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Christopher Naber April 15, 2015

Account and Acquisition of Hiatus Resolution: /r/-Linking and /r/-Intrusion

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Abstract

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A corpus-based study was conducted examining the development of two features, /r/-linking and /r/-intrusion, in the speech of a child from age 2;0 to 4;11. This was compared to the speech of his primary caregiver during the same period. Findings show that /r/-linking and /r/-intrusion, though often viewed together by theoretical accounts, follow along different developmental timelines, suggesting that they are governed by different rules and represent distinct linguistic phenomena. This is corroborated by the adult's speech using /r/-intrusion proportionately less than /r/-linking, and /r/-intrusion being sensitive to aspects of vowel quality and stress. In the child's speech, /r/-linking first appeared earlier relative to /r/-intrusion (2;2 compared to 2;11), /r/-linking enjoyed a "growth spurt" sooner (3;0 compared to 3;6), however, neither phenomenon reached adult-like levels of usage by 4;11. The function word *to* was also considered in hiatus contexts and shows elements of allomorphy between its long and short/reduced form. Overall, findings suggest that /r/-linking and /r/-intrusion are distinct phenomena, and that /r/-intrusion may be more complex, calling on higher-level linguistic processes than simply phonology.

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Table of Contents

List of Tables

1. Introduction

Many British English dialects delete /r/ if it appears in a syllable coda (after the nucleus), as can be seen in (1)–(2).

(1) farther [fɑ.ðə]

(2) fourth [fɔθ]

As seen in (1), after a word ending in /r/ undergoes /r/-deletion, it can be end in a vowel. If the following word begins with a vowel, this can produces a situation called hiatus, as in (3), where two vowels are adjacent across a word boundary.

(3) farther away [fɑ.ðə ə.weɪ]

Hiatus is generally disfavored in language[1], and English has various means of resolving vowel adjacency. One of those hiatus resolution strategies is to insert a glide (/j/ or /w/) from the preceding to the following vowel, as in (4)-(5). Another strategy inserts a glottal stop between the two vowels, as in (6)-(7). A similar strategy used in dialects which delete coda /r/ also allows the insertion of an /r/ between the two vowels. When the preceding word does not lexically have an /r/, this is called /r/-intrusion, in (8)-(9), and when there is lexically an /r/ present, this is called /r/-linking, in (10)-(11).

Glide

(4) Tea is healthy [tʰi ʲ ɪz hɛlθi]

(5) Go away [goʊ ʷ əweɪ]

Glottal stop

(6) Tea is healthy [tʰi ʔ ɪz hɛlθi]

(7) Go away [goʊ ʔ əweɪ]

[1] See Barry (1984) for features which characterize connected speech.

/r/-Intrusion

(8) His idea is this [hɪz aɪdiə ɹ ɪz ðɪs]

(9) Is the sofa a nice one? [ɪz ðə soʊfə ɹ ʌ naɪs wʊn]

/r/-Linking

(10) His deer is this one [hɪz diə ɹ ɪz ðɪs wʌn]

(11) Go for a walk [goʊ fə ɹ ʌ wɑk]

Previous studies have established that /r/-intrusion can only occur after the vowels [ɑ], [ɔ], and [ə], although /r/-linking can occur in any vowel context (see §2.1). It may appear that /r/-intrusion and /r/-linking are separate hiatus resolution strategies, but comparing (8) to (10) and (9) to (11), it should be clear that the results of this process produce identical phonological outputs. For a nonliterate (or preliaterate, in the case of children) speaker, these forms would not be aurally distinguishable. It is also worth noting that although /r/-deletion, /r/-intrusion, and /r/-linking (henceforth /r/-effects[2]) have traditionally been viewed as distinct linguistic phenomena, it is possible to reconcile all of them under the single linguistic generalization in (12).

(12) /r/ only appears in coda position when resolving hiatus.

Whether /r/-effects are distinct phenomena or governed by a single rule is an important question for positioning /r/-effects theoretically.

The goals of the current study are as follows. First and foremost, I examine when and how often different hiatus resolution strategies are used through development of a child's speech. If a preliterate child shows different developmental trajectories for /r/-linking and /r/-intrusion, it follows that they are distinguished within the grammar. Secondly, I compare /r/-linking to /r/-intrusion in adult speech to shed light on the disparity between theory and practice, where

[2] In the literature, /r/-effects are variously called r-liaison and r-sandhi

theoretically the same phono-syntactic rules govern both phenomena, but practically /r/-intrusion appears less frequently in speech than /r/-linking. In doing so, I hope to answer questions of when and how /r/-effects develop, how they differ from each other, and how they relate to hiatus resolution as a whole.

2. Previous Work on /r/-Effects

2.1 Theoretical Background: McCarthy (1993) and Nespor and Vogel (1986)

/r/-Effects have been well documented as English liaison phenomena, occurring in almost all English dialects with /r/-deletion (Hay and Sudbury, 2005). Early theoretical research by Nespor and Vogel (1986) suggested that /r/-intrusion applies across the board and is an utterance-level phenomenon. This is based on their observation that /r/-intrusion can apply across large phrase boundaries, seen in (13)-(14). By saying that /r/-effects are utterance-level phenomena, they suggest that /r/-effects are categorical, that is, /r/ always appears in these hiatus contexts.

(13) I want to pet the panda[r]. Is that okay? [no intonational break]

(14) Visiting the spa[r], if you know what I mean, is really nice this time of year.

Other research, however, has shown that /r/-intrusion may only apply in limited contexts (McCarthy, 1993; Selkirk, 2000). McCarthy states that /r/-intrusion "is completely impossible" after a function word (where *to*, *do*, *for*, etc. are function words).[3]

(15) To add to his troubles [tə(*r) æd tə(*r) ɪz trəbəlz]

(16) Why do Albert and you [waɪ də(*r) ælbət ən juʷ]

(17) To Ed [tə(*r) ɛd]

[3] In fact, McCarthy later shows that there are syntactic constructions where /r/-intrusion can surface after function words. For a full discussion see Footnote 4, or McCarthy (1993).

McCarthy recognizes that /r/-linking is acceptable in the same situation, i.e., after a function word, as can be seen in (18)-(19). This shows it is not a particular quality of function words themselves that limits the presence of /r/, but rather that the rule for when /r/-intrusion can apply is limited in some way.[4]

(18) They were eating [ðeɪ wɛr itɪŋ]

(19) …for any reason… [fər əni rizɛn]

Even with a theoretical explanation for /r/-effects, several questions remain unanswered. Theoretical accounts present /r/-effects as rules, but in contexts where these /r/-effects are possible, other hiatus resolution forms at times surface. While it may be impossible to define exactly how often /r/-effects occur given the variety of methodology used, it is clear that /r/-

[4] An explanation for why function words cannot undergo /r/-intrusion that McCarthy entertains is that /r/-intrusion occurs at an earlier step in the derivation process than vowel reduction. If this were the case, then *to add* [tu(ʷ) æd] would not reduce, because the underlying glide at the end of *to* would break the hiatus. This explains the data above, but does not account for (1)-(2). In (1), the initial /h/ in *him* must be deleted before /r/-intrusion occurs. Similarly in (2), the initial /ð/ of *them* must be deleted before /r/-intrusion occurs. Therefore, a simple ordering of rules cannot explain the impossibility of /r/-intrusion after function words.

