is also the possibility to omit the relative pronoun if the extracted NP is not a subject. Although this introduces a small confound to our system, children rarely extract a non-subject, so we need not be particularly concerned about this option.

Adult speaker choice in relative clauses, especially the choice of omitting the relative pronoun, continues to be a hotbed for research. A major debate in this previous work is whether that-omission is driven by production concerns (Ferreira & Dell, 2000; Race & MacDonald, 2003) or by audience design (H. Clark & Fox Tree, 2002; Jaeger, 2005). Both of these options require complex thought; production effects require the child to plan upcoming portions of the sentences and audience design requires a developed theory of mind.

2.2 Relative clauses in child language

Relative clauses are complex syntactic structures, requiring the embedding of one clause within another and the co-indexation of a noun phrase in the matrix clause with a gap in the embedded clause. As such, they are acquired only after children have had the chance to acquire simpler syntactic structures. Limber (1973) notes that children produce their first \(wh\)-questions, such as where’s mommy? around two years old. This is followed a few months later by the appearance of verbs with \(wh\)-complements around 2;6 — phrases like I show you how to do it. \(That\)-complements (e.g., I think that you see it) appear still later, around age 3;0.
Relative clauses appear in spontaneous speech around the same time as the two complement types. (Limber, 1973; Hamburger & Crain, 1982) Proto-relatives, either completely headless (2-a) or free relatives with a wh-word (2-b), may serve as a stepping stone to relative clauses (O’Grady, 1997):

(2) a. Let’s see ... [she’s doing] (2;6)
    b. Look-a [wha I made] (2;4)

Note that in both of the above utterances, there is no overt extracted NP that the relative clause modifies. Full relative clauses, with overt extracted NPs, appear at around 30-36 months, either slightly after the proto-relatives or contemporaneously. It is unclear whether relative clauses with overt relative pronouns appear before or after relative clauses without overt relative pronouns, although Hamburger and Crain (1982) seem to suggest that the first relative clauses do not have overt relative pronouns.

Certain relative structures are more common than others in early productions. Diessel and Tomasello (2000) showed that in spontaneous child speech, early relative clauses (those produced by children younger than 3:0) mostly appear in predicate nominals (3-a), and occasionally in object position. This remains true through age 5, although the proportion of predicate nominals drops substantially, with objects becoming the more common position for relativized NPs. Relative clauses rarely appear in the subject position (3-b) in spontaneous child speech, even for older children (around age 5).

(3) a. Common: I’m [the big brother [who’s sick]]. (Ross, 3:4)
    b. Uncommon: [The person [who puts dem on]] has to. (Adam 3;11)

Some extraction types are also more common in spontaneous speech. Diessel and Tomasello report that early RCs are primarily subject extractions from intransitive clauses (3-a), with object and oblique extractions (3-b) substantially rarer. Later RCs contain more object extractions than subject extractions, while oblique extractions remain rare.

The preference for certain RC structures also shows up in comprehension, although the preferences are different from those of production. Sheldon (1974) and Tavakolian (1981) showed that children are best able to comprehend subject-extracted relative clauses in subject position (4-a). Object-extracted RCs in object position (4-d) are the next most comprehensible, although these are far harder than subject-subject RCs. The two mixed RCs (4-b,c) are the hardest, and children as old as 5:5 still encounter substantial difficulty determining their meanings.

(4) a. SS: The dog [that jumps over the pig] bumps into the lion. (easiest to comprehend, very rarely produced)
    b. SO: The dog [that the pig jumps over] bumps into the lion. (very hard to comprehend, rarely produced)
    c. OS: The dog bumps into the lion [that jumps over the pig]. (very hard to comprehend, somewhat commonly produced)
    d. OO: The dog bumps into the lion [that the pig jumps over]. (hard to comprehend, commonly produced)

The most readily interpreted relative structure (subject-subject) is one of the least used in spontaneous child speech, while the hard-to-comprehend object-position RCs are common in child speech. Hamburger and Crain (1982) have suggested this is a problem of experimental design, and report that subject-extracted RCs in object positions (4-c) can be readily understood by three-year-olds, given an appropriate pragmatic situation, as would be expected from the production data of Diessel and Tomasello. The particular differences in production and comprehension difficulty are not our primary concern; the key is that there are such differences, and that in spontaneous production, RCs are more common in predicate positions, and object extractions grow more common with age.

