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Vocal strategies to signal biological fitness in public speaking

a study on the effects of aging in American English charismatic speech

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Content

Research field and theories

- Voice as Indicator of Biological Fitness
- Vocal Attractiveness in Political Leadership
- Acoustic Changes in Voice With Aging

Experimentation

- Aging Voice and Attractiveness
- F0 and SPL Changes With Age
  - Cross-Sectional Study
  - Longitudinal Study
- Discussion
- Conclusion

Voice

Indicator of biological fitness

- Voice is a behavior (signal) that conveys the vocalizer's identity (cue)

- Signal

  - Act or structure that affects the behavior of other organisms

    - Evolved because of that effect

    - Effective because the receiver's response also evolved

- Cue

  - Feature of the world, animate or inanimate

  - Used by an animal as a guide to future action

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Vocal Attractiveness
Political Leadership

- Fitness

- Gender

- Ethnicity

- Language

- Personality

- Emotions

- Culture

- Philosophy

- Political Background

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Vocal Attractiveness in Political Leadership
The role of f0 and SPL

- The variety of things is source of joy and pleasure (Cicero, De Natura Deorum, 1, 9, 22)

- Orators diversify

  - f0

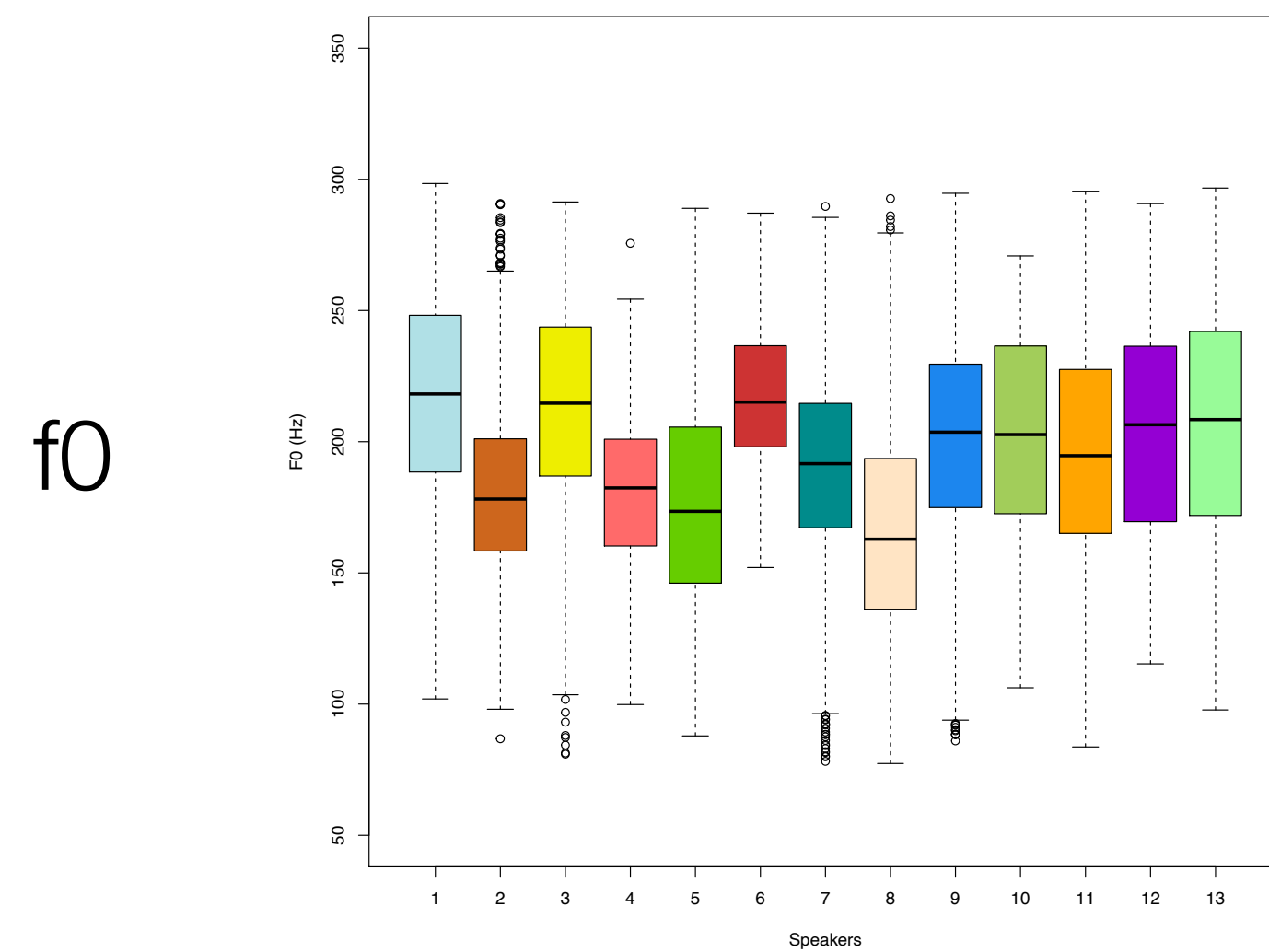 - Intensity

Vocal Attractiveness in Political Leadership

f0 (Hz)