(1) I saw him [ə sɔr ɪm]

(2) I saw them [ə sɔr ɛm]

McCarthy then presents further evidence which marks function words differently than lexical words in how they relate to /r/-effects. Even though /r/-intrusion cannot normally appear after function words, it can appear if the function word is phrase-final, as in (3)-(4). With this full account of the phenomenon, McCarthy concludes that an accurate description of /r/-linking and intrusion must include some degree of the syntactic relationship between the two constituents.

(3) I said I was gonna[r] and I did.

(4) If you hafta[r], I'll help.

McCarthy turns to Optimality Theory. He posits two contraints, the first being FINAL-C, which acts at the level of the Prosodic Word (PrWd) and the second CODA-COND, which acts at the level of the syllable (σ):

(5) FINAL-C: *V]$_{PrWd}$

(6) CODA-COND: *V*r*X]$_{σ}$

In other words, FINAL-C states that a Prosodic Word must not end in a vowel, but consonants and glides are acceptable. Since lexical words (but not function words) are categorized as being their own PrWd, any lexical word that *does* end in a vowel (in violation of FINAL-C) attempts to adhere to FINAL-C by undergoing /r/-intrusion. CODA-COND states that a syllable may not have /r/ in its coda. CODA-COND is normally satisfied by /r/ being deleted when it occurs in a syllable coda. However, in the case of /r/-linking, where /r/ surfaces even when in a syllable coda, McCarthy cites the Linking Condition, making /r/ function ambisyllabically. This means that in the case of /r/-linking, /r/ is both in the coda of the preceding word and the onset of the following word. This ambisyllabicity does not violate CODA-COND, and allows /r/ to surface. In conclusion, when the CODA-COND constraint is given precedence over FINAL-C such that CODA-COND >> FINAL-C, all surface forms of /r/-linking, /r/-intrusion, and /r/-deletion are attestable.

effects are not categorical. Newton and Wells (2002) report 75-80% usage of /r/-intrusion; Mompeán and Mompeán (2007) report 31.50% usage of /r/-intrusion; Hay and Sudbury (2005) and Foulkes (1997) find variation depending on age, language community, socioeconomic status, and reporting style, so their results for prevalence of /r/-intrusion range, respectively, from 0–70%, and 8.5–57.3%. As discussed in §1, if /r/-linking and /r/-intrusion differ either in their prevalence rates or in the contexts where they appear, this provides evidence for their being distinct phenomena. In order to understand /r/-effects in relation to one another, it is imperative to study empirical accounts of when and how often /r/-effects appear in actual speech.

2.2 Empirical Research: Mompeán-Gonzalez and Mompeán-Guillamón (2009)

Given the degree of variation reported above, Mompeán-Gonzalez and Mompeán-Guillamón (2009) set out to determine what phonetic factors may condition the presence of /r/-effects. They found that the quality of the vowel preceding hiatus influences how often /r/-effects occur. /r/-Effects were more common after the back vowels [ɔ] and [ɑ] than the mid vowel [ə]. They cite phonetic reasons for the difference: "There are important acoustical similarities between rhotic approximants and back vowels like the presence of a low L2," whereas there was little phonetic motivation for /r/ occurring after a mid vowel (Mompeán and Mompeán, 2007).

Significantly for the current study, Mompeán-Gonzalez and Mompeán-Guillamón (2009) observed that /r/ was used to resolve hiatus in only 60.5% of /r/-effects contexts (instances in which /r/ could be used to resolve hiatus), a far stretch from categorical. Additionally, they observed a significant difference in the prevalence rates of /r/-effects: /r/ was more frequent in /r/-linking contexts (65.5%) than /r/-intrusion contexts (38.1%). Mompeán-Gonzalez and Mompeán-Guillamón also examined what was produced in those /r/-effects contexts if /r/ was not the phoneme used to resolve hiatus. They found that glottal stop (either a full stop or creaky

voice), followed by hiatus (no resolution) were second- and third-most-frequent, trailing behind /r/.

The primary methodological decision with these studies which I aim to modify in the present study is that the corpus used for these experiments was taken from the BBC Learning English website. The researchers used these data to represent Received Pronunciation British English speech. However, these news stories were intended primarily for non-native English speakers, and because they represent careful speech, they may show significant deviation from natural speech.

In the current study, I instead focus exclusively on unelicited speech, and control for sociological factors that influence the prevalence of /r/-effects. In this different setting, I attempt to replicate the research findings of Mompeán-Gonzalez and Mompeán-Guillamón that /r/-linking appears more frequently than /r/-intrusion, and that /r/-effects were less common after the mid vowel [ə].

2.3 Sociolinguistic Factors: Foulkes (1997)

Foulkes's focus was the sociological factors which can influence the prevalence of /r/-intrusion (1997). Foulkes studied elicited and unelicited speech in Derby and Newcastle upon Tyne, England, finding that there were group differences attributable to socio-economic status, age, location, and register. The interactions between these factors are complex: in Derby, the use of /r/-intrusion was stigmatized, whereas it was seen as presitigious in Newcastle. Because of this, when presented with an elicited reading, rates of /r/-intrusion increased for Newcastle speakers and decreased for Derby speakers. With this in mind, it becomes very important to control for dialectal differences if comparing the speech of multiple speakers. By examining the speech of a child relative to that of his caregiver (and primary source of linguistic input), I

control for dialectal differences between the speakers; the child's target form is strongly modeled after the form the caregiver is producing.

Foulkes anecdotally notes that child speech sometimes includes overgeneralization of /r/-effects. Foulkes uses this point to argue that /r/-effects are based in the phonology, and this process is a way of children figuring out which contexts /r/-effects apply to and which they do not. Foulkes also notes that in adult speech, some specialized forms of hiatus involving definite and indefinite articles have a particular way of being resolved allomorphically. Rather than taking /r/-intrusion, *the* and *a* have their own built-in method for resolving hiatus (*the* [ðə] → [ði]; *a* [ə] → [ən]). Overgeneralization of the type Foulkes describes would look like (20) or (21).

(20) the[r] animals

(21) a[r] aeroplane

Given the larger dataset involved in my study, I was able to find instances of these types of overgeneralization occurring in child speech (see §5.5, "Overgeneralization").

Foulkes observes a broad lexical trend: the prevalence of /r/-intrusion varies depending on the category of the preceding word, which Foulkes breaks down into Proper Nouns, Other Items, and Reduced Vowel words (Foulkes' examples provided).

(22) Proper Nouns: 76% intrusion *Philadelphia[r] I enjoyed*.

(23) Other Items: 59.2% intrusion *We saw[r] each other*.

(24) Reduced Vowel: 31.8% intrusion *He's yellow isn't he?* [ɪz jɛləʊ ɪnti:]

Foulkes hypothesizes that the Reduced Vowel category is least receptive to /r/-intrusion because "the required vowel reductions are rare" (1997), and /r/-intrusion is not required as a form of hiatus resolution with the non-reduced form of the word. This is similar to what is

observed by McCarthy (1993), where he states that /r/-intrusion is never possible after function words such as *to* [tuʷ]/[tə], because they obligatorily take the long, glide-final form when produced in a potential hiatus context, i.e., prevocalically.

