University of Pennsylvania Working Papers in Linguistics

Volume 16
Issue 2 *Selected Papers from NWAV 38*

Article 18

1-1-2010

Chain Shift Advancement by Children

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Abstract
The present paper examines the role of children in the propagation of chain shifts. Males and females in three age groups, children (6-11), teens (13-15), and parents, are compared to determine which age and sex group is the most advanced in an ongoing chain shift in standard Canadian English: the Canadian Shift (CS) (Clarke, Elms and Youssef 1995, Labov, Ash and Boberg 2006). The CS minimally consists of the successive lowering and/or backing of the front lax vowels /æ/ and /e/. It will be seen that children, in particular girls, appear to demonstrate vowels significantly lower than teens and parents, indicating that the principles of chain shifting are active from a young age. Teens' vowel means are backer but not significantly different from parents'. Sex differences apparent in the group of children indicate that the social factors proposed to be instrumental in chain shift advancement among teens and adults are equally relevant to children. However, a secondary examination of the Canadian Raising diphthongs reveals children fail to lead ongoing changes on the F2 dimension. This suggests that children's vowels may be subject to a type of formant-specific age-grading, possibly as a result of differing vocal tract dimensions (Lee, Potamianos and Narayanan 1999). As a result of these maturational factors, it is suggested that children's highly shifted vowels are not in their final positions, making their lead a temporary one. Instead, teens are probably more accurate indicators of CS pace and trajectory.

Chain Shift Advancement by Children

Emily Sadlier-Brown

1 Introduction

In order to understand the process of language change, we must know which people produce a language variety that differs systematically from what they've heard. The present study pursues this question in an examination of the role of children, in particular, in the propagation of chain shifts. Males and females in three age groups—children, teens, and parents—are compared to determine which age and sex group is the most advanced in an ongoing chain shift in Canadian English, the Canadian Shift (CS) (Clarke et al. 1995). It will be seen that children, in particular girls, appear to demonstrate vowels significantly more shifted than their parents, but that shift advancement is a complex process: highly shifted vowels may be partially a result of temporary maturational factors specific to children.

First described by Clarke et al. (1995), the CS is proposed to be a pull-chain involving the lowering and/or backing of, minimally, the front, lax English vowels /æ/ and /e/.[1,2] It has since been identified in many regions across Canada (Labov et al. 2006, Boberg 2008) including Vancouver, British Columbia, the location of the present study (Esling and Warkentyne 1993, Labov et al. 2006, Sadlier-Brown and Tamminga 2008). In line with general findings on sound change, Clarke et al. (1995) described the CS as being led by women, a fact which is corroborated by more recent studies (Boberg 2005). As would be expected, apparent-time studies generally find the CS to be most advanced in the youngest groups of speakers, whether this group be teenagers (De Decker and Mackenzie 2000) or young adults (Boberg 2005, Sadlier-Brown and Tamminga 2008). The one exception to this pattern is found by D'Arcy (2005) whose examination of /ae/ retraction and lowering among girls in St. John's, NL revealed adolescents (16–17) to be more shifted than their pre–adolescent (8–11) counterparts. In St. John's, a local vernacular exists alongside the incoming standard variety, and D'Arcy concludes that "speakers continue to favour features of the local vernacular through preadolescence, and that it is only during adolescence that they shift toward the new, incoming variants" (D'Arcy 2005:314). Thus, the CS appears to be an archetypal Principle II chain shift, led by women and young people, and possibly catalyzed by social factors during adolescence.

D'Arcy's conclusion conforms to the earlier views of Eckert on the importance of the adolescent period for linguistic innovation. Eckert's (1988, 1989) studies of the Northern Cities Shift (Labov et al. 1972) in suburban Detroit have consistently demonstrated the importance of social factors for advancing chain shifts during the adolescent period. In their study of the koineization of a local variety in Milton Keynes, UK, Kerswill and Williams (2000) found that 12–year–olds showed the most use of the new, local, fronted variety of /ow/. However, they also found that by age 8, children had already diverged from their parents' model, which suggests younger children play a non-trivial role. Indeed, a growing corpus of sound change research is beginning to highlight younger children as sensitive and capable participants in certain sound changes. Eckert (1996) relates the backed /ae/ of young Californian Latino speech to pre–adolescent social structure. Strikingly, Roberts and Labov (1995), examining the incidence of short-a tensing in children, found that tensing was increased in the direction of the change by children as young as 3–5.