Speaker	Gender	Language	MON	CON	INT	Kruskal-Wallis
Clinton	F		218	188	175	$H(2)=196.69, p<.001$
Fiorina	F		206	186	148	$H(2)=169.23, p<.001$
Obama	M	American English	217	182	112	$H(2)=317.88, p<.001$
Sanders	M		201	181	138	*ns*
Trump	M		195	183	136	$H(2)=288.18, p<.001$

Source: Signorello, R., Demolin, D., Henrich-Bernardoni, N., Kreiman, J., Gerratt, B. R., and Zhang, Z., *Journal of Voice* (2021).
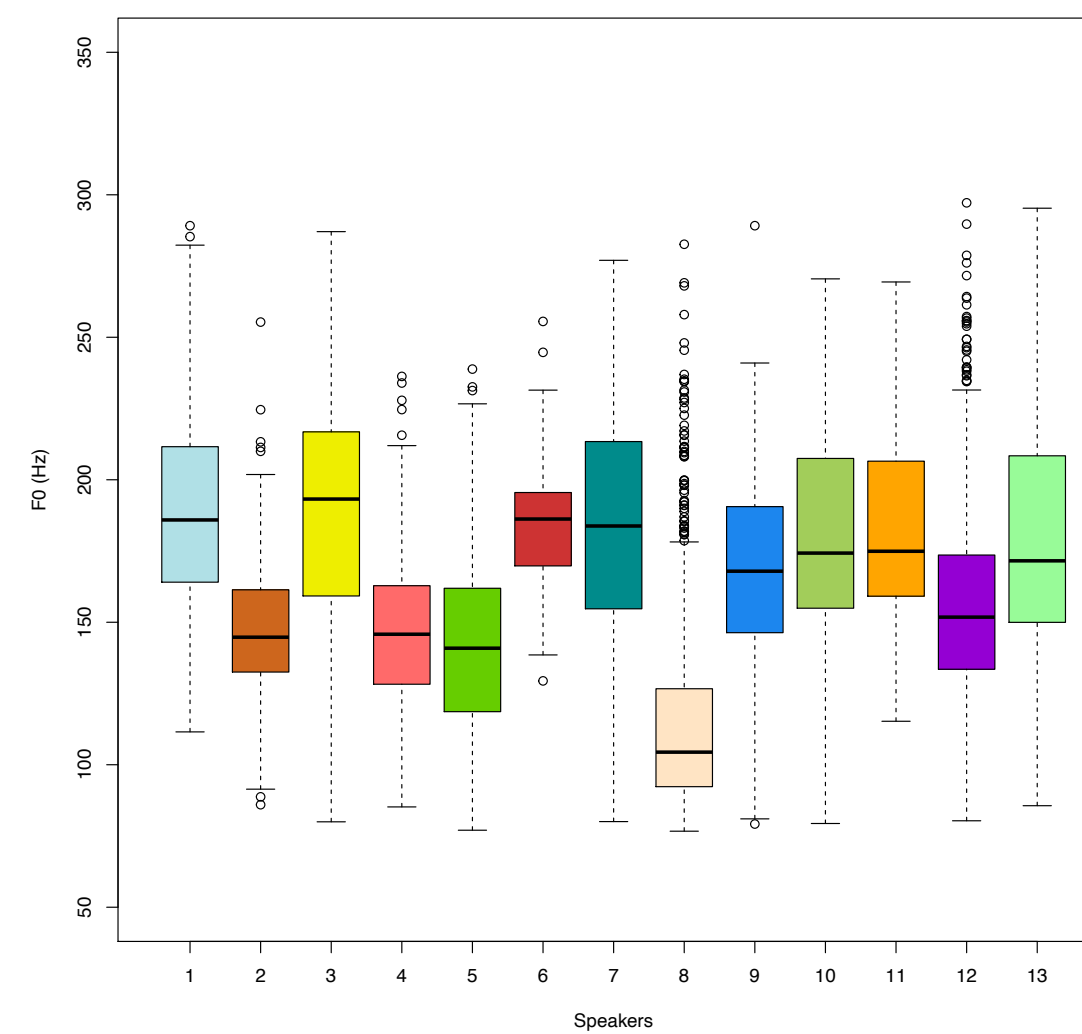
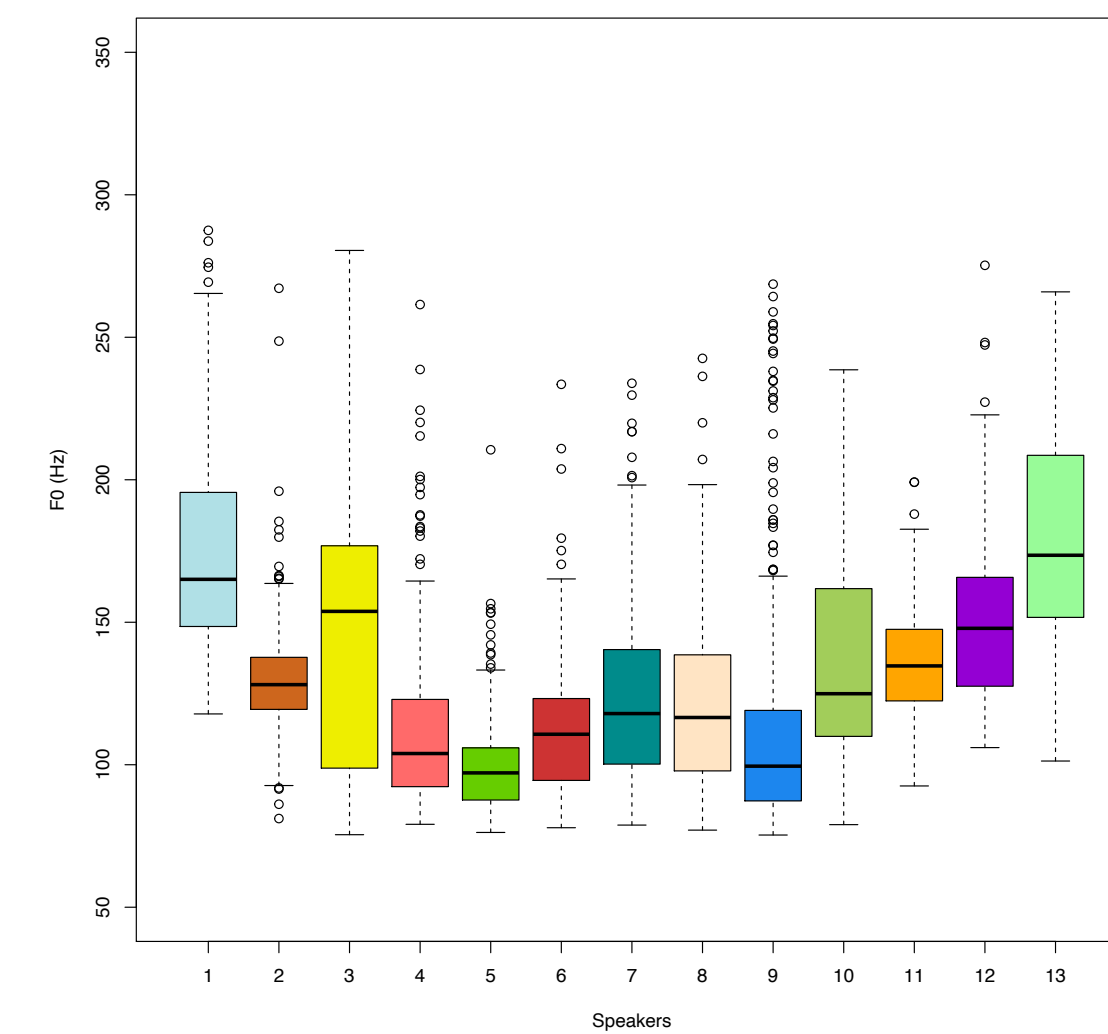# Vocal Attractiveness in Political Leadership

f0 (Hz)

Speech to Followers (MON)   Speech to Peers (CON)   Interview (INT)

f0

1) Clinton; 2) de Magistris; 3) Fiorina; 4) Hollande; 5) Lula; 6) Obama; 7) Sarkozy; 8) Serra; 9) Veltroni; 10) Sanders; 11) Trump; 12) Moon; 13) Park

Vocal Attractiveness in Political Leadership

f0 range (semitons)

Speaker	Gender	Language	MON	CON	INT	Kruskal-Wallis
Clinton	F		18.93	14.57	11.21	*ns*
Fiorina	F	American English	20.6	18.59	16.01	*ns*
Obama	M		14.62	7.02	4.35	$H(2)=11.22, p=.003$
Sanders	M		13.48	3.12	2.59	*ns*
Trump	M		20.44	13.92	7.85	$H(2)=16.45, p<.001$

Source: Signorello, R., Demolin, D., Henrich-Bernardoni, N., Kreiman, J., Gerratt, B. R., and Zhang, Z., *Journal of Voice* (2021).

