Gender and linguistic variation: a role for hormonal organising effects?

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(based on joint work with
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Introduction

- **Linguistic sex/gender effects:** it is well known that speaker-sex has a stochastic effect on the frequency with which linguistic variants are used. Reasons unknown.
- **Hormonal Organising Effects:** the action of sex steroids, during the critical period for sexual differentiation (*in utero*, esp. weeks 8-24 for humans), affecting primary/secondary sex characteristics, and "gender":
  - Behaviour: mating behaviours in mammals, sexuality and gender identity in humans, pair-bonding and other behaviours in birds.
  - Brain morphology: e.g. the sexually-dimorphic nucleus of the pre-optic area in mammals, including humans, with a correlate in birds; also e.g. parts of the avian song system (Balthazart et al., 2009).
  - Not to be confused with hormone activational, or circulating, effects, which are often independent.

Outline

Sex/Gender and Change from Below

- When linguistic changes begin, a new linguistic feature is innovated, and has to spread through a population.
- As it spreads, there is both inter-speaker and intra-speaker variation, essentially for all variants studied.

(1) a. Have you any money?
    b. Do you have any money?
    (British Isles)

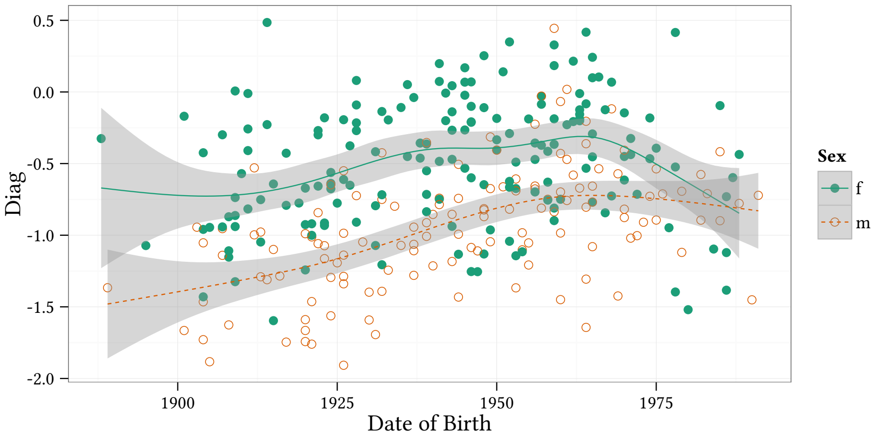
(2) John is going to his {[haus]/[hæəs]}.
    (Philadelphia English)

(3) I want to, {*um*, *uh*}, tell you some things.
    (All Englishes so far, and Dutch?!)

- Women tend to lead **changes from below** the level of consciousness (see Labov 2001, Chapt. 8 long list of references up to that date).

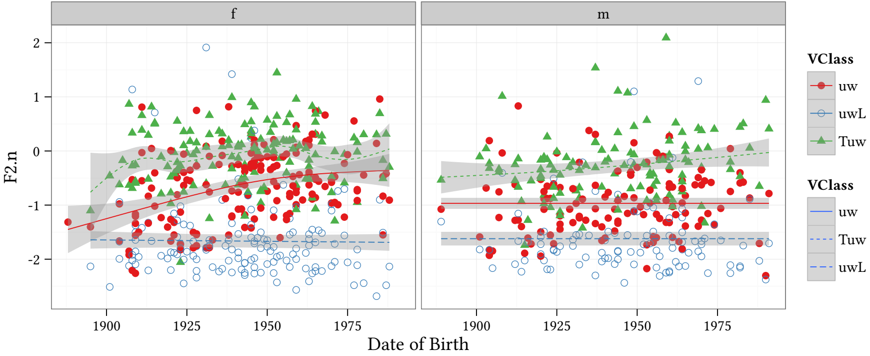
Sex and Change from Below, /aw/ (Fruehwald, 2013)