For chain shift advancement, existing work favors adolescence as an important time of linguistic innovation, citing social factors such as the desire to symbolize autonomy (Eckert 1988, 1989, Kerswill and Williams 2000, D'Arcy 2005). However, these studies have generally taken place in environments in which two varieties are present (e.g. urban/suburban, new/old, incoming/local), providing a "choice" for speakers. In such cases, the innovative variant often exists in

[1]This paper will employ the notational conventions of Labov (1994a,b).

[2]Researchers disagree on the precise directionality of the CS vowels and on the participation of /i/. This study does not favor any one previous description over another: any apparent-time backing or lowering of /ae/ and /e/ will be considered a possible instance of Canadian Shift. Finding no significant movement of /i/ among the present age groups, this study will focus on /ae/ and /e/.

one of the choice varieties so that strictly speaking, *innovation* may amount to the *adoption* or importation of a pre-existing variant and the desirable qualities associated with it. Where two varieties are not in opposition, and the opportunity for linguistic symbolism is not readily present (as in Roberts and Labov 1995), the age of innovation could be much younger. The present study, therefore, addresses a gap in existing research on children by exploiting the dialectal uniformity of Vancouver rather than dialectal differences as in Kerswill and Williams 2000 and D'Arcy 2005. An attempt was made to eliminate the external factors on which other studies have focused in order to restrict the set of possible motivating factors. Linguistic, regional and social class homogeneity in the sample is to this end. Furthermore, the present study is the only acoustic analysis among the studies of children described above. Acoustically−derived data is important to confirm results that have been gained through impressionistic means. Lastly, the present sample consists of males and females, which is important in order to be able to safely conclude whether social factors play a role.

2 Methodology

The study comprised 37 participants in three age groups: parents (aged 35−49, n=13), teens (13−15, n=10), and children (6−11, n=14). Table 1 summarizes the sex make-up of each age group. All participants were native speakers of Canadian English, resided in a middle−class area of Metro Vancouver, and had spent only minimal time outside of Southwestern British Columbia.

	Parents		Teens		Children	
	F	M	F	M	F	M
N =	7	6	6	4	6	8

Table 1: Sex make-up of participant groups.

Data were collected in January 2009 via modified sociolinguistic interviews lasting approximately one hour. These were digitally recorded at a bit−depth of 16 and a sample rate of 44.1 kHz using Zoom Corporation's Zoom H2 Handy Recorder. For parents and teens, interviews contained six parts, including the eliciting of demographic data such as the participant's residential history, the eliciting of speech data in four styles (reading list, orally−elicited list,[3] reading passage, and conversational), and a written opinion survey targeting a participant's interests and language attitudes. For children, the interview was modified in two principal ways: instead of the reading list, children were instructed to name items as they were presented on a series of picture cards, and instead of the reading passage children looked through a wordless book and were asked to describe what they saw. 10− and 11−year−olds were given the choice of either format.

The present analysis is based on reading list data for teens and parents and either reading list or picture−naming data for children. From the data were extracted all mono-syllabic words containing a token of one of the three CS vowels (/i/, /e/, /ae/), one of the four Canadian Raising diphthongs (/aw/, /awT/, /ay/, /ayT/), or one of the six peripheral vowels collected for normalization purposes (/iy/, /ey/, pre−l /uw/, /ow/, /o/[4,5]). With the exception of /uw/, which always appeared pre−/l/ to ensure its peripherality, tokens that were pre−nasal, pre−approximant, and pre−g were eliminated due to the significant conditioning effect of these environments. Remaining tokens appeared in an approximately even distribution of pre-/t,d,s,p,k/ and word-final environments. Tokens were excluded if audible interfering factors, such as laughter or background noise, were present. This amounted to a total of 2256 tokens for analysis, an average of 61 tokens per speaker (range 51−71), or 5 tokens per phoneme per speaker (range 2−7).