Vocal Attractiveness in Political Leadership

SPL (dB)

Speaker	Gender	Language	SPL$_{rel}$ (dB)			Kruskal-Wallis
			MON	CON	INT	
Clinton	F	American English	13	11	9	$H(2) = 30.27$, $P < 0.0001$
Fiorina	F		11	9	8	*ns*
Obama	M		9	8	7	$H(2) = 20.15$, $P < 0.0001$
Sanders	M		9	7	3	*ns*
Trump	M		13	11	10	*ns*

Source: Signorello, R., Demolin, D., Henrich-Bernardoni, N., Kreiman, J., Gerratt, B. R., and Zhang, Z., *Journal of Voice* (2021).

Acoustic changes in voice with aging

Acoustic changes in voice with aging

Modal Voice

f0

SPL

Source:
Kremain and Sidtis, 2011, p. 114

Table 4.1 Acoustic changes in voice with aging.

Infants/Children	Adults < 60	Adults > 60
F0 is high; male/female differences emerge	F0 decreases with age	F0 decreases with age for females, but increases for males
Pitch range is wide; remains constant after infancy	Pitch range fairly constant	Pitch range fairly constant, but center frequency may shift downward
Formant frequencies are high; male/female differences begin to emerge by age 4	Formants frequencies lower; large male/female differences in formants	Formant frequencies continue to lower
Control of phonation is poor; hoarseness	Phonation is stable	Phonation becomes somewhat less stable; hoarseness/breathiness
Control of loudness is poor	Good control of loudness	Loudness may increase or decrease
Speaking rate is slow initially, but increases with age	Fast speaking rate	Speaking rate declines (due to more frequent breaths)

Acoustic changes in voice with aging

Disordered Voice

	1994					2011		
PAR. AC.	*loc-mod*	Ass	Inc	Que	*loc-dys*	Ass	Inc	Que
Fo-μ	178.89	152.62	225.51	138.28	120.20	116.77	142.02	117.93
Fo-min	101.84	95.25	107.74	96.07	91.78	86.64	86.2	90.56
Fo-max	241.10	210.94	270.36	189.39	155.99	146.45	182.08	192.99
Fo-sd	‡	12.40	38.58	27.98	‡	10.74	38.58	15.54
Fo-rng	‡	13	16	11.72	‡	9	12	13
I-μ	‡	66	68.29	68	‡	67.90	74	68.01
I-min	‡	45.93	46.94	45.03	‡	53.32	62.04	56.35
I-max	‡	72.50	73.65	72.08	‡	86.68	89.05	84.77

f0 (rows Fo-*), SPL (rows I-*)

Source: Signorello, R., Ph.D. Thesis (2014)

f0 and SPL changes with aging

Cross-sectional study:
Chronological age
≠
fitness age

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f0 and SPL changes with aging
Chronological age ≠ fitness age

- Speakers
  - Hillary Clinton (62 y.o.)
  - Carly Fiorina (60 y.o.)
  - Bernie Sanders (c.a. 76 y.o.)
  - Donald Trump (c.a. 71 y.o.)
  - Barack Obama (c.a. 56 y.o.)

- Communication contexts
  - Monologue (MON)
  - Rally (CON)
  - Interview (INT)
- Stimuli
  - /a/ vowels
- Measurements
  - f0 (range in semitones)
  - SPL (relative range in dB)