Foulkes also provides evidence in opposition to a hypothesis that /r/-intrusion relates to a speaker's lack of knowledge of the spelling of a word, or its orthographic representation. This possibility holds little argument when we find speakers producing their own name with /r/-intrusion (*Sarah[r] is my name*). The finding is perhaps unsurprising, but should serve as a reminder that the only difference in surface representation of /r/-linking and /r/-intrusion lies in their orthography. In this way, any study of /r/-effects in child speech has an advantage, since pre-literate children, who do not have a knowledge of the spelling system, cannot be influenced by spelling to think that an utterance is "/r/-linking" or "/r/-intrusion." All children hear is the surface form, like in (25), and must decide between interpretations (26) and (27).

(25) The teacher is smart [ðə titʃə ɹ ɪz smɑ:t]

(26) Interpretation 1: *teacher* underlyingly contains /r/ [titʃəɹ], and (25) is an instance of r-linking.

(27) Interpretation 2: *teacher* underlyingly does not contain /r/ [titʃə], and (25) is an instance of r-intrusion.

Given that both interpretations are perfectly viable based only on surface form, it would be quite revealing if children show a difference in their prevalence rates of /r/-linking and /r/-intrusion, since phonetically they would not immediately distinguish them. A difference in child's speech between /r/-linking and /r/-intrusion would provide strong evidence to the hypothesis that they are distinct phenomena.

2.4 Child Language Acquisition: Newton and Wells (2002)

Two studies by Newton and Wells (1999; 2002) serve as the foundation for the discussion of the acquisition of /r/-effects. In their 2002 study, they conduct a case study of a single child in development from 2;4 to 3;4 to examine the child's development of junctural phenomena in early multi-word speech. Multi-word speech begins around 2 years old, so it is possible to trace between-word phonological features (including /r/-effects) starting at that point. Newton and Wells examine the child's use of /j/, /w/, and /r/ in vowel hiatus contexts. Their overall findings show that /j/ and /w/ are in use from the onset of the study (2;4), and reach nearly adult-like usage by the end (3;4). The use of /r/ in hiatus contexts, though, shows a different trajectory: it does not appear in hiatus contexts until 2;11, and does not reach adult rates by 3;4, although it enjoys a surge in use around 3;0. From this, Newton and Wells reject the hypothesis put forth by Broadbent (1991) and Gick (1999) that /r/ is phonetically similar to the glides /j/ or /w/. They also note that /r/ has less phonetic motivation for occurring after low vowels than /j/ does after high front or /w/ after high back vowels.

Noteworthy from Newton and Wells' corpus is that they found no instances of "overgeneralization," that is, no instances of /r/ occurring where /j/ should or vice versa. They note one instance of /r/ occurring after the indefinite article (*a[r] engine*), but this only happens when the child is being prompted to alter his speech. They note that if further research were able to locate instances of this happening, it would further position /r/-intrusion as a phonological rule, rather than one motivated by phonetics. Newton and Wells' study is limited by sample size, collecting fewer than 100 instances of /r/-effects in the child's speech. A larger dataset may more readily reveal these rare instances of overgeneralization.

What Newton and Wells do not include is the prevalence of other types of resolution in /r/-effects contexts. They do not mention how often glottal stop, or other phonemes or no resolution was used if an /r/ did not appear. Newton and Wells' study does not cover the full development of hiatus resolution, since /r/-effects have not reached an adult-like level of usage by the end of their study (3;4). It would therefore be fruitful to follow the development of /r/-effects later into development, in order to see how long is required for /r/-effects to reach adult-like levels. Additionally, Newton and Wells take the approach that /r/-linking and /r/-intrusion are part of the same "multi-word junctural speech phenomenon," so they do not differentiate between the two in their analyses. As we have seen with the findings of Mompeán-Gonzalez and Mompeán-Guillamón and Foulkes (1997), when considering prevalence, /r/-linking and /r/-intrusion should be considered separately. With sufficient data, it may be possible to determine if /r/-linking and /r/-intrusion are part of the same phenomenon – if they develop similarly – or if they are distinct phenomena – if they develop differently.

2.5 Positioning the Current Study

With this in mind, I set out to perform my own case study similar to Newton and Wells. I focus my topic to specifically /r/-linking and /r/-intrusion compared to the alternatives, specifically glottal stop and no resolution (hiatus). I have extended the timeline of development 19 months beyond where Newton and Wells' study ends (from 3;4 to 4;11), in order to have a better sense of the trajectory of the phenomena. To account for the various sociolinguistic factors which can significantly alter the target adult form, I study the child's speech in relation to the speech of his mother, the primary caregiver. To further investigate the interaction of /r/-intrusion and function words, I examine the appearance of the function word *to* in short (hiatus-producing) and long (hiatus-avoiding) forms, to see if it completely prevents /r/-intrusion, as McCarthy

(1993) suggests of Massachusetts English's grammar, or if its form is variable. To determine if vowel quality affects rates of /r/-intrusion, I examine the adult's speech in a naturalistic, unelicited setting. By examining the speech of two individuals, I will also be able to draw on a larger body of data than previous studies. This will allow me to see if rare forms, such as overgeneralization, actually occur in developmental speech. I conduct the current study to map the developmental trajectories of /r/-linking and /r/-intrusion, to better understand /r/-linking and /r/-intrusion in relation to other hiatus resolution strategies, and to determine what differences, if any, exist between /r/-linking and /r/-intrusion.

3. Method

3.1 Overview of Method

To determine rates of acquisition and use of /r/-linking and /r/-intrusion, a corpus-based study following a child from age 2;0-4;11 was used. Instances of the target phenomena in the child's and his mother's speech were located, then assigned phonemic information by listening to the tagged recordings. Utterances were tagged for the age of the child and what phoneme was used to resolve hiatus.

3.2 Corpus and Analysis Tools

The corpus database used in this study comes from the CHILDES (Child Language Data Exchange System) Project, part of the TalkBank system at Carnegie Mellon University (MacWhinney, 2000). Within CHILDES, the particular corpus used for this study is called the Thomas corpus (Lieven, Salomo, and Tomasello, 2009). The corpus follows the development of a child, Thomas, from age 2;0.12 – 4;11.20. Thomas was born to a middle-class family living in Manchester, England, with his mother serving as the primary caregiver. Recordings were performed during everyday home activites, such as playing with toys, eating a snack, or taking a

bath. From age 2;0.12 – 3;02.12 Thomas is recorded for one hour, five times per week, and from age 3;03.02 – 4;11.20 Thomas is recorded for one hour, five times per month, totaling 379 scripts.

The recordings are transcribed in CHAT format, which includes the text of all speakers, as well as some contextual information. The corpus notably does not include a phonemic transcription. This would be necessary for measuring rates of /r/-linking and /r/-intrusion, which are not marked orthographically. Since the original recordings from the corpus are readily available online in tandem with the text transcription, it was feasible to manually assign phonetic information. To facilitate finding instances of the phenomena, the program CLAN (Computerized Language Analysis) was used.