Using Praat, a spectrogram was generated for each word and linear predictive coding (LPC) analysis was used to estimate the first and second formants of the target vowel. A single measure-

[3]This section utilized a brief oral framework such as "Please list some items which…"

[4]In this study, the phoneme written as /o/ comprises the merged phonemes /o/ and /oh/, which are phonetically identical in Vancouver.

[5]The sixth peripheral vowel is /ae/, which doubles as a CS variable.

ment was taken of each vowel's nucleus, defined as the maximal height of the first formant, or a central point in the vowel's steady state if no peak F1 was present. In the latter such cases, inflections of F2 were sometimes used as an aid in determining the point at which the vowel was most target–like. The resultant formant measurements were then normalized using the method of Labov et al. (2006) (which itself utilizes the algorithm developed by Nearey (1977)) in order to render them comparable despite differences in individual vocal tract length. The process adjusts each speaker's formant values by a scaling factor derived from the difference between his or her natural log means and those of the group as a whole.

All statistical analysis was performed in R. Vowel means for each speaker were calculated. To determine the effects of sex and age, a 2–way analysis of variance (ANOVA) was performed. This ANOVA also signaled the existence of any interaction between these two variables. Among the variables that did not demonstrate an interaction, a post-hoc Tukey test was performed to determine the level of significance of differences between each pair of age groups. For variables which did show an interaction, three 1–way ANOVAs were performed to determine the effect of sex within each of the three age groups and two further 1-way ANOVAs and subsequent Tukey tests were performed to determine significant age differences within each sex group.

3 Results

3.1 Age

The results of a 2–way ANOVA reveal age to be a significant factor influencing the F1 of /ae/ (p=.01) and /e/ (p<.001). No significant differences between age groups were found for F2, although the most retracted means were found in teens and children. No significant differences were found for either the F1 or F2 of /i/. Tables 2 and 3 provide summaries of the normalized mean and standard deviation (in parentheses) of the F1 of /ae/ and /e/ respectively, for each age and sex sub–group. Age group differences are illustrated in Figure 1.

	Parents	Teens	Children	*Mean*
Female	876 (111)	914 (84)	994 (69)	925 (100)
Male	829 (49)	808 (42)	916 (116)	863 (95)
Mean	854 (88)	872 (86)	950 (103)	895 (101)

Table 2: F1 of /ae/ by age group and sex, mean and standard deviation (in parentheses).

	Parents	Teens	Children	*Mean*
Female	719 (41)	729 (24)	834 (67)	759 (69)
Male	707 (43)	682 (30)	724 (51)	709 (45)
Mean	714 (41)	710 (35)	771 (79)	735 (63)

Table 3: F1 of /e/ by age group and sex, mean and standard deviation (in parentheses).

A post-hoc Tukey test indicates that for /ae/, the significant effect of age is due to children being lower than parents (p=.01). Teens are not significantly different than parents, although their mean is slightly (18 Hz) lower.

For the F1 of /e/, ANOVA results reveal a significant interaction between sex and age. To determine the nature of the interaction, sex and age were analyzed separately. Among females, children are significantly lower than parents (p=.001) and teens (p<.01), but teens and parents are not significantly different. No age differences are significant among males. Within the group of teens and the group of children, females display a lower F1 (p<.05 for teens; p<.01 for children). Parents do not show this sex difference. Figure 2 schematizes this interaction.