Chronological age ≠ fitness age
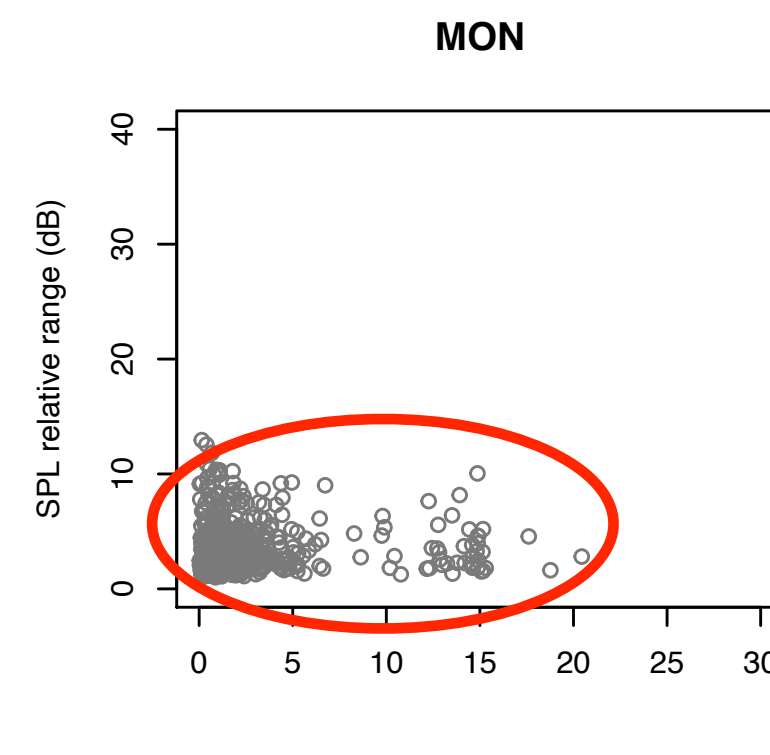
Different chronological age
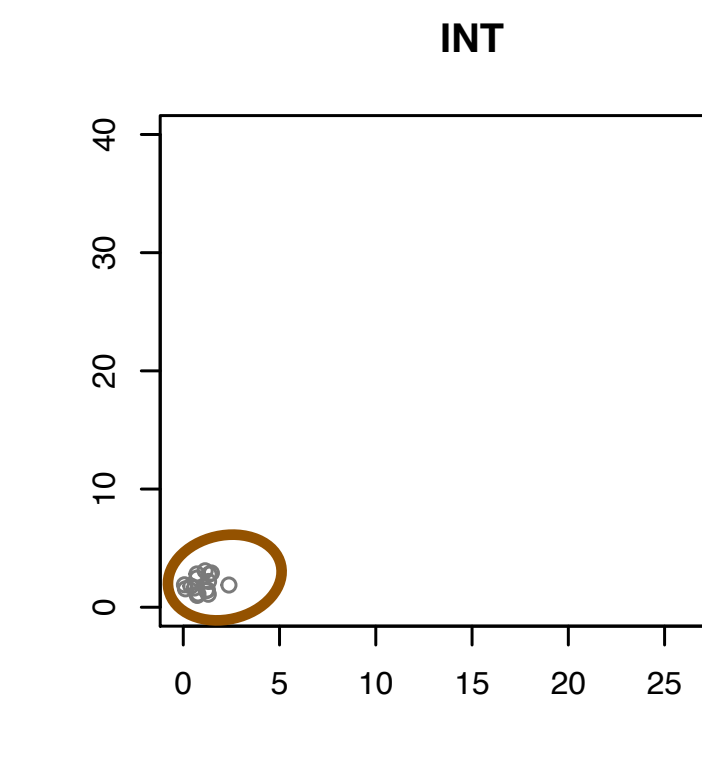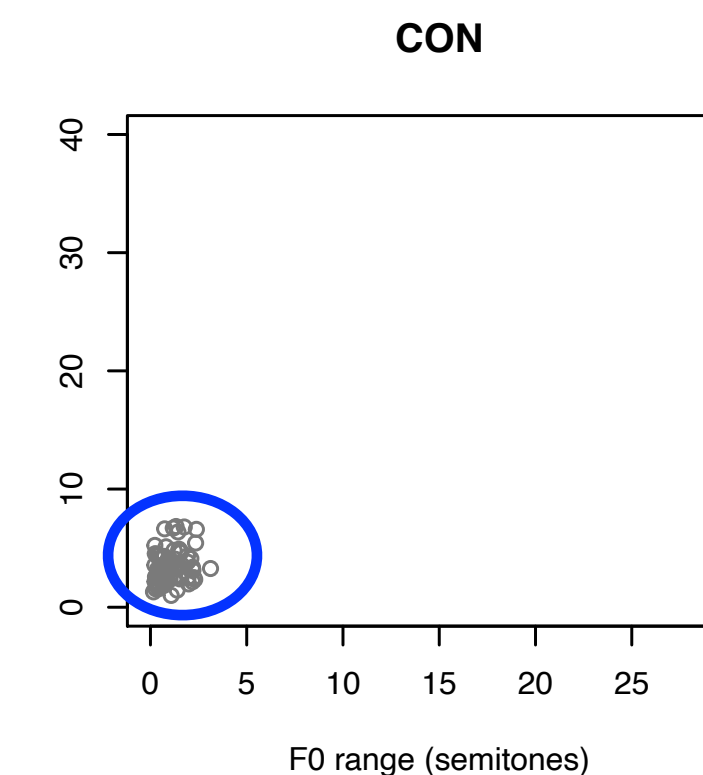