$n_{speakers} = 308$, $n_{vowels} = 16046$



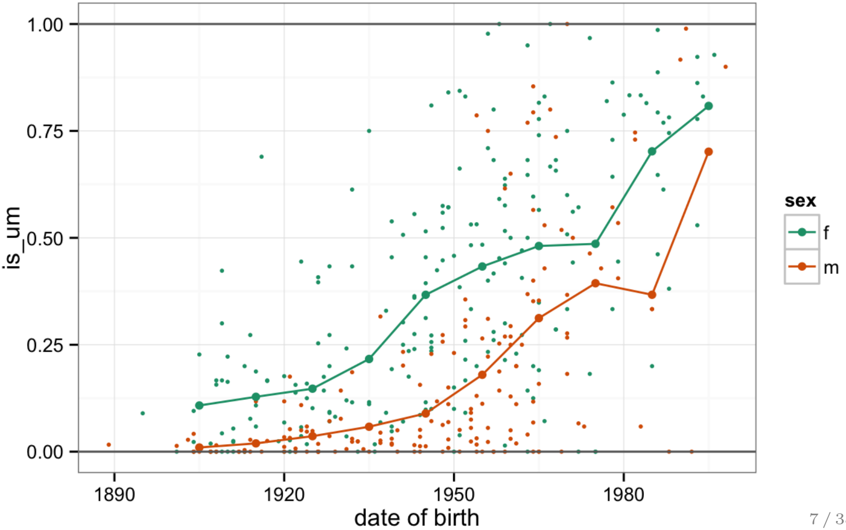
Sex and Change from Below, /uw/ (Fruehwald, 2013)

$\text{n}_{speakers} = 308$, $\text{n}_{vowels} = 16232$



Sex and Change from Below, *um* (Fruehwald, p.c.)

$n_{speakers} = 308$, $n_{tokens} = 25514$



Labov (2001)

1. New variant initially spreads among women, by chance.
2. All children get most of their linguistic input from women caregivers.
3. Men in pre-adolescence retreat from women-led changes, so as to distinguish themselves socially.
4. The change increments in each generation (reason unknown), with men staying behind women (and still retreating??).

Labov entertains two possible biological possibilities, but dismisses them: one based on sexually dimorphic verbal ability, and another which only applies to vowels.

[u:] vs. [ʌʉ] (Smith et al., 2007)

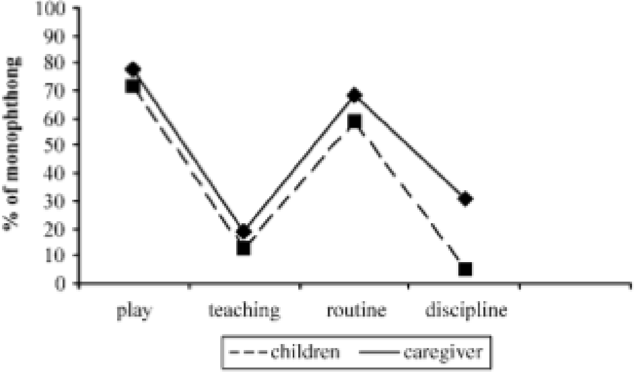


FIGURE 4. % of monophthong by situational context.

Eckert (2011)

1. New variant spreads anywhere in the population.
2. In pre-adolescence, women figure out which is the new variant.
3. Women adopt more of the new variant to distinguish themselves as "trendy", "flamboyant", in the "heterosexual marketplace".
4. Change increments in each generation because women continue this bias.

Problems with Labov, Eckert

- Even though there's a proposed psychological and/or social effect, the mechanism for it is unexplained; except:
  - Labov implicates men in retreating.
  - Eckert implicates women in pushing change forward.
- Neither clearly explains what's pushing the change forward, though Eckert tries (but maybe we'll never know).

Problems with Labov, Eckert

- Both imply some social awareness of the change as a whole and its trajectory, but this effect specifically shows up in Changes from Below.
- Also, while the effect is significant, the size of the effect is so small that it may not be effective social signaling (in an information theoretical sense) of any kind, especially towards the middle of the change (Fruehwald, *to appear*).
- **Prediction:** men should be 1 generation behind if they run away in 1st generation, or if women drive the change itself (which might be true). Men should be increasingly more behind if they run away many times.