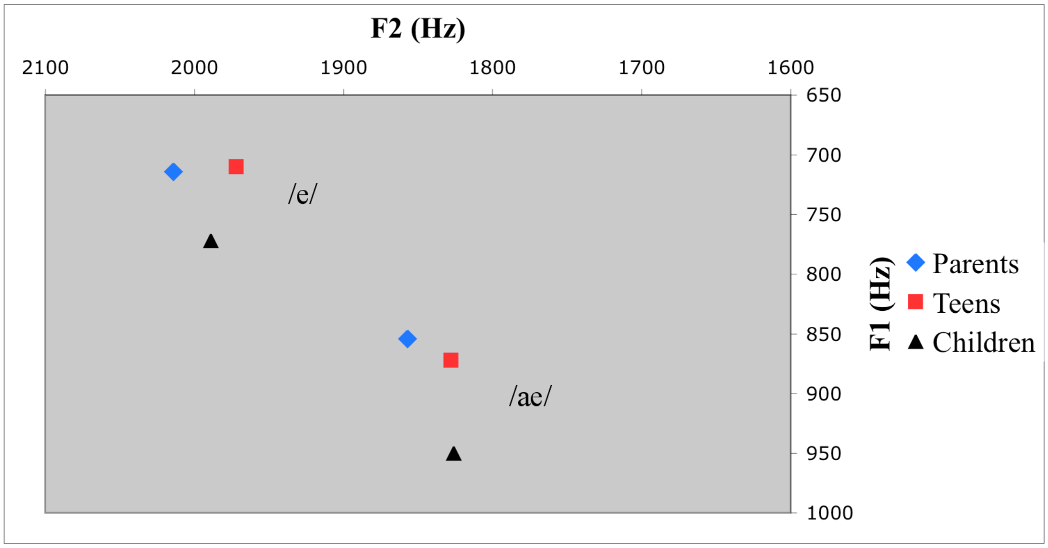

Figure 1: The Canadian Shift, differences among age groups.

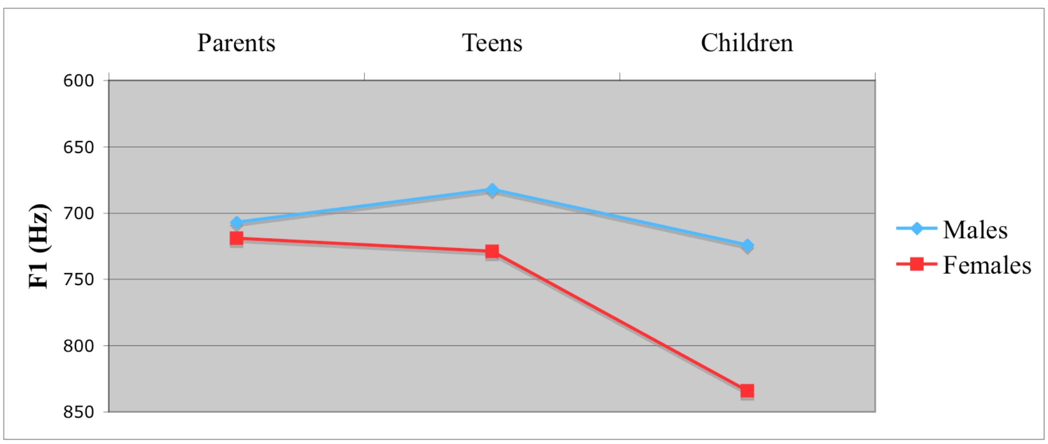

Figure 2: Interaction of age and sex in /e/ lowering. Males' relatively flat dispersal is contrasted with females' sharply dropping position of /e/, responsible for significant sex differences in teens and in children.

3.2 Sex

A 2–way ANOVA reveals that sex is a significant factor influencing the F1 of /ae/ and /e/ but not /i/. Like for age, no F2 differences are significant but the more retracted means are among females. For /ae/, sex differences are not dependent on age; females of all ages are lower than their male counterparts (p=.04). For /e/, the interaction between age and sex is outlined above.

4 Discussion

4.1 Children and the Canadian Shift

As in previous studies of Vancouver, differences between the age groups point to an active shift in apparent time. For the two vowels previously confirmed to be participating in the CS (/ae/ and /e/)

children are the most shifted, although for /e/ this is only true of girls.[6] Notwithstanding the possibility of age grading, it appears that female speakers, at least, advance the CS during or before the elementary school years.

