The emergence of gendered production between childhood and adolescence:
A real time analysis of /s/ in Southern British English

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ABSTRACT

This paper investigates gendered speech development between childhood and adolescence. A longitudinal sociophonetic analysis of /s/ was conducted across a panel of 13 speakers, first recorded aged 9-11 and again at 13-15. Acoustic measures of Centre of Gravity (CoG) revealed a significant interaction between Year of Interview and Gender. Male CoG significantly fell, while female CoG significantly rose. These data suggest that gendered speech styles emerge incrementally over time. Moreover, as CoG is inversely related to vocal tract length, typical physical development would predict a fall over time for both genders. As we only find this for the males, this indicates the emergence of gendered /s/ production is primarily driven by females. Inspection of style in the adolescent data supports this interpretation: only females show significant stylistic conditioning, while males are consistent across contexts. These findings are discussed in relation to the role of women in language variation and change.

Keywords: sociophonetics; phonetic variation; real time; gender; child and adolescent language

1. BACKGROUND

1.1. /s/ production and gender

In articulatory terms, one source of /s/-variability in English is along a front-back cline where it can be produced with a fronter articulation which results in a shorter front cavity between the point of constriction and the teeth, or a backer articulation which results in a longer one [3]. Acoustically, front cavity length has been shown to be inversely related to measures of frequency [4, 13] where fronter /s/ articulations are associated with higher frequencies as measured by spectral peak frequency or Centre of Gravity [4, 29, 15].

Given the tendency for males to exhibit larger vocal tracts than females, and therefore longer front cavity lengths, it follows that males will also exhibit /s/ productions associated with lower Hz values. Studies that have examined sex related differences have largely confirmed this [28, 14]. However, many studies analysing differences in acoustic measures between male and female /s/ have reported differences of a larger magnitude than is predicted by anatomical factors alone [7, 21, 10]. These studies suggest that a sociophonetic explanation provides a better account where speakers make use of /s/ variability to index aspects of gender. Subsequent studies have observed gendered patterns of /s/ variation which further intersect with other socially relevant categories such as class, and ethnicity [30, 25]. The interpretation of these data requires a socially grounded account. This in turn emphasises the sociophonetic potential of /s/ variability as a resource available for speakers to socially index elements of their identities.

1.2. Development of gendered speech patterns

Research examining the acquisition of variation has shown that children are exposed to socially meaningful variation virtually from birth [8]. Further, patterns in Child Directed Speech (CDS) suggest that caregivers use their input to prime their children to linguistically relevant social categories, and that gender appears to be chief among these [9]. However, less clear is when children start to use this social information to produce gendered patterns in their own speech. Studies have shown evidence for gendered speech production in children aged between three and six [24, 8, 31] while others suggest that it does not emerge until 12 [19], and others as late as 16 [24].

Work which has specifically targeted sibilant production reported gender patterning for /ʃ/ between ages 8-9, but not until 11-13 for /s/ [32]. Results indicated that the process was incremental where the distance between male and female measures was greater for older than younger children. In other words, children's speech production became more gendered as they got older. Perceptual work investigating the evaluation of children's speech showed gendered /s/-production affected 'gender-typicality' judgements of the child [22, 23].

This study builds on recent work by examining the emergence of gendered speech production across a panel of individuals in real time. It targets the transition from childhood to adolescence and compares the speech of males and females. Specifically, we ask:

- Is there evidence for the emergence of gendered production of /s/ across real time?
- Is this effect driven by males, females, or both?

2. METHODOLOGY

2.1 Sample

Data come from a real time panel of speakers interviewed and recorded twice, first in 2012 aged between 9-11 years, and second in 2016 aged 13-15 years. Participants were recruited and recorded at school and interviewed using traditional sociolinguistic techniques [17] in pairs with the first author. The 2016 set of interviews included a stylistic component where participants read a short passage before they were interviewed. All participants are monolingual English speakers, born and raised in Hastings, a coastal town in southeast England, situated within the wider Southern British English dialect area.