Blind Social Network (Bloomfield)

1. Change spreads in women first, by chance.
2. Men jump on board at the same rate, and they never catch up.
3. The change increments in each generation for unknown reasons.

- Possible problem with acquisition, from caregiver data.
- Must assume that there is no real trend for women to lead change from below.
- Prediction: men should be 1 generation behind or less (?), with the lag remaining constant.

A socio-biological model

Theory: one effect of hormonal organising effects is on how people learn socially from models of different sex/gender.

- Learning from social models differs by gender (and so is roughly sexually dimorphic).

1. Change spreads anywhere first, by chance, driven by an unknown factor (but **note** Kevin Stadler's work).
2. Women copy women more than men copy anyone.
3. Women increment the change at a rate determined by the unknown factor, while men miss the incrementation some of the time.
4. Men should be increasingly behind in each generation, showing a different rate of change.

A socio-biological model

- **Hypothesis:** the difference should show up not only between different sex (genetic, genital, or assigned-at-birth) cohorts, but also within them by gradient gender.

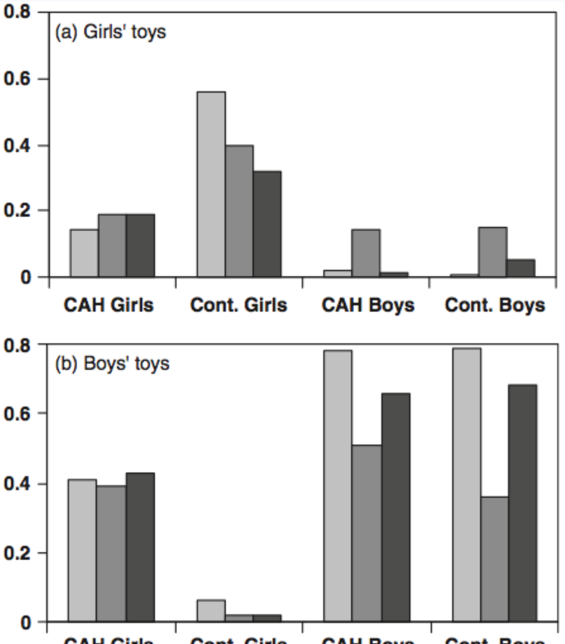
CAH women

- Congenital Adrenal Hyperplasia: genetic disorder which inhibits the synthesis of cortisol, which causes the adrenals to secrete high levels of androgens, e.g. T.
- CAH women have measurably high levels of pre-natal T, and often partially masculinized genitalia (Pasterski et al., 2005; Balthazart, 2011, and refs therein).
- Socialized as women.
- Usually receive hormone replacement therapy and other treatment upon birth, so circulating androgens and estrogens are like non-CAH women.
- A number of studies have shown CAH women to show more masculine-typical behaviours from childhood into adulthood, including adult gender-identity and sexuality (see Hines, 2006; Balthazart, 2011, for reviews).

Pasterski et al. (2005)

Study Design

- Compares CAH women and CAH men to control **siblings**, between 3-10 years old: 34 females and 31 males with CAH, 27 unaffected sisters and 25 brothers.
- Children allowed 8 minutes free play with various male-typical and female-typical toys (first 6 minutes scored for toy choice).
- CAH women's play was significantly different from all men and control women.
- In short, with the scores converted to ratios of "girls' toys" / all toys...