The fact that /ae/ lowering is advanced by both boys and girls as young as 6 suggests that the internal factors proposed to play a role in language change (e.g., Labov 1994a) are operative at a young age and play an important role in chain shift advancement. However, sex differences are apparent even in children: /ae/ lowering is more advanced in young girls, and male children do not seem to participate in /e/ lowering. For /ae/, the patterning of the variables between the sexes is the same in children as in adults, and for /e/, female teens and children lead their male counterparts. This pattern is reminiscent of the general findings of research with adults and adolescents (for example, the female lead in older stages of the Northern Cities Shift (NCS) found by Eckert (1988)), and indicates that internal factors cannot be solely responsible for CS advancement in Vancouver. That females lead the CS may be an expected result, but that they do so even in the first few years of elementary school suggests that the factors responsible for women leading sound change are active even in young children.

These results, however, raise the question: Why does teens' behavior, in contrast to children's, appear so conservative? Here, an age group normally associated with innovation is not statistically different from the group of parents. Although the teens attain backer vowel means, the absence of any lowering runs counter to the predictions of the apparent time hypothesis.

4.2 Insights from the Canadian Raising Variables

In addressing this question, it will be helpful to examine children's and teens' behavior on another set of variables, the Canadian Raising (CR) diphthongs. "Canadian Raising" is the process of raising the nucleus of the diphthongs /aw/ and /ay/ before voiceless consonants (Joos 1942, Chambers 1973), yielding the well-known "oot and aboot" stereotype of Canadian speech. Both the F1 and the F2 of the variables in the pre-voiced and pre-voiceless environment will be considered, as recent studies have demonstrated they are active on both dimensions (Chambers and Hardwick 1986, Rosenfelder 2005). Variables in the pre-voiced consonant environment will be written /aw/ or /ay/; in the pre-voiceless consonant environment they will appear as /awT/ or /ayT/.

During the course of the study, the analysis of the CR variables was performed on the same participants in a manner identical to that described for the CS. Labov et al. (2006) defined CR as a difference of at least 60 Hz between a diphthong in its pre–voiced and pre–voiceless environment. In this study, all age and sex sub-groups exceeded this threshold for both diphthongs, confirming the continuing presence of CR in Vancouver English.

4.2.1 Canadian Raising Variables: F1

ANOVAs for age find no differences in the height of the raised variants (Figure 3). However, in general, children's unraised variants are lower than parents' (/aw/, $p<.05$; /ay/, $p<.01$) and teens' (/aw/, $p<.05$; /ay/, n.s.), putting children in the lead of a hitherto undescribed process of diphthongal lowering. Like for the CS, teens are no lower than their parents. We will see, however, that diphthongal lowering is likely the artifact of maturational factors specific to children.

4.2.2 Canadian Raising Variables: F2

/aw/ fronting was described by Chambers and Hardwick (1986) as a process led by young women which finds particular prevalence in Vancouver. More recently, Rosenfelder (2005) described the possibly analogical process of /ay/ fronting in the nearby city of Victoria, B.C., again led by young women. The F2 of the CR variables was examined with the expectation that, should these processes be confirmed, children would be in the lead. ANOVAs reveal no significant differences among age groups for the *un*raised variants, supporting earlier suggestions that the process may be

[6]The nature of chain shifts hypothesizes that /e/ is a newer change, a consequence of the earlier backing of /ae/. The non-participation of males in /e/ lowering is consistent with this hypothesis in that they may not yet be participating.

near–complete (Rosenfelder 2005). However, the *raised* variants differ between the age groups (/awT/, $p<.05$; /ayT/, $p<.01$). In contrast to diphthongal lowering, it is not children but teens who lead /awT/ and /ayT/ fronting (Figure 4). In this instance, teens finally play the innovative role to which we are accustomed, while children lag well behind the other two age groups. If children are capable of leading diphthongal lowering, what could account for their sudden failure to lead diphthongal fronting?