3.3 Data Collection

In order to find instances of /r/-linking and /r/-intrusion, it was necessary to use the orthographic representation of word-final /r/, word-final low vowels, and word-initial vowel sounds in English. As with previous research (Mompeán 2007), the current study identified word-final /r/ as being represented by *-r* or *-re*, vowel-initial words as being represented by the vowels *a-*, *e-*, *i-*, *o-*, or *u-*, and word-final low vowels as being represented by *-a, -ah, -aw,* or *-o*. To compile instances of /r/-linking, all utterances with a word-final /r/ preceding a word-initial vowel were collected. To compile instances of /r/-intrusion, all utterances with a word-final low vowel preceding a word-initial vowel were collected.

The potential instances for target phenomena were catalogued. Several passes were made through the data to identify "false positives," that is, instances where the transcription fulfilled the requirements of the search, but the utterance did not present a possible site for the phenomenon. For example, the utterance *The tea is hot* orthographically appears to fulfill the

requirements for /r/-intrusion, since *tea* ends in a letter which can be low-back, and the following word, *is*, is vowel-initial. However, *tea* /tʰi:/ phonologically ends in a high-front vowel. This makes the utterance ineligible for /r/-intrusion.

For /r/-linking, *one* /wʌn/ was removed from the list of potential instances, since it is vowel-initial orthographically, but actually consonant-initial phonemically. Additionally, the filler *er* /ʌ:/ was considered ineligible, both as a conditioning context for /r/-intrusion and a target site for /r/-linking. There were also several instances in which the particular coding scheme of the corpus produced "false positives." For example, adding *@r* to the end of a word may signify within the corpus that that word contained special inflection. These were also removed.

3.4 Features Encoded

Once the utterances were captured, I listened to each utterance and marked it for a number of features which would be used for later analysis. The primary feature was Resolution Type, which marked what phoneme occurred between the target words. In adult-like uses of /r/-linking and /r/-intrusion, /r/ was encoded for Resolution Type. Other resolution types noted were /j/ and /w/ (marked collectively as "glide"), the glottal stop /ʔ/, and no resolution (hiatus). Other resolution types appeared with less frequency: /n/, /l/, /ɾ/, /b/, /h/, and /ʁ/.

There were several instances in which a pause occurred between the two words. A pause was defined as a period of complete silence by the speaker between the target words. Utterances where a pause occurred were excluded from primary analysis, since utterances with a pause destroyed hiatus and necessarily produced a glottal stop when the following word was vowel-initial. On rare occasions in the mother's speech, a pause was marked when there was not silence. In these cases, the utterance's intonation strongly suggested that the speaker had initially

intended to end the utterance, but then decided to continue speaking. These instances always produced a glottal stop as resolution, but were not considered in primary analysis.

The age of the child at the time of the utterance was marked. Age is rounded down to the nearest month, so the study follows the child from 24-49 months.

The utterance was marked for Speaker as either "Mother" or "Child".

Some function words have "short" and "long" forms (Selkirk, 2000). This is the case with *to* (c.f. long form /tuʷ/ and short form /tə/), which can produce /r/-intrusion contexts only when it surfaces in its short form. This presents an additional question for the present study, because *to* may surface in long form for two reasons. It may be because of standard variability, and for whatever extraneous reason the long form was selected. Or, it may be that the speaker unconsciously knows that the short form would produce hiatus, and thus the long form is favored to prevent hiatus from occurring. In (28), neither the short nor long form produces hiatus, but in (29), only the short form produces hiatus. This may lead (29) to more often appear in long form, which would avoid hiatus.

(28) I'm going to Chicago *short* [tə ʃikɑgoʊ] *long* [tuʷ ʃikɑgoʊ]

(29) I'm going to Atlanta *short* [tə ætlæntə] *long* [tuʷ ætlæntə]

In this way, the selection of the long form over the short form may itself be a form of hiatus resolution, albeit a less overt one than /r/-effects. To take this factor into account, words which could appear in hiatus-producing or non-hiatus-producing forms were marked for Variable Form, as either short or long. Utterances marked in this way were considered separately from primary analysis.

3.5 Determining Eligibility

During the process of phonemic transcription, there were rare instances in which the transcriber's transcription differed from my interpretation of what was spoken, mostly in the early years of the child's speech. Given the utterance [ˈɛɹəˌbl̩], the transcriber may have labeled this as the child attempting "for a ball." However, given the greater context of the conversation where the mother is discussing elephants and tigers, I interpret the utterance as "animal." It is impossible to have absolute certainty what forms the child is attempting in these contexts. For the sake of the current study, it was sufficient to consider an utterance ineligible if I could not be reasonably certain of what form the speaker was attempting.

Along the same lines as above, there were occasionally utterances in which it was difficult to determine if /r/ or any other phoneme appeared in the target location. Due to the nature of the uninvasive recording setup, the microphone was often several feet away from the speaker. Other sounds in the home, such as toys or running water, occasionally obscured speech sounds. The less-than-ideal recording situation (for the purposes of phonemic analysis) prohibited the use of computer tools in most cases, as there was too much extraneous noise. I found it sufficient for the current study to merely exclude questionable utterances from eligibility.

4. Results

4.1 Mother

4.1.1 /r/-Linking. 20,500 potential instances of /r/-linking in the mother's speech were identified in the corpus through CLAN. A cursory analysis of 200 tokens revealed that /r/-linking was nearly categorical. At this point, I decided to conduct the primary analysis using 328 coded

tokens.[5] A full analysis of the 328 coded tokens supported the cursory analysis that /r/-linking is nearly categorical. The resolution strategy used was /r/ 97.0%, glottal stop 2.4%, and no resolution (hiatus) 0.6% of the time. Findings are summarized in Table 1.

Table 1

Methods of Hiatus Resolution Used by the Mother in /r/-Linking Contexts

	Hiatus Resolution Type				
	/r/	Glottal Stop	Other	Hiatus	Total
/r/-linking contexts	318 (97.0%)	8 (2.4%)	0 (0.0%)	2 (0.6%)	328

Note. "Other" designates glides, off-glides, and any other phonemes which resolved hiatus. "Hiatus" designates that there was no resolution.

Even when examining the mother's speech, the age of the child was a potentially relevant variable. Since the mother's speech was most often directed to the child, it is possible that she would have adjusted features of her speech to accommodate the child's understanding of certain linguistic phenomena. No difference was found when comparing the mother's use of /r/-linking from the child's earlier age (2;0-2;2, 98.8% use of /r/-linking) to his later age (4;9-4;11, 95.6% use of /r/-linking). Based on this finding, the age of the child was not considered when examining the mother's speech in other analyses.

[5]After parsing through CLAN's "false positives," several of the remaining tokens were usuable due to the utterance being unidentifiable. These tokens were thrown out, but the process produced strange-looking numbers of tokens.

4.1.2 /r/-Intrusion. 5,100 potential instances of /r/-intrusion in the mother's speech were identified in the corpus through CLAN. Primary analysis was conducted using 407 coded tokens. A similar process was used for selecting tokens as that used for mother's /r/-linking.