(a) Girls' toys
0.8
0.6
0.4
0.2
0
CAH Girls
Cont. Girls
CAH Boys
Cont. Boys
(b) Boys' toys
0.8
0.6
0.4
0.2
0

ALSPAC Study (Hines et al., 2002)

Study Results

- Avon Longitudinal Study of Parents and Children (Team et al., 2001)
- A maternal blood sample was taken from gestational weeks 5-36, though they targeted 16-20
    - 55% between weeks 8-24
    - 24% between weeks 5-7
    - 21% between weeks 25-36
- Assays for T and sex hormone-binding globulin.
- Pre School Activities Inventory (PSAI); at age 3.5, parents score children's various gender-related behaviors from 1-5

ALSPAC Study (Hines et al., 2002)

Study Design

- PSAI scores were used to select 6 groups of children for T and SHBG assays:
  - 128 boys, 113 girls with the most masculine (highest) PSAI scores for their sex cohorts.
  - 112 boys, 118 girls with the most feminine (lowest) PSAI scores for their sex cohorts.
  - 102 boys, 106 girls randomly selected from remainder of cohorts.

ALSPAC Study (Hines et al., 2002)

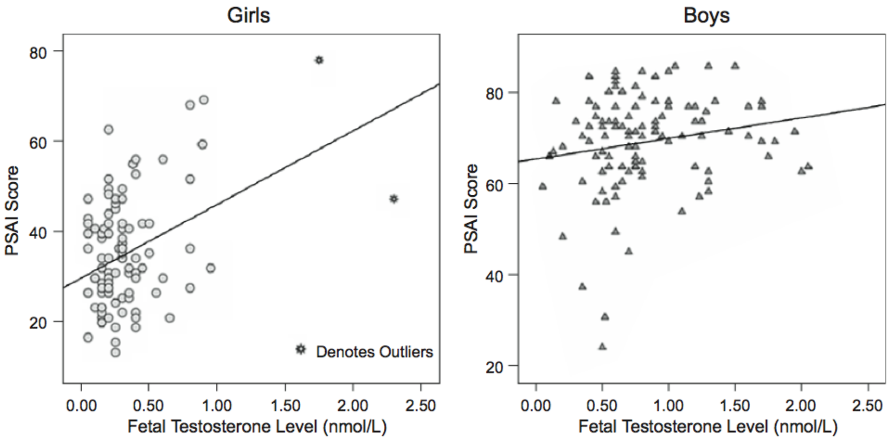
Summary of Results

- one-way ANCOVA within *girls* indicated significant relationship between T and PSAI group, F(2, 310) = 5.80, p = 0.003, with a significant linear trend (F(1, 328) = 7.39, p = 0.001) of increasing PSAI (by group) with increasing T.
- No significant effect of SHBG.
- No significant effect of T or SHBG within *boys*.
- **Interpretation:** maternal T during gestation affects gender role behaviour in 3.5-year-olds, but:
  - The effect is unobservable in men because it's overwhelmed by fetal T produced by the testes
- Not entirely sure how I feel about the statistical procedure here, but I believe there is an effect, if small and noisy (probably partly due to the rough PSAI instrument).

Auyeung et al. (2009)

- Confirmed Hines et al's results in a more controlled study: predicting PSAI with amniotic fluid samples all within gestation weeks 11-21.
- 112 male, 100 female.

Auyeung et al. (2009)



Social Learning

- Because of the possibility of more direct experimental manipulation, animal studies showing the behavioural results of hormonal organising effects make the human studies more convincing.
- There are lots of non-human studies showing the result of hormonal organising on brain morphology (e.g. in rats, going back to Gorski et al., 1978), sexuality (many references in Balthazart, 2011, Chapts. 3-4), and birdsong (see Balthazart et al., 2009, for an overview).
- There's less explicitly on the effect of hormonal organising on social learning, though this may be implicit in the human studies above, and implicit in the birdsong literature (though these do not always distinguish learning from production).

Mansukhani et al. (1996)

Study Design

- Pair-bonding preferences in female zebra-finches, who partner for life.
- Not the same as mating-preferences, which have been investigated in a number of species; presumably more related to social learning.
- 30 females, in two conditions: raised in all-female aviaries vs. mixed aviaries, and treatment with estradiol benzoate (synthetic estradiol) vs. no treatment
    - All subsequently given hormone treatments to equalize adult circulating hormone levels.