2.3 Speaker Choice in Children

This study considers how children make a choice between two approximately equivalent relative pronouns. But are children at young ages actually capable of making sophisticated lexical choices? The answer seems to be yes. E. V. Clark and Svaib (1997) showed that children as young as two years old were able to produce and recognize multiple names for an animal, even if the animal had already been la-

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1 O’Grady notes Kim’s (1987) claim that full relative clauses actually appear before headless relatives, but I have been unable to locate Kim’s work. Given the brief period between the first attested proto-relatives and first attested full relatives, and the difficulty inherent in distinguishing early relative clauses from other forms of modification, it is likely best to treat the two acquisitions as contemporaneous.

2 Hamburger and Crain’s methodology has itself been objected to by O’Grady (1997).
belled. The different names for the animal could vary either in specificity (cat versus animal) or in domain (cat versus doctor when the cat was dressed as a doctor). Furthermore, children are able to simultaneously regard objects as belong to multiple categories, each with its own lexical label, by age three to four. (Nguyen, 2007) This ability appears in spontaneous speech as well; E. V. Clark (1997, §7.1) shows that children around age two will produce multiple names for the same object in succession. For instance, a 19-month old child seated at the breakfast table first looked at a bowl cereal and declared it food and shortly thereafter referred to it as cereal. These results show that children are able to consider multiple words for an object when they know multiple words for it. Since relative clauses emerge in third year, it appears that children should at least be able to exhibit rudimentary speaker choice during their acquisition of relative clauses.

3 Children’s Use of Relative Clauses

3.1 Potential sources of variance

We consider three potential sources of variance in this study: animacy/humanness, definiteness, and extraction type.

Animacy The first is animacy of the extracted NP. Who is only acceptable as a relative pronoun in adult speech if the extracted NP is being treated as human-like. Thus the sentence

(5) I saw a tree who was six feet tall

implies that the tree has been somehow personified. One might expect a speaker to be more likely to use who if the extracted NP is a more prototypical human. Since that may seem odd for a clearly human NP. Alternately, the speaker could be more likely to use who when the extracted NP is less prototypically human, if the speaker wants to stress the humanness of the NP as in (5). Animacy has already been shown to be a source of variance in other alternations (Prat-Sala, 1997 for passives, Bresnan et al., 2007 for dative, Rosenbach, 2003 for genitives) and fits in with the general Animacy Hierarchy of Silverstein (1976).

We code animacy at four levels in the regression models: human, animal, monster, or generic. The human and animal categories are self-explanatory. The monster category houses objects that neither human nor animal, but are referred to with a specific noun and show clear signs of animacy or sentience. This includes monsters, robots, and ghosts. The generic category is a catch-all for generic nouns, such as one or somebody. Limber (1973) suggests that true relatives first appear with generic extracted NPs, and with more specific NPs later, so this seems a reasonable place to expect to find differential speaker choice.

Definiteness Another potential source of variance is definiteness of the extracted NP. We consider four levels of definiteness: discourse-linked, definite, indefinite, and quantified NPs. Discourse-linked NPs are those that use the determiners that, those, this, or these; such NPs have referents that are especially salient to the discourse, often visible to the conversants. Names are also put in this category. Definite and indefinite NPs are straightforward: definites have the determiner the, indefinites have a(n) or no determiner if plural. Quantified NPs contain both quantified expressions like all the people and generic NPs like somebody or nobody. Like animacy, definiteness has an effect on the dative and genitive alternations. It also serves as a proxy for restrictiveness, which Fragman, Goodluck, and Heggie (2007) discuss. This stems from the preference of discourse-linked NPs to take non-restrictive RCs in adult speech (6), since the referent has already been established in the discourse.