Overall in hiatus contexts suitable for /r/-intrusion, /r/ was used as the resolution strategy only 50.4% of the time. The majority of the instances where /r/ was not used to resolve hiatus do not have another form of hiatus resolution, and hiatus was maintained (35.9%).

4.1.3 Vowel Quality. A main effect was also observed for some interaction of vowel quality and stress of the vowel immediately preceding hiatus. Curiously, monosyllabic words with the orthographic ending *–aw* (i.e., those ending in [ɔ]) were only very rarely resolved with /r/ (5.0%; 7 of 139 tokens). This group is composed of the words *saw*, *draw*, *straw*, and *raw* within the corpus. When this group of monosyllabic [ɔ] is excluded from the rest of the /r/-intrusion tokens, the rate of /r/-intrusion in the mother's speech increases dramatically, from 50.4% to 73.9% (198 of 268 tokens).

An additional analysis was performed examining two groups of words ending in [ɔ]: monosyllabic and polysyllabic. Only a small sample of polysyllabic words ending in [ɔ] was available. That group was comprised of the words *jigsaw* and *coleslaw*. Of the 24 instances of these words, they were most likely to use /r/ to resolve hiatus (66.7%; 16 of 24 tokens), putting polysyllabic words ending with [ɔ] generally in-line with the rest of the sample.

Further analysis was performed comparing words ending in schwa [ə] (words like *Sarah*, *tuna*) and [ɑ] (words like *Grandma*, *spa*). Schwa was used with /r/-intrusion 69.2% of the time (90 of 130 tokens), while [ɑ] was used with /r/-intrusion 80.2% of the time (93 of 116 tokens). Meanwhile, when considering mono- and polysyllabic words together, [ɔ] is used with /r/-intrusion only 13.7% of the time (22 of 161 tokens). Findings are summarized in Table 2.

Table 2

Methods of Hiatus Resolution Used by the Mother in /r/-Intrusion Contexts

	Hiatus Resolution Type				
	/r/	Glottal Stop	Other	Hiatus	Total
All /r/-intrusion contexts	205 (50.4%)	25 (6.1%)	31 (7.6%)	118 (35.9%)	407
Following [ə]	90 (69.2%)	16 (12.3%)	0 (0.0%)	24 (18.5%)	130
Following [ɑ]	93 (80.2%)	3 (2.6%)	0 (0.0%)	2 (17.2%)	116
Following [ɔ]	22 (13.7%)	6 (3.7%)	31 (19.3%)	102 (63.4%)	161
Monosyllabic [ɔ]	7 (5.0%)	5 (3.6%)	28 (20.1%)	99 (71.2%)	139
Polysyllabic [ɔ]	16 (66.7%)	2 (8.3%)	3 (12.5%)	3 (12.5%)	24
All /r/-intrusion context except monosyllabic [ɔ]	198 (73.9%)	20 (7.5%)	3 (1.1%)	47 (17.5%)	268

Note. "Other" designates glides, off-glides, and any other phonemes which resolved hiatus. "Hiatus" designates that there was no resolution type.

There was no evidence that proper nouns compared to other types of words were more likely to use /r/ for hiatus resolution. Proper nouns were resolved with /r/ 71.8% (140 of 195 tokens), while other words (not including monosyllabic [ɔ] words), were resolved with /r/ 79.5% of the time (58 of 73 tokens).

4.2 Child

4.2.1 /r/-Linking. Primary analysis for the child's use of /r/-linking used all 1903 tokens available in the corpus. The child's first use of /r/ in an /r/-linking context occurred at 2;2. Data, compiled into three-month periods, are in Table 3 below. A full account of the data can be found in the appendix.

Table 3

Methods of Hiatus Resolution Used by the Child in /r/-Linking Contexts

	Hiatus Resolution Type				
	/r/	Glottal Stop	Other	Hiatus	Total
2;0 to 2;2	2 (5.9%)	6 (17.6%)	3 (8.8%)	23 (67.6%)	34
2;3 to 2;5	9 (7.5%)	42 (35.0%)	30 (25.0%)	39 (32.5%)	120
2;6 to 2;8	17 (13.9%)	19 (15.6%)	13 (10.7%)	73 (59.8%)	122
2;9 to 2;11	52 (19.3%)	35 (13.0%)	33 (12.3%)	149 (55.4%)	269
3;0 to 3;2	128 (47.6%)	27 (10.0%)	29 (10.8%)	85 (31.6%)	269
3;3 to 3;5	46 (39.7%)	21 (18.1%)	9 (7.8%)	40 (34.5%)	116
3;6 to 3;8	96 (57.1%)	12 (7.1%)	7 (4.2%)	53 (31.5%)	168
3;9 to 3;11	83 (55.3%)	8 (5.3%)	14 (9.3%)	45 (30.0%)	150
4;0 to 4;2	84 (56.0%)	14 (9.3%)	7 (4.7%)	45 (30.0%)	150
4;3 to 4;5	105 (75.5%)	4 (2.9%)	4 (2.9%)	26 (18.7%)	139
4;6 to 4;8	152 (76.4%)	7 (3.5%)	4 (2.0%)	36 (18.1%)	199
4;9 to 4;11	110 (65.9%)	19 (11.4%)	5 (3.0%)	33 (19.8%)	167

Note. “Other” designates glides, off-glides, and any other phonemes which resolved hiatus. “Hiatus” designates that there was no resolution.

As can be seen in Table 3 from 2;0 until 3;0, hiatus is most often not resolved in any way. From 2;2 until about 2;8, the glottal stop is the most frequent means for resolving hiatus when it is resolved. Around 3;0, /r/ begins to resolve hiatus much more frequently, overtaking hiatus quickly as the most-used form in hiatus contexts. From about 3;4 onward, /r/ steadily increases its use in /r/-linking hiatus contexts, peaking at 83.9% usage at 4;5, and ending at around 70% the last six months (4;6-4;11). Even by 4;11, the child has not yet mastered hiatus resolution in /r/-linking contexts, since his caretaker's usage is nearly categorical at 97.0%. In the child's speech, hiatus decreases relatively steadily from 3;0 onward, but its usage in the last six months, around 20%, is still much higher than in adult speech.

4.2.2 /r/-Intrusion. 162 tokens of /r/-intrusion contexts were coded and available for analysis. The child's first use of /r/ in an /r/-intrusion context occurred at 2;10, near the same time that the child's use of /r/-linking expanded. Data, compiled into six month periods, are in Table 4 below. A full account of the data can be found in the appendix.

Table 4

Methods of Hiatus Used by the Child in /r/-Intrusion Contexts

	Hiatus Resolution Type				
	/r/	Glottal Stop	Other	Hiatus	Total
2;0 to 2;5	0 (0.0%)	8 (30.8%)	9 (34.6%)	9 (34.6%)	26
2;6 to 2;11	1 (1.8%)	6 (10.9%)	11 (20.0%)	37 (67.3%)	55
3;0 to 3;5	2 (6.7%)	4 (13.3%)	8 (26.7%)	16 (53.3%)	30
3;6 to 3;11	10 (52.6%)	0 (0.0%)	0 (0.0%)	9 (47.4%)	19
4;0 to 4;5	5 (23.8%)	3 (14.3%)	4 (19.0%)	9 (42.9%)	21
4;6 to 4;11	6 (46.2%)	1 (7.7%)	1 (7.7%)	5 (38.5%)	13

Note. "Other" designates glides, off-glides, and any other phonemes which resolved hiatus. "Hiatus" designates that there was no resolution.