2.2 Data and analysis

Data were recorded using a solid state recorder with a sampling rate of 44.1kHz. Following orthographic transcription, the data were automatically aligned at a phonemic level using the University of Pennsylvania's Forced Alignment and Vowel Extraction Suite [26]. Acoustic measures of spectral Centre of Gravity were automatically extracted from time averaged spectra in Praat [2] (with a proportion hand-checked).

A total of 11,538 tokens were analysed using Linear Mixed Effects Regressions (lmer) [1] where Year of Recording and Gender were entered as fixed social factors, Duration and Following Phonetic Context were entered as fixed phonetic factors; Speaker and Word were included as random factors. Therefore, reported values from social factors are based on model estimates which control for phonetic and random factors. Fully saturated models were stepped [16] and post hoc within factor contrasts were derived using differences of Least squares means [20] Tukey method corrected for multiple comparisons.
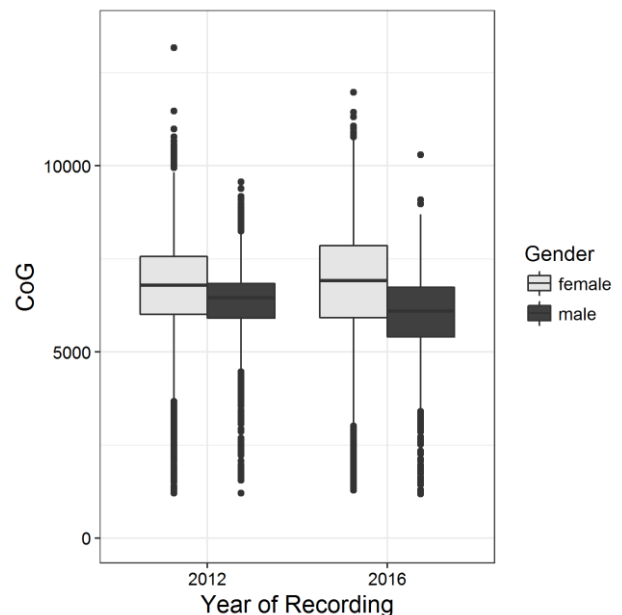
3. RESULTS

Real time data
As shown in Figure 1, the distance between the average male and female measures of CoG increases across the time points. On average, the adolescent females show a higher CoG compared to their childhood measures. The opposite pattern is visible

for the males: their adolescent CoG measure is lower than the one based on their childhood recordings.

Figure 1: CoG in real time separated by gender[1].

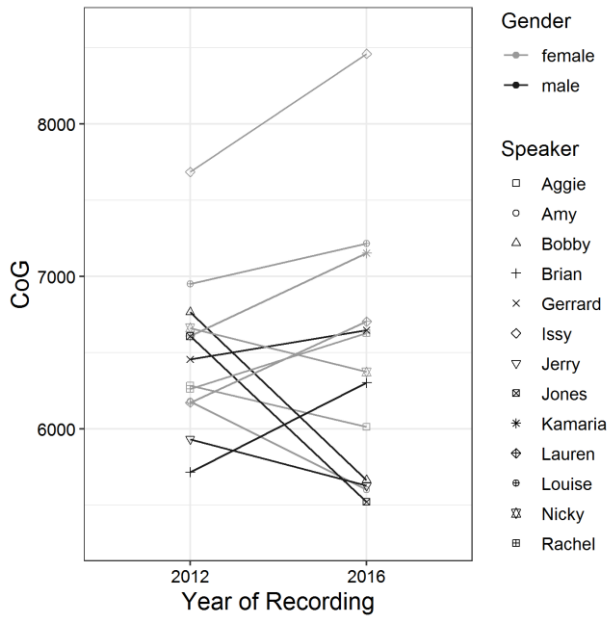Consistent with Figure 1, lmer analysis of the real time data revealed a significant interaction between Year of Recording and Gender ($p<.0001$). Post hoc pairwise comparison of lsmeans indicated a within-factor difference across time for both genders. Females showed significantly higher CoG in 2016 compared to 2012 (model estimated difference of 251Hz, $p<.0001$), while Males showed the opposite pattern: their average CoG was significantly lower across the two time points (model estimated difference of 141Hz, $p=.003$). Differences between the genders were not significant at either time point: male and female measures showed no significant difference in the data from 2012 ($p=.55$), or 2016 ($p=.09$).