56 y.o.
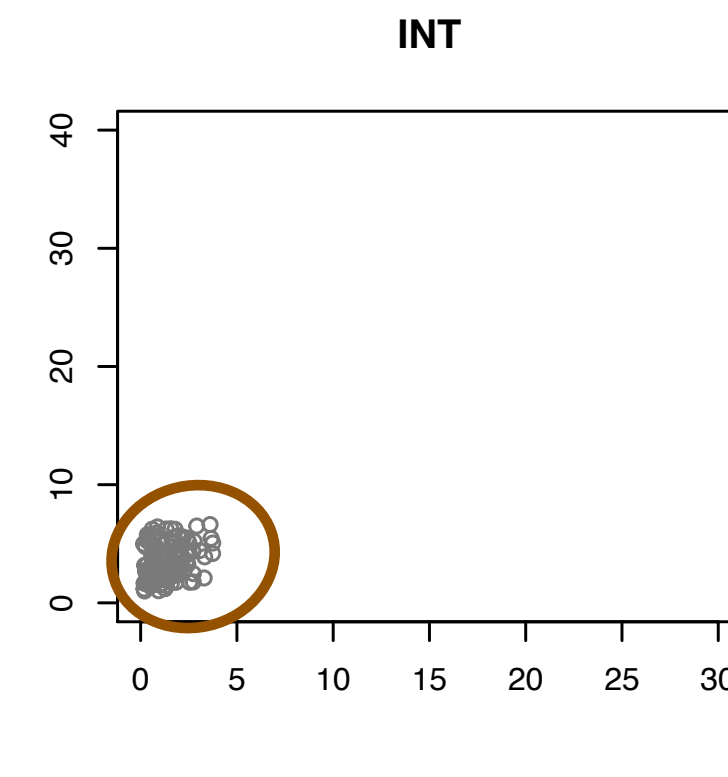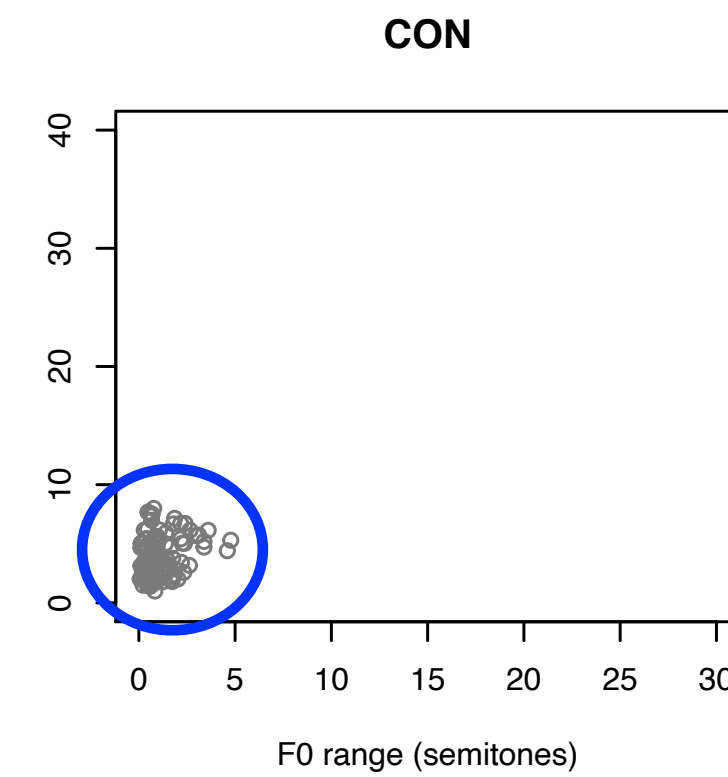