As can be seen, the use of /r/ in /r/-insertion contexts increased over the period. The use of /r/-intrusion increases after 3;6, but by the end of the 4;11 period does not surpass 50% usage, with hiatus being unresolved in the majority of the remaining contexts. /r/-Intrusion appears to take on a different development than /r/-linking, in that it increases in use at a later time period (cf. 3;0 for /r/-linking). By baseline percentages, the child appears to have developed an adult-like use of /r/-intrusion, since the mother's use of /r/-intrusion also falls at around 50%. However, as was observed in the mother's speech, applying vowel quality to when to use /r/-intrusion must also be learned to legitimately attain adult-like usage.

4.2.3 Vowel Quality. The dataset is too small for a reliable analysis, but a prospective analysis was conducted to see if, by the end of the corpus, the child exhibited sensitivity to the difference in vowel quality observed in the mother's speech. If the child's speech is adult-like, he would exclude /r/-intrusion for monosyllabic [ɔ]-final words, or if his speech is not adult-like, he would use /r/-intrusion across the board, regardless of the preceding vowel's quality. Examining the last 12 months of the sample, of the 23 instances of monosyllabic [ɔ]-final words, the child uses /r/-intrusion 43.5% of the time (10 of 23 tokens). This is similar to the child's use of /r/-intrusion overall (32.3%), and higher than the mother's use of /r/-intrusion in the same context (5.0%). This shows that the child has not yet learned to distinguish /r/-intrusion contexts based on vowel quality.

4.3 Function Words

I next examined the mother's speech for how often *to* appeared in short or long form in prevocalic contexts. *To* surfaced in long form [tuʷ] 99.2% of the time in the mother's speech (262 of 264 tokens). In the child's speech, the long form surfaced 96.9% of the time (186 of 192 tokens) from age 4;0-4;11. In adult speech, the short form is not supposed to be able to undergo /r/-intrusion (McCarthy, 1993).[6] Despite this prediction, the child's speech showed three instances of /r/ following short-form *to*: at 2;10, 3;2, and 3;7. One instance was noted of the mother using /r/-intrusion with the short form of *to*.[7]

To might by itself have a built-in form of hiatus resolution by the speaker selecting the long form, rather than the short form (see discussion in §3.4). To see if this bore out in the

[6] McCarthy's description was based on Massachusetts English. It may be that the dialect of British English observed here allows /r/-intrusion, albeit rarely, in this context.
[7] The utterance was *We'll have to ask Grandad when he comes today*, and was spoken with normal intonation at a normal speed.

corpus, I randomly selected 207 instances of *to* that were not hiatus-inducing (that is, the word following *to* was consonant-initial) in the mother's speech. As expected, in non-hiatus contexts, *to* occurs in the long form only 9.7% of the time (20 of 207 tokens), supporting the hypothesis that short/long form selection is itself a type of hiatus resolution. Results are summarized in Table 5.

Table 5

Use of to *in Short and Long Form Prevocalically and Preconsonantally*

	Form of *to*			
	Mother		Child (age 4;0 to 4;11)	
	Short	Long	Short	Long
Prevocalic (*to Atlanta*)	2 (0.8%)	262 (99.2%)	6 (3.1%)	186 (96.9%)
Preconsonantal (*to Chicago*)	187 (90.3%)	20 (9.7%)	—	—

Note. Utterances of the child's speech were taken from when the child was between 4;0 and 4;11. Short form is [tə], long form is [tuʷ].

One additional pattern suggests that the surface form of *to* is sensitive to its immediate phonemic context. Of the small group of non-hiatus *to* which appeared in long form, e.g. [tuʷ ʃikɑgoʊ], ten of them (50.0%) were immediately followed by a word beginning with the glides [j] or [w]. Both [j] and [w] have the phonological property [+high], the same property present in the last phoneme of *to* when it appears in long form. Even in non-hiatus contexts, *to* appears to assimilate to the manner of articulation of the sound that follows it. As when comparing pre-

vocalic and pre-consonantal *to* overall, the trend is not categorical, but shows a distinction nevertheless.

5. Discussion

5.1 Adult Speech

Considering the mother's speech, the difference between /r/-linking and /r/-intrusion is clear: /r/-linking is basically categorical, and /r/-intrusion is not. There was no vowel and stress context in which /r/-intrusion was used more than 90% of the time. Excluding monosyllabic [ɔ] words, the mother used /r/-intrusion approximately 70% of the time, a proportion similar to that reported by Hay and Sudbury (2005) and Mompeán and Mompeán (2007).

Unlike the findings reported in Mompeán-Gonzalez and Mompeán-Guillamón (2009) however, in those /r/-effect contexts when /r/ was not used, my study found that the glottal stop was used much less frequently than hiatus remaining unresolved. As with my study, Mompeán-Gonzalez and Mompeán-Guillamón explicitly state that utterances were not considered in their study if there was a pause between the two words, since that necessitated the use of a glottal stop (Foulkes, 1997). To explain this difference, perhaps the speakers in their study, using a careful speaking register, were more likely to use glottal stops than they would in natural speech.

5.2 Developmental Trends

Many of the findings seen here for the child are similar to those reported by Newton and Wells (2002): the child has a "growth spurt" in his use of /r/-linking around 3;0, and is not at adult-like levels of /r/-usage by 3;4. In fact, neither /r/-linking nor /r/-intrusion reaches adult-like levels even by 4;11. Using a larger dataset, my findings show that the child's first use of /r/-linking occurred at 2;2, much earlier than the 2;11 reported by Newton and Wells. Overall, my findings support Newton and Wells' conclusion that /r/-effects should be positioned differently

than the glides /j/ and /w/, which in their study are present at 2;4 and adult-like by 3;4. It may be that /r/-effects follow a similar timeline to that of *a*/*an* allomorphy, a phenomenon which, like /r/-effects, is sensitive to the phonetic material of the following word. Developmental studies have shown that children do not achieve adult-like usage of *a*/*an* even by age seven (Newton and Wells, 1999; Pak, 2015).

Despite the larger dataset, the infrequent nature of /r/-intrusion contexts in natural, everyday speech led to only a small number of tokens being collected in the child's speech for /r/-intrusion contexts. It would be unwise to draw any decisive conclusions without collecting more data, but a few trends can be observed. It was not until 2;10 that the child's first instance of /r/-intrusion was observed, and it never became the preferred means of hiatus resolution by a noticeable margin, even by 4;11. Unlike /r/-linking, /r/-intrusion did not increase in use until 3;6 and after (compared to approximately 3;0 for /r/-linking). This suggests that /r/-linking and /r/-intrusion are on different timelines, but without seeing either timeline reach its endpoint of adult-like usage, the comparison is somewhat weakened.