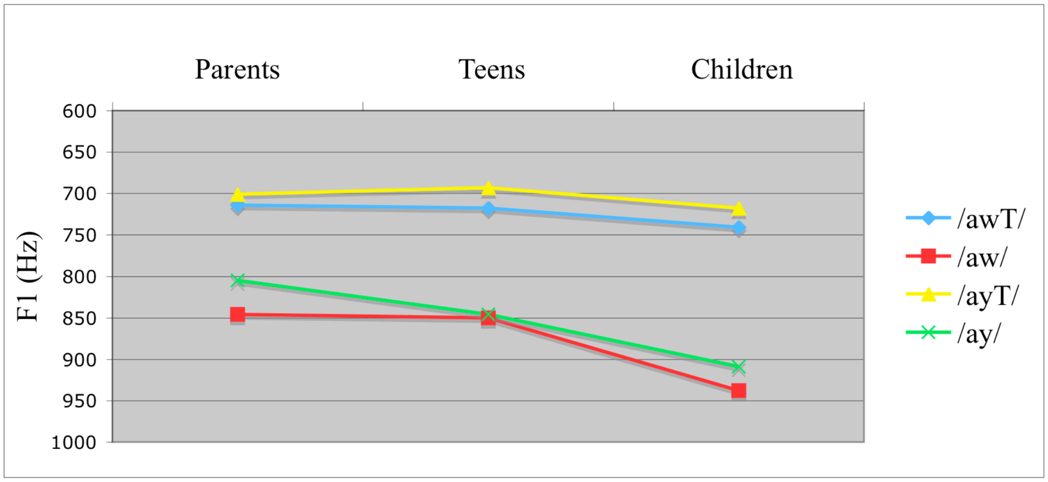

Figure 3: The CR diphthongs in apparent time. Children's lowering of /aw/ and /ay/ results in a greater difference between their raised and unraised variants, evident in the widening gap between the upper two and lower two lines.

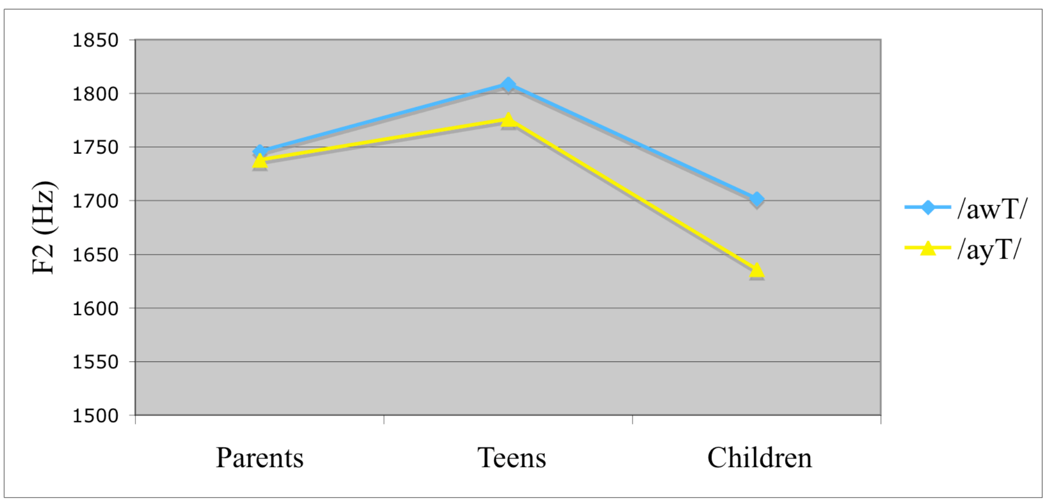

Figure 4: /awT/ and /ayT/ fronting, by age group.

4.2.3 Maturational Factors

The failure may be rooted in maturational factors evidenced in the limited body of research on children's phonetics. As part of an in-depth survey of the acoustic characteristics of child speech, Lee et al. (1999) examined formant frequencies as a function of children's age and gender. Their results indicate that variability of F1 is greater than variability of F2 (and F3) for speakers younger than 12. Lee et al. conclude that "limitations imposed by the dimensions of the vocal tract on the dynamic range of formants are much more stringent on F2…than F1" (Lee et al. 1999:1466).