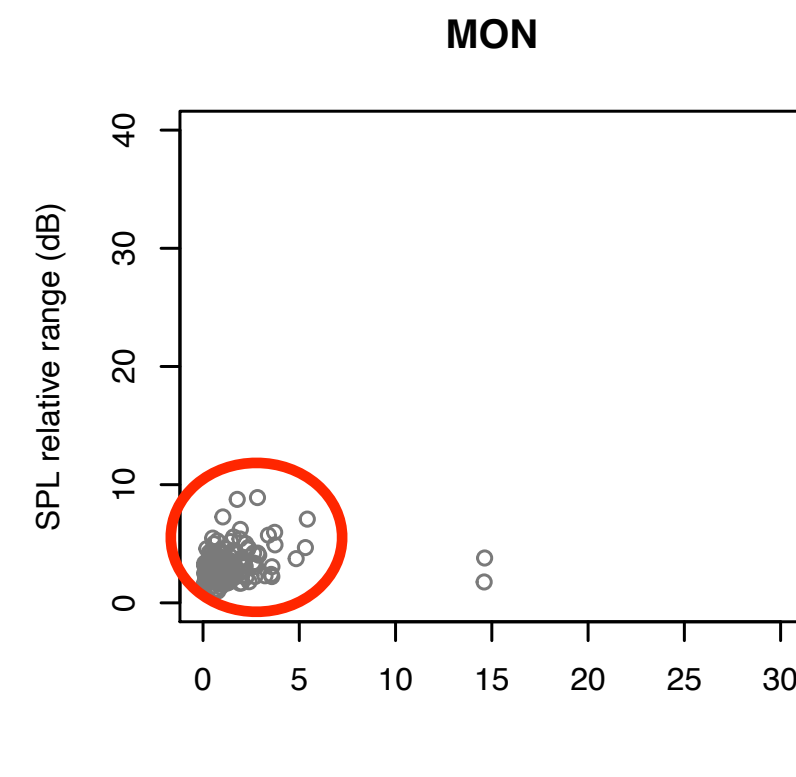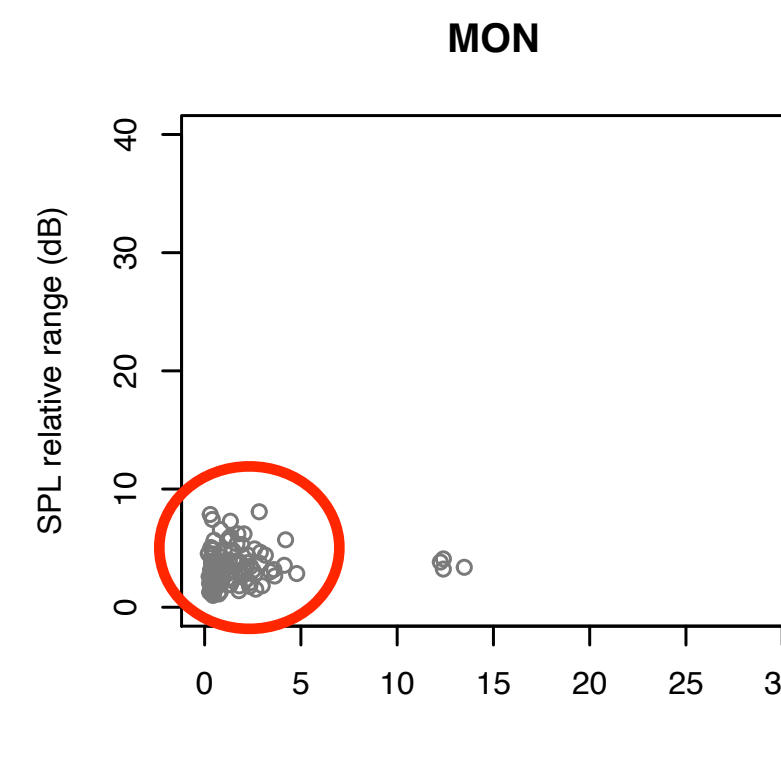
76 y.o.
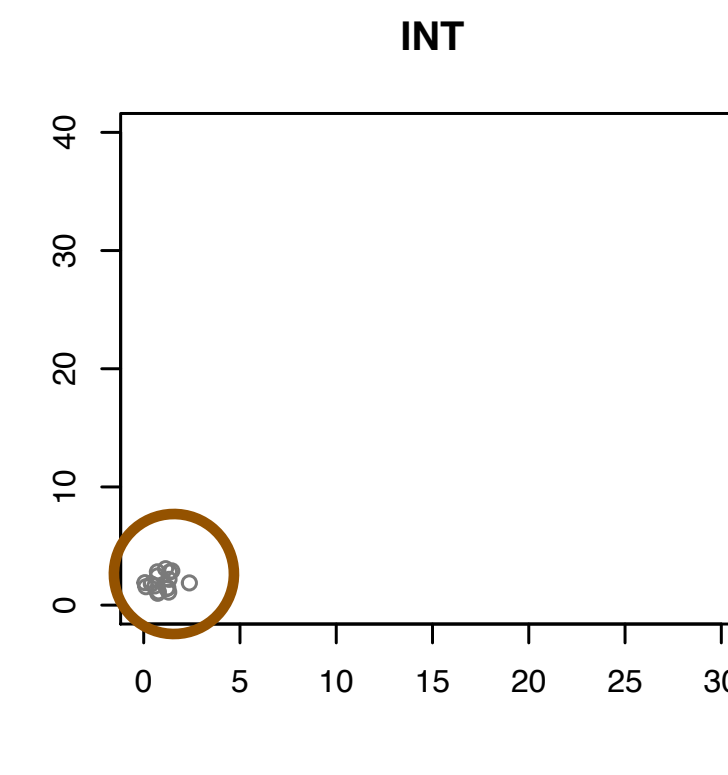