5.3 Vowel Quality

The current study provides an interesting discussion on the effect of vowel quality on the prevalence of /r/-intrusion. Previous research by Mompeán-Gonzalez and Mompeán-Guillamón (2009) has found that /r/-intrusion is more common after the low vowels [ɔ] and [ɑ] than schwa [ə]. My results suggest an alternate pattern: [ə] and [ɑ] pattern similarly, and it is [ɔ] that is different. The interaction that vowel quality has with stress, where only monosyllabic words are affected, has not been documented in previous studies and experiments. Two differences in methodology help explain the difference between my findings and those of Mompeán-Gonzalez and Mompeán-Guillamón (2009). For one, the current study uses a larger dataset overall.

Perhaps more importantly, the speech data in Mompeán-Gonzalez and Mompeán-Guillamón (2009) was highly formal, and the current study's speech is unelicited and naturalistic, a difference which Foulkes (1997) has shown can have a significant difference on /r/-effects' prevalence. It is unclear how a difference in register may have a produced this type of discrepancy between our findings. Regional variation may also contribute to the differences in findings of this study compared to others. How word-level stress interacts with this finding on vowel quality has yet to be seen, and deserves to be explored by future research.

5.4 Function Words

Barring few exceptions, the mother's speech uses *to* in the long form in hiatus contexts, and in the short form in non-hiatus contexts. This supports the tentative findings by Foulkes (1997) that words which can appear as hiatus-producing or hiatus-avoiding will surface in the hiatus-avoiding form when possible. A noteworthy exception in the mother's speech includes *to* surfacing in the short form and then taking /r/-intrusion, an occurrence considered strictly ungrammatical by McCarthy (1993), although McCarthy's description comes from a different dialect, Massachusetts English.

The idea that *to* and other function words could undergo allomorphy between their short and long forms is an interesting one, but the current study cannot provide much beyond speculation.[8] It is appealing to claim that *to* is experiencing allomorphy, since that would explain why it is nearly categorically sensitive to whether the following phoneme is a consonant or a vowel (or [+high], seen with the glides [j] and [w]).

[8] Allomorphy is discussed within the domains of phonology and morphology, where a word obligatorily appears with different phonological outputs, depending on its phonological and morphological (and some would say syntactic, see Selkirk, 2000) surroundings. The indefinite article *a*/*an* is traditionally viewed as allomorphic, where it appears as *a* before a consonant, and *an* before a vowel. Note that although its pronunciation changes, the meaning of *a* or *an* does not change between these contexts.

Traditional accounts of allomorphy would claim that the decision of which form surfaces is determined earlier in spell-out than simple phonetic variation, making allomorphy a "higher-level" process. Selkirk (2000) argues that function words can "see" syntactic boundaries. My study did not contain contrastive examples of the types of sentences Selkirk hypothesizes, but future experimental studies could aim to incorporate the findings presented here, where *to* is clearly sensitive to surrouding phonetic material, into theoretical work. My findings, where prevocalic *to* appears in long form and does not undergo /r/-intrusion, may also show that allomorphy involving *to* is a higher-level process than /r/-intrusion; that is, *to* selects its long form before the /r/-insertion rule applies.

5.5 Overgeneralization

Although Foulkes (1997) claims the existence of overgeneralizations like *the[r] animals* and *a[r] aeroplane* in child speech, Newton and Wells were unable to confirm this point. Having access to a larger dataset than Newton and Wells, I was able to find instances of the overgeneralization Foulkes described.

(30) I've got a[r] idea (4;7)

(31) I wanna draw[n] on there (2;11)

(32) Fire [m]engine go bump (3;9. Pronounced as [faɪə mɛndʒɪn])

(33) I want to[r] eat them (3;2)

(34) We'll have to[r] ask Grandad (adult)

While rare in the child's speech and non-existent in the adult's speech, instances of the indefinite article *a* taking /r/-intrusion were observed. There were also instances, predicted by Newton and Wells, of the glides /j/ and /w/ being applied in both /r/-linking and /r/-intrusion contexts. This points to the idea that the child is learning that hiatus can be resolved by different means, and

that in different contexts, any of /j/, /w/, or /r/ can be used. As Newton and Wells hypothesize, the presence of these types of overgeneralization suggest that /r/-effects are phonological and learned, rather than being purely phonetic and "natural." The steady trajectory of developing /r/-linking leads to the same conclusion, where there is a narrowing period, during which the child learns the specific contexts in which to apply each of the different hiatus resolution strategies.

5.6 Limitations

Generalizability is tentative when using a dataset composed of a small number of speakers. Despite this, findings regarding rates of /r/-effects in the mother and the overall trajectory of development of /r/-effects in the child are quite similar to those reported in previous research. This lends credence to the study's findings which have not been previously documented, specifically relating to vowel quality and function words.

Due to the setting in which recordings were made, computational phonetic analysis was impossible for the current study. The data were susceptible to a larger degree of human error, since tokens were coded aurally. This has been the preferred method for previous research, making the current studies findings, if imperfect, still comparable to the majority of the literature available on the subject (for notable exception, see Mompeán and Gómez, 2011).

5.7 Future Research

The findings regarding the interaction of vowel quality and stress, especially its contradiction to previous findings, provides a rich opportunity for additional research. This may come in the form of a larger dataset, which is able to compare more conclusively all of the available vowel sounds. It would also be possible to conduct cross-dialectal research examining whether or not these effects are present in other speakers' dialects. On that same note, the findings regarding *to* provide additional information to the discussion by McCarthy (1993). If *to*

represents some sort of allomorphy, this needs to be represented in the theory, and tested to see if it is similarly observed in McCarthy's Massachusetts English as it is observed here, in Manchester English. One could also examine the developmental timeline of *to*, in order to see if it patterns more similarly to /r/-effects, suggesting a phonological basis, or more similarly to *a*/*an*, suggesting a type of allomorphy.

Despite the size of the corpus, the number of tokens examining the child's development of /r/-intrusion was still small, making conclusions difficult. An even larger database, perhaps comparing multiple speakers and computational coding, might be able to draw stronger conclusions relating to the development of /r/-intrusion.

6. Conclusion

The purposes of this study were posited as follows: to determine when and how /r/-effects develop, to examine if they differ from each other, and to relate them to hiatus resolution as a whole. We have seen that /r/-linking, in this child, begins developing at 2;2, flourishes around 3;0, and achieves a 70% prevalence rate by 4;11, relative to the categorical adult speech. /r/-Intrusion begins developing at 2;10, flourishes around 3;6 and achieves a 50% prevalence rate by 4;11, relative to the 70% prevalence rate in adult speech, though adult speech also shows subtleties in vowel quality not yet present in the child's speech. In this way, /r/-linking and /r/-intrusion should be viewed as distinct phenomena. In adult speech, their prevalence rates are different overall, and /r/-intrusion is sensitive to aspects of vowel quality that /r/-linking is not. Hiatus resolution can also occur in the form of allomorphy of function words, with *to* preferring to appear in long form in would-be hiatus contexts, so that hiatus does not occur in the first place. This observation, in combination with overgeneralizations that the child and mother, suggests that hiatus resolution involves many linguistic processes, not the least of which is

phonological. While hiatus resolution has many outputs, all of them are underlyingly related, and theoretical accounts must be able to integrate these relations to account for variability in surface forms.