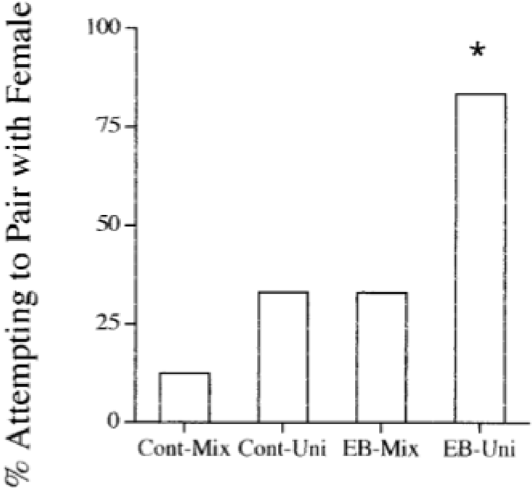
Mansukhani et al. (1996)

Results

- Significant effects of EB treatment on plumage, singing, dancing, and mounting behaviours in choice tests.
- However, EB treatment only significantly affected pair-bonding behaviours in colony tests **with females also raised in all-female aviaries**.
- **Interpretation:** the masculinizing, organisational effect of estradiol affected the process of learning suitable models for pairing.
- The brain structures affected must be implicated in social learning, beyond directly instinctual behaviours (e.g. mounting, dancing (?))
  - The singing data is ambiguous, since it must be learned, but we don't know which part of the song system has been changed here (see Balthazart et al., 2009).

Mansukhani et al. (1996)

Results



Hines' social learning

- Some unpublished experimental evidence suggests (Balthazart p.c., citing Hines 2012):
  - Non-CAH women tend to mimic female models in an artificial social learning task.
  - (non-CAH) men are not significantly affected by any models in the same task.
  - CAH women are similarly unaffected, and not distinguishable from male participants.

Future Study

- A sample of 200 participants from ALSPAC
- Assays for maternal T and estradiol. (To the extent possible, we will sample the same participants studied in Hines et al. 2002).
- Standard sociolinguistic interview procedures (Tagliamonte, 2006); about an hour of speech per participant.
- Semi-automatic extraction of changes in progress from transcribed audio:

Future Study

- Nice categorical change from below: *um/uh*
- Some below-consciousness phonetic and phonological variables (maybe production and perception), such as:
  - /uw/-fronting
  - Pre-aspiration
  - Amount of coarticulation across word-boundaries
  - ultrasound /r/
  - VOT?
- Maybe a more stable, sociolinguistically sensitive variable, e.g. h-dropping?
- If possible, a syntactic variable (relative clause extraposition?; Wallenberg *to appear*)
- Some self-report gender identity measures.
  - Worth seeing if there are openly gender-nonconforming people in ALSPAC.

Future Study: Hypothesis

If linguistic variables are learnt differentially depending on how masculinised brain structures have been by pre-natal androgen levels, then:

- Within a given sex cohort (i.e. genital-sex, or sex designated at birth), more advanced linguistic variants correspond to lower levels of pre-natal T, and perhaps other androgens (esp. women).
- If the gender effect in language is purely social, then we should see no effect of hormones within each sex (only between sexes).

Conclusions

- There's no clear explanation of the linguistic effects in "purely social" terms, though there are a few ideas.
- Biological explanations have generally been dismissed.
- Hormonal organising action suggests a partly biological, partly social model, with the following properties:
  - It could explain both sex/gender effects based on independently attested mechanisms.
  - The view of gender is interestingly non-binary or gradient, which tallies with people's self-reports of gender identity.
- Though we'd like more independent data on social learning, this study could provide additional evidence.
- Linguistic productions could be a more precise measure of social learning, than rougher questionnaire and experimental techniques.

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The socio-biological model

(Version 2; based on Kevin Stadler's work)

- **Theory:** one effect of hormonal organising effects is on how people learn socially from models of different sex/gender.
- Learning from social models differs by gender (and so is roughly sexually dimorphic).

1. Women copy women more than men copy anyone.
2. The change arises because women sampling finite utterances from women perceive a change.
3. There's systematic overshoot in women's productions as they try to copy, in the direction of a perceived trend, which drives the change.
4. Men should be about one generation behind (?).