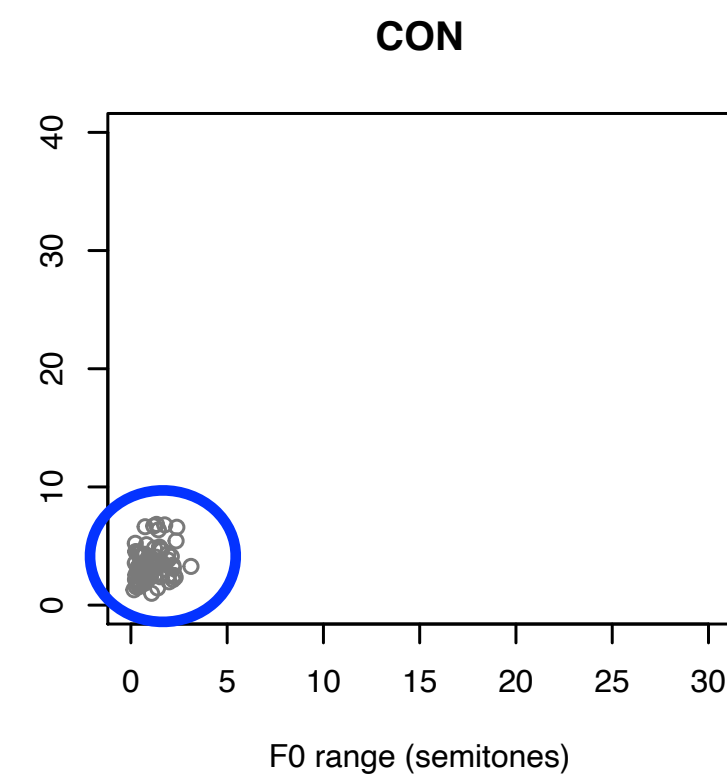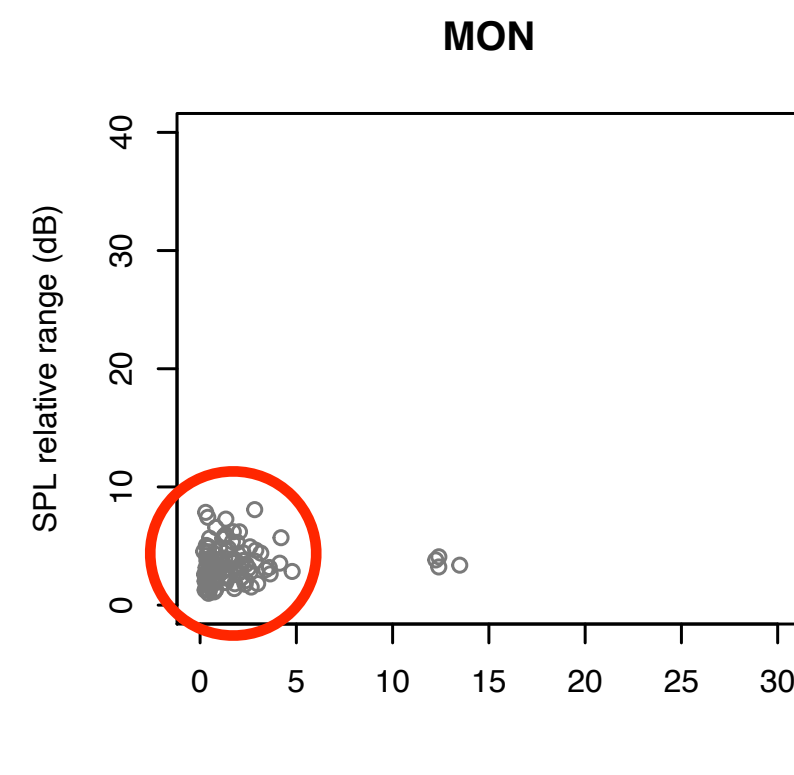