(6) a. #That computer that has a decal is running hot.
   b. That computer, which has a decal, is running hot.

I did not directly encode restrictiveness because it is difficult to determine from a transcript whether a given relative clause is intended to be restrictive or not, especially with quantified NPs.

Extraction type The last coded source of variance is extraction type. Studies of adult relative clauses show that object-extracted relative clauses are generally more difficult to comprehend than subject-extracted relative clauses. (e.g., Gordon, Hendrick, & Johnson, 2001) Children seem to follow a similar pattern in their production, with object-extracted RCs uncommon, especially in early RCs. Adults choose whether to omit the relative pronoun that based in part on the difficulty of the extraction (Race & MacDonald, 2003); it is possible that children would also choose their relative pronoun to alleviate production difficulty. Note that who-relatives could be harder than that-relatives, since the use of
who requires the child to check that the extracted NP is indeed sentient. Thus one might expect children to use that-relatives when the relative clause is a hard (object or oblique) extraction. This effect might weaken as the child ages and object-extracted relative clauses become more common.

Extraction type is coded as a binary variable: subject or object extraction. Subject extractions lump together the transitive and intransitive subject extractions of Diessel and Tomasello (2000); object extractions lump together direct object extractions and oblique extractions. These combinations were required because oblique and transitive subject extractions were too rarely attested to stand alone.

### 3.2 Regression Models

Following standard practice in speaker choice studies (Weiner & Labov, 1983, a.o.), we use a mixed-effects logistic regression model to assess the factors that children use in choosing their relative pronoun. Logistic regression treats speaker choice probabilistically, with different influences affecting the probability that the speaker will choose an alternant. The regression calculations estimate the multiplicative effect that each factor has on the odds of one alternant being chosen over the other. So if a factor $F_1$ has a strength of, say, 2, and the baseline odds of the alternant are 1 : 1 (i.e., 50% probability), then the odds of the alternant when $F_1$ is true are 2 : 1 (67% probability). The particular regression model used in this study is a mixed-effects regression, which allows the model to set different baseline ratios of that- to who-relatives for each child.

### 3.3 Dataset

The relative clause data used in this study is a combination of longitudinal studies of three children’s speech: Abe, Mark, and Ross. All data comes from the CHILDES database. All three were children of the experimenters, and their spontaneous speech in daily interactions were recorded. Abe’s data is a series of 210 files, each comprising 30 minutes of spontaneous speech, ranging from age 2:4 to 5:0. (Kuczaj, 1977) Mark and Ross, two brothers, have 275 files, most with both children in the conversation. (MacWhinney, 2000) Ross, the elder, was recorded from age 0:6 to 8:0, and Mark was recorded 0:7-5:6. These three children were chosen because they had good coverage both at the point of relative clause acquisition and a few years thereafter. They also produced many relative clauses in their spontaneous speech, so their speech permits an effective regression model to be built. Only utterances before age 6 were included in the dataset.

Isolating the relative clauses from the rest of the children’s speech was a non-trivial endeavor. All three children’s utterances were automatically annotated for grammatical relations and morphosyntactic categories using the GRASP program (Sagae, Davis, Lavie, MacWhinney, & Winter, 2007). However, these annotations cannot be used directly; while that is often annotated as a relative pronoun, there is substantial noise, with relative that often mislabelled as a determiner or demonstrative. Further, who is never marked as a relative pronoun, but instead as a general wh-pronoun. Thus loading all annotated relative clauses would offer a skewed view of speech.

To rectify this problem, I constructed a subset of the data consisting of all utterances that had a noun or pronoun that was immediately followed by that or who. Any word annotated as a noun or pronoun satisfied the first condition, and that or who could be annotated in any syntactic category to satisfy the second. Note that only a subset of all relative clauses will fulfill these conditions; a sentences like (7-a,b) would be missed.

(7)  

a. I noticed the man in red that we saw earlier.

b. A man walked in who was wearing red.