These findings bear on the current results in two principal ways. First, given that children seem capable of leading diphthongal lowering, it is possible that their failure to lead diphthongal fronting is explained by a physical inability to do so.[7] Children's extreme F1 lead may in turn represent a form of (over)compensation on the dimension with "greater room for variation." Second, if the relative dimensions of children's vocal tracts are different from adults' as Lee et al. suggest, then the present method of formant–extrinsic normalization would be expected to compromise the comparability of children's and adults' normalized results.[8] It is unlikely that the latter is solely responsible, as Lee et al.'s conclusions surfaced despite their use of unnormalized data; however, it is highly possible that the present normalization method magnified existing maturational differences. In either event, it appears that the children's vowels as they appear in this analysis are subject to some form of formant–specific age grading at once responsible for their apparent lead on diphthongal lowering and lag on diphthongal fronting.

An explanation for teens' apparent conservativeness in the CS arises by extension. It appears that, in parallel to the CR diphthongs, children's CS vowels are not in their final positions. Children's extreme lowering and lack of backing is likely the result of similar formant–specific age grading leading to vowels which are currently much lower and fronter than they will be in a few years. On the other hand, it seems that teens' moderately retracted values, which fail to achieve significant difference from parents, are more reflective of the true pace and direction of changes in progress involving the CS, and CR, vowels.

5 Conclusion

At first glance, children appear to lead the CS by lowering the vowels to an extent far beyond that evident in adults and teens. However, a closer examination of their behavior on the CR vowels finds that, although they seem to lead diphthongal lowering, they do not lead in the better–attested process of diphthongal fronting. After the conclusions of Lee et al. (1999), it was suggested children's relative deployment of the formants is different from that of adults, perhaps due to differing dimensions of the vocal tract. This difference may have been amplified by the method of normalization. In comparison to adults and teens, it appears that children are subject to a greater degree of restriction on the F2 dimension, which may result in their failure to lead sound changes involving F2 and, possibly as a consequence, lead to exaggerated effects on the F1 dimension. Therefore, it is suggested that here, children's vowels are not representative of the apparent–time direction of the CS. Instead, their lead is merely temporary, their vowels being lower and not as retracted as they will be in the future. Teens, whose vowels are only moderately more retracted than their parents', are probably more accurate indicators of CS pace and trajectory.

However, it is important to recall that children's CS vowels are nevertheless differentiated from their parents and that the differentiation is in the direction of the CS, which continues to support that the principles of chain shifting are active in children as young as 6. Though the current vowel positions may be temporary, children do not seem to be merely reproducing what they hear. Rather, this age group seems to have already begun the process of chain shift advancement, though the vowels may take a more circuitous path to their final locations. Furthermore, females have a lower /ae/ than male children, and male children are not currently participating in /e/ lowering. Such sex differences, which mirror the effects found in adults, cannot be attributed to a failure of normalization and indicate that social factors are likely relevant to the youngest children.

This study therefore concludes that children play an important role in the advancement of the CS and chain shifts more generally. However, children are not necessarily participating in these changes in the way we might expect them to: they are not merely smaller, younger versions of adults. Physiological–maturational factors probably affect each formant differently, but it is possible that this divergence is systematic and therefore predictable. More research is needed to dis-

[7]The reasons for the difference must be left to further research. Smaller mouths might effect a smaller range for F2, or more difficulty in aiming for a desired target. A different relationship between the height and backness of children's vocal tracts could disproportionally handicap the backness dimension. Furthermore, proposed differences between children and adults could stem, partially or fully, from systematic differences in how children perceive each formant.

[8]Thank you to Anne Fabricius and Dominic Watt for their aid and insight into this issue.

cover the precise effects of maturation[9] on F1 and F2 respectively, and to determine or develop methods of normalization that ensure maximal comparability between younger and older vocal tracts. Since it is so important to uncover the role of children in language change in order to understand how the process unfolds, the study of these peculiarities must be undertaken. That is, if it is true that "most linguistic influence is exerted…before the system stabilizes" (Labov 1994b:502), then understanding the nature of this instability should be at the forefront of research on language change.

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[9] Although this paper has focused on the process of physical maturation, it is suggested that all forms of maturation, including psychological and social, have consequences on the progress of children's speech development.

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