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8. Appendices

8.1 Appendix A—Child's Hiatus Resolution Types in /r/-Linking Contexts

	Hiatus Resolution Type				
	/r/	Glottal Stop	Other	Hiatus	Total
2;0	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100%)	2
2;1	0 (0.0%)	0 (0.0%)	2 (18.2%)	9 (81.8%)	11
2;2	2 (9.5%)	6 (28.6%)	1 (4.8%)	12 (57.1%)	21
2;3	2 (6.1%)	13 (39.4%)	3 (9.1%)	15 (45.5%)	33
2;4	0 (0.0%)	17 (34.7%)	16 (32.7%)	16 (32.7%)	49
2;5	7 (18.4%)	12 (31.6%)	11 (28.9%)	8 (21.1%)	35
2;6	6 (17.1%)	6 (17.1%)	2 (5.7%)	21 (60.0%)	35
2;7	6 (14.0%)	5 (11.6%)	7 (16.3%)	25 (58.1%)	43
2;8	5 (11.4%)	8 (18.2%)	4 (9.1%)	27 (61.4%)	44
2;9	13 (15.1%)	12 (14.0%)	11 (12.8%)	50 (58.1%)	86
2;10	16 (19.3%)	5 (6.0%)	13 (15.7%)	49 (59.0%)	83
2;11	23 (23.0%)	18 (18.0%)	9 (9.0%)	50 (50.0%)	100
3;0	59 (50.0%)	15 (12.7%)	10 (8.5%)	34 (28.8%)	118
3;1	41 (42.3%)	9 (9.3%)	12 (12.4%)	35 (36.1%)	97
3;2	28 (51.9%)	3 (5.6%)	7 (13.0%)	16 (29.6%)	54
3;3	9 (25.0%)	5 (13.9%)	6 (16.7%)	16 (44.4%)	36
3;4	17 (45.9%)	7 (18.9%)	2 (5.4%)	11 (29.7%)	37
3;5	20 (46.5%)	9 (20.9%)	1 (2.3%)	13 (30.2%)	43
3;6	39 (51.3%)	6 (7.9%)	4 (5.3%)	27 (35.5%)	76
3;7	33 (62.3%)	5 (9.4%)	2 (3.8%)	13 (24.5%)	53
3;8	24 (61.5%)	1 (2.6%)	1 (2.6%)	13 (33.3%)	39
3;9	28 (54.9%)	0 (0.0%)	7 (13.7%)	16 (31.4%)	51

3;10	27 (49.1%)	4 (7.3%)	6 (10.9%)	18 (32.7%)	55
3;11	28 (63.6%)	4 (9.1%)	1 (2.3%)	11 (25.0%)	44
4;0	13 (61.9%)	3 (14.3%)	1 (4.8%)	4 (19.0%)	21
4;1	36 (50.0%)	6 (8.3%)	3 (4.2%)	27 (37.5%)	72
4;2	35 (61.4%)	5 (8.8%)	3 (5.3%)	14 (24.6%)	57
4;3	24 (66.7%)	2 (5.6%)	1 (2.8%)	9 (25.0%)	36
4;4	29 (70.7%)	2 (4.9%)	1 (2.4%)	9 (22.0%)	41
4;5	52 (83.9%)	0 (0.0%)	2 (3.2%)	8 (12.9%)	62
4;6	49 (75.4%)	3 (4.6%)	2 (3.1%)	11 (16.9%)	65
4;7	43 (72.9%)	2 (3.4%)	1 (1.7%)	13 (22.0%)	59
4;8	60 (80.0%)	2 (2.7%)	1 (1.3%)	12 (16.0%)	75
4;9	32 (65.3%)	6 (12.2%)	3 (6.1%)	8 (16.3%)	49
4;10	38 (67.9%)	4 (7.1%)	0 (0.0%)	14 (25.0%)	56
4;11	40 (64.5%)	9 (14.5%)	2 (3.2%)	11 (17.7%)	62

Note. “Other” designates glides, off-glides, and any other phonemes which resolved hiatus. “Hiatus” designates that there was no resolution.

8.2 Appendix B— Child's Hiatus Resolution Types in /r/-Intrusion Contexts

	Hiatus Resolution Type				
	/r/	Glottal Stop	Other	Hiatus	Total
2;0	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	1
2;1	0 (0.0%)	0 (0.0%)	3 (75.0%)	1 (25.0%)	4
2;2	0 (0.0%)	1 (50.0%)	0 (0.0%)	1 (50.0%)	2
2;3	0 (0.0%)	0 (0.0%)	3 (37.5%)	5 (62.5%)	8
2;4	0 (0.0%)	2 (33.3%)	2 (33.3%)	2 (33.3%)	6
2;5	0 (0.0%)	4 (80.0%)	1 (20.0%)	0 (0.0%)	5
2;6	0 (0.0%)	3 (42.9%)	0 (0.0%)	4 (57.1%)	7
2;7	0 (0.0%)	0 (0.0%)	3 (42.9%)	4 (57.1%)	7
2;8	0 (0.0%)	1 (8.3%)	5 (41.7%)	6 (50.0%)	12
2;9	0 (0.0%)	0 (0.0%)	2 (25.0%)	6 (75.0%)	8
2;10	1 (7.7%)	1 (7.7%)	1 (7.7%)	10 (76.9%)	13
2;11	0 (0.0%)	1 (12.5%)	0 (0.0%)	7 (87.5%)	8
3;0	0 (0.0%)	2 (15.4%)	3 (23.1%)	8 (61.5%)	13
3;1	1 (16.7%)	1 (16.7%)	2 (33.3%)	2 (33.3%)	6
3;2	0 (0.0%)	1 (14.3%)	3 (42.9%)	3 (42.9%)	7
3;3	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
3;4	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
3;5	1 (50.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	2
3;6	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
3;7	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	2
3;8	6 (66.7%)	0 (0.0%)	0 (0.0%)	3 (33.3%)	9
3;9	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (100.0%)	3
3;10	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1

3;11	4 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4
4;0	0 (0.0%)	1 (50.0%)	0 (0.0%)	1 (50.0%)	2
4;1	1 (16.7%)	1 (16.7%)	1 (16.7%)	3 (50.0%)	6
4;2	2 (40.0%)	0 (0.0%)	1 (20.0%)	2 (40.0%)	5
4;3	1 (25.0%)	1 (25.0%)	1 (25.0%)	1 (25.0%)	4
4;4	1 (50.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	2
4;5	0 (0.0%)	0 (0.0%)	1 (50.0%)	1 (50.0%)	2
4;6	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0
4;7	0 (0.0%)	1 (33.3%)	1 (33.3%)	1 (33.3%)	3
4;8	3 (60.0%)	0 (0.0%)	0 (0.0%)	2 (40.0%)	5
4;9	1 (33.3%)	0 (0.0%)	0 (0.0%)	2 (66.7%)	3
4;10	2 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2
4;11	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0

Note. “Other” designates glides, off-glides, and any other phonemes which resolved hiatus. “Hiatus” designates that there was no resolution.