However, most relativized noun phrases seem to have a noun up against the relative clause, and extraposed relatives like that of (7-b) are certainly rare in child speech. Thus, I suspect we are not missing many relative clauses with the search described above. Note that both that and who are being treated the same in the search, ignoring the fact that some thats are correctly labelled. This is essential to the modelling problem; since the choice is being treated as an alternation, it is imperative that the two options be treated equally. Using the category labels to get additional that-relatives would skew the data. Note that this search casts too wide a net; some non-relativized utterances are caught in it (8-a), and some relative clauses that do not have an animate extracted NP are caught as well (8-b). These erroneously flagged utterances were removed manually during annotation.

(8)  

a. hey that’s my jump rope that’s my jumprope. [Abe 3:6]

b. get the toys that have been in this box out I want to put my new toys in. [Abe 3:6]
In the end, we are left with 275 relative clauses. 183 of them are that-relatives; the remaining 92 are who-relatives. For the regression model, the dataset is split into early RCs (those produced by a child aged 2;10-4;3) and late RCs (those produced by a child aged 4;4-5;11). There was no effect of age on the that-who ratio; in both categories, that outnumbers who 2:1.

4 Results

4.1 First uses of who

Surprisingly, the children in our study begin producing who-relatives contemporaneously with that-relatives. We consider here the first utterance that is unambiguously a relative clause and is not immediately primed by adult speech:

(9) a. there was a little girl who put me on the merry+go+round [Ross 2;10]
   b. I know a nice story about a boy that yelled [Ross 3;0]

(10) a. I want a real real bad monster who steps on He-man [Mark 3;0]
   b. but I'm the one that has glasses [Mark 3;4]

(11) a. people who have spears hit people in the nose who say ... charge [Abe 3;11]
   b. a man that killed another cow. [Abe 3;0]

Despite the seemingly more complex nature of a who-relative, Ross and Mark both produce who-relatives before that-relatives, although only by a few months. Abe produces that-relatives first, with the first attested who-relative coming almost a year later. However, Abe does produce who-relatives when primed by adults at ages 3;1 and 3;4, suggesting that Abe can use who-relatives earlier than 3;11. I suspect that Abe’s late first attestation is an outlier; neither Mark nor Ross, for whom more productions are available, show a delay between primed usage and unprimed usage of who-relatives. Additionally, Abe used fewer who-relatives than Mark or Ross, even beyond the age of who-relative acquisition.

Furthermore, the ratio of that- and who-relatives remains constant with age. A linear regression of the likelihood of using a who-relative given the age of the child in months showed a slope barely different from zero ($m = -0.002$) and no significant correlation ($r = -0.03$). Thus it seems that children acquire the use who-relatives at approximately the same age as that-relatives, and that they use who with animate extracted NPs at a constant rate from acquisition.

4.2 Restrictions on who

Unlike that, which can be used as a relative pronoun regardless of the extracted NP, who has a restriction that the extracted NP must be personifiable. Since the pronouns are close to but not quite interchangeable, one might well expect children to initially use the two interchangeably, with who used with an inanimate NP, before learning that who applies only to personifiable NPs. However, there is no evidence of such confusion, even at an early age, in the corpora. Only one who-relative appeared with an inanimate extracted NP:

(12) the same thing who makes the bombs [Abe 4;1]

The “thing” being referred to here is a device within an airplane that Abe is showing his mother. This device is inanimate, but Abe shortly afterward mentions an “invisible man” who seems to be the actual bombmaker, in which case who is once again appropriate. This is the only such irregular usage by Abe, and neither Mark nor Ross appear to violate the animacy constraint on who-relatives.