Figure 2 shows average individual CoG across the two time points, shaded by Gender, in order to investigate the uniformity of the observed aggregate gender findings across individual speakers in real time. The figure shows that there is a degree of variability in the direction, and extent, of the shifting. Some females increase, and some decrease, some make large shifts, others smaller ones – the same is true of the males. However, for both males and females, the majority of individuals conform to the broader gender pattern. For females, 5/8 individuals increase, and for males 3/5 decrease. It is also noteworthy that the most extreme shifters across both males and females shift in the direction predicted by their gender.

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[1] Real time analyses uses data from Interview contexts only to ensure it is fully comparable across the time points.
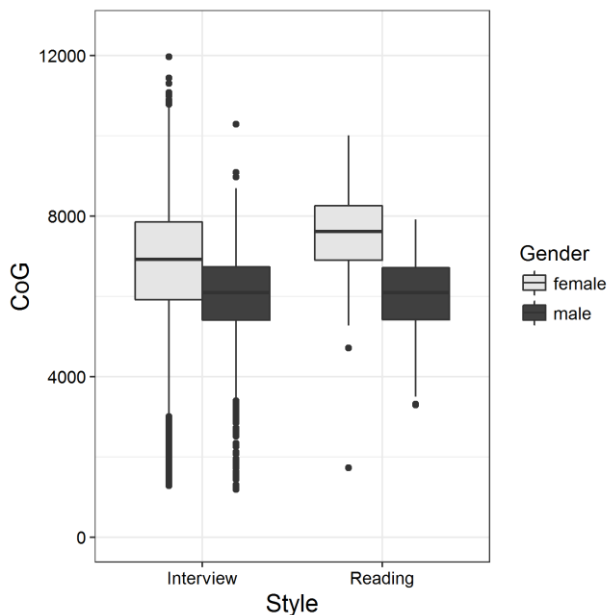
Figure 2: CoG in real time by individual speaker.

Style in adolescent data

In order to investigate the status of the form across the speakers, speech context was analysed in the 2016, adolescent recordings. Figure 3 illustrates the result of this analysis showing CoG across the different speech contexts (Interview and Reading Passage) separated by Gender (males dark grey, females light).

Figure 3: CoG in 2016 by style and gender.

The distribution of CoG across speech context as shown in Figure 3 demonstrates the interaction of Style and Gender. Only female participants show a shift where they exhibit higher CoG values during the reading passage compared to the interview speech. This effect is not visible across the males who show consistent measures across the contexts. These observations are supported by the statistical analysis where Style and Gender show a significant interaction ($p<.0001$). Analysis of lsmeans further corroborate the visible tendency where female CoG measures are significantly different across the two contexts ($p=.0002$), but male CoG measures are not ($p=.502$).

4. DISCUSSION

We now return to our research questions.

- Is there evidence for the emergence of gendered production of /s/ across real time?

Our results showed that the distance between male and female measures of CoG increased over time: male CoG significantly fell, while female CoG significantly increased. In line with previous apparent time findings [32], these data suggest a divergence of male and female patterns in the production of /s/ which emerge gradually. However, our first question explicitly asks if there is evidence for the emergence of a *gendered* production, as opposed to one explained by sex-based anatomical differences. Essentially, whether the differences we observe between males and females suggest a social, or a biological, process. Our results suggest that both types of processes may come in to play, but that they do not apply equally across both genders. Specifically, to a large extent, the changes witnessed in the male data can be explained by typical physical maturation. As outlined in Section 1, longer front cavity length has been shown to correlate with lower /s/ frequency [4, 13, 15, 29]. Our data are sampled across two points, and while direct physical measurements were not taken, our participants showed a level of growth in line with typical development [33], this will have included an increase in vocal tract length [11]. If only biological factors affected changes in /s/ production, we would have predicted a decrease in CoG measures for both genders in real time. In our data, this was only the case for the males; the female measures decreased. This observation suggests that, while a biological explanation can partially account for the changes exhibited in the male data, a social one is necessary for the female. We discuss the reasons for this below. First we consider the individuals.