4.3 Evidence of choice

As discussed in Section 2.3, children show the ability to alternate between different names for animals and objects depending on the situation they are in. It is not immediately clear that this would carry over to syntactic speaker choice. However, even in the limited data available from the children, we see examples of switching between the relative pronouns, showing that the children are able to make such choices, even if they do not have a clear rationale for their decisions:

(13) a. it’s a guy that goes around looking for guys who rob things. [Abe 4;9]
   b. would you tell the people who live here that know Dutch ... [Ross 3;8]

This is direct confirmation that at least two of the three children display an alternation between the relative pronouns in a situation, a necessary component for speaker choice.
Table 1: Effect strengths for definiteness and extraction type. Strengths greater than one indicate a preference for *that*-relatives. (* \( p < .05 \), ** \( p < .01 \), *** \( p < .001 \))

(a) Early RCs

<table>
<thead>
<tr>
<th>Factor</th>
<th>Effect strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>indefinite NP</td>
<td>2.55</td>
</tr>
<tr>
<td>quantified NP</td>
<td>4.39</td>
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<tr>
<td>discourse-linked NP</td>
<td>1.31</td>
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<tr>
<td>object extraction</td>
<td>1.73</td>
</tr>
</tbody>
</table>

(b) Late RCs

<table>
<thead>
<tr>
<th>Factor</th>
<th>Effect strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>indefinite NP</td>
<td>3.90 **</td>
</tr>
<tr>
<td>quantified NP</td>
<td>9.04 **</td>
</tr>
<tr>
<td>discourse-linked NP</td>
<td>3.64</td>
</tr>
<tr>
<td>object extraction</td>
<td>39.2 *</td>
</tr>
</tbody>
</table>

4.4 Logistic regression

We construct two logistic regression models, one on the early RCs and one on the late RCs. These regressions identify which factors influence speaker choice in each age group. Table 1 shows the effects of definiteness and extraction type on pronoun choice in the early and late acquisition periods. As shown by Table 1(a), there is no significant effect of definiteness or extraction type in speaker choice for young children (2;10-4;3). For the older children, there are significant effects of both in speaker choice.

For older children, we see a significant preference for *that*-relatives if the extracted NP is indefinite or quantified. This preference is relative to a definite NP. Intuitively, the effect strength here says that if one takes a a relative clause with a definite extracted NP and replaces the definite article with an indefinite article, then the odds of the speaker choosing *that* as the relative pronoun are multiplied almost four times.

There is also a remarkably strong preference for *that* in object extracted relative clauses. This may be motivated by cognitive load concerns; the default relative pronoun *that* may be preferred with difficult object extractions because it is easier to use than the more specialized *who*. If this indeed a production difficulty effect, it is surprising that younger children do not use it, since one would expect them to encounter even greater difficulty with object-extracted RCs than older children do. This may reflect an inability of the younger children to perform sophisticated speaker choice during production; choosing *that* to reduce their cognitive load may be beyond their abilities.

4.5 Animacy effects

Animacy effects need to be discussed separately from the other effects because of data sparsity. While the younger children had at least one occurrence of each relative pronoun with each animacy type, the older children did not have any examples of *who* with an animal or monster. As a result, logistic regression will learn nonsense strengths for animacy in the older children’s usage. Instead, we look at the counts of each condition and determine significant differences using a Fisher exact test.

As with definiteness and extraction type, the young children show no significant effect of animacy on pronoun choice. No animacy category is significantly different from the rest by the Fisher test. For older children, though, animals, monsters, and generics are all significantly different from the mean, with animals and monsters favoring *that*-relatives and generics favoring *who*-relatives. Furthermore, there is a significant difference in the way that young and old children choose pronouns for monsters and generic NPs, suggesting a maturation of speaker choice in this time period.
5 Discussion

These results suggest that older children apply a more sophisticated method of determining which pronoun to use, taking account of animacy, definiteness, and extraction type. Although there is not clear evidence for the reasons that these factors are used by older children, one possible explanation is that children are choosing the relative pronoun based on a desire to alleviate production difficulties. The effect of animacy suggests that children may be engaging in syntactic audience design, and attempting to send a message about how they view the extracted NP based on choice of relative pronoun.

One the whole, we see that *that* and *who* are acquired as relative pronouns at approximately the same time. *Who* is acquired precisely and immediately; children do not seem to overapply *who* in situational contexts where it would be invalid – namely with inanimate extracted NPs – even when they have only just acquired *who*.

While both younger and older children are able to correctly use both relative pronouns, it appears that only the older children are able to take full advantage of the option.

References