In addition to the aggregate gender patterns, the individual trajectories also suggest a social motivation. Moreover, that changes in /s/ production are not wholly predicted by a binary male/female split. While the majority of individuals conform to the dominant gender pattern, males and females do not behave as two uniform groups. This suggests that social factors may influence shifts in production for

males as well as females. In addition to interspeaker variation, intraspeaker variation, i.e. the degree that individuals shift across real time, may suggest further evidence for a social account. Previous research has observed that women 'actively' produce more front /s/ articulations [7]. Indeed, the most extreme female shifters within our sample, Amy and Kamaria, show strikingly higher CoG measures in 2016 which may suggest an actively fronted articulation. Equally, the most extreme male shifters, Bobby and Jones, both make marked shifts down the Hz range. This may imply an actively backed articulation, and in turn suggest a combination of social and biological factors for the shifts. However, while the extent of these male speakers' shifting may be beyond that predicted by an anatomical account, they do shift in the predicted direction. The same cannot be said for the females which leads us to our second question.

- Is this effect driven by males, females, or both?

Patterns across real time indicate that, while both social and biological factors may contribute to changes in the male data, only social factors can account for the female data. This interpretation is corroborated by the results of the style analysis: only the female speakers show a significant difference across the contexts where higher CoG measures are associated with a more careful style. The males show no significant shift across contexts. These results demonstrate the emergence of gendered /s/ variation is driven by the females. More broadly, taking the real time and style results together, they indicate that the young female speakers are making use of the social value of /s/ variation in a way that the males are not.

This finding echoes previous research which found adolescent females used the most innovative and conservative rates of a phonetic variable shown to index social group affiliation. Female speakers spanned the entire variable range. In doing so, they utilised the socio-symbolic value of the phonetic variation, and thus symbolically indexed their group membership, to a greater extent than the males [5]. This finding is underlined by a study which examined the intersection of class and gender as it patterned with /s/ variation across style. Here, only the working class females showed significantly different /s/ measures across interactional stances [12]. Both studies interpreted the findings in light of broader social hierarchies where groups with less access to power, i.e. women, lower socioeconomic statuses etc., rely more heavily on symbolic manifestations of capital, for example, physical appearance, or, in these instances, linguistic variation. The same interpretation could apply to our data: the women make greater use of the socio-indexical use of the

form because their position within the social hierarchy makes it a more valuable resource.

While this may explain why female speakers make greater use of the variation, it does not explain the timing – why does gendered speech emerge during adolescence? The answer to this may lie in what the variation actually signifies. On the surface, fronter /s/ appears to be a resource used by the females in order to distance themselves from the naturally lowering male /s/. However, our analysis indicates that, while the genders diverge, they are not actually significantly different *to each other* at either time point, they are only significantly different to earlier measures of themselves. This suggests that the primary category is not gender, but age; speakers are not distancing themselves from the opposite gender, rather younger speakers. Indeed, research into language change indicates that teenagers experience an imperative to 'grow up' in order to gain access to the privileges associated with young adulthood (freedom to make their own choices, respect of other adults etc.) [27]. Further, that they are sensitive to linguistic variation as it correlates with age vectors [18]. One way young people can expedite their access to young adult privilege is through symbolically demonstrating their status as 'legitimate adolescents'. They can do this by adopting various adult-like behaviours many of which are predicated on 'gender-appropriate' activities: wearing make-up; growing facial hair; sexual experience etc. [6]. This interpretation suggests that the young female speakers are not using gendered speech patterns to distance themselves from the males, but rather to align themselves with older females. The underlying aim is to sound 'older' and this is seemingly achieved by replicating the gendered speech patterns they observe within the wider adult speech community. In short, they index age by performing gender.

5. CONCLUSION

Our findings demonstrate the emergence of gendered speech across time. We interpret these findings as evidence for a primarily social process driven by females. Our discussion relates these results to the larger questions they pose. Namely, why females, and why during adolescence. We suggest the gender asymmetry is due to a broader societal structure where less access to power and concrete capital leads women to make greater use of symbolic forms. In turn, this currency becomes particularly valuable at adolescence, when individuals experience a pressure to assert themselves as adults. One way to achieve this is by reproducing gendered behaviours associated with the adult community, hence we observe the emergence of gendered speech during this life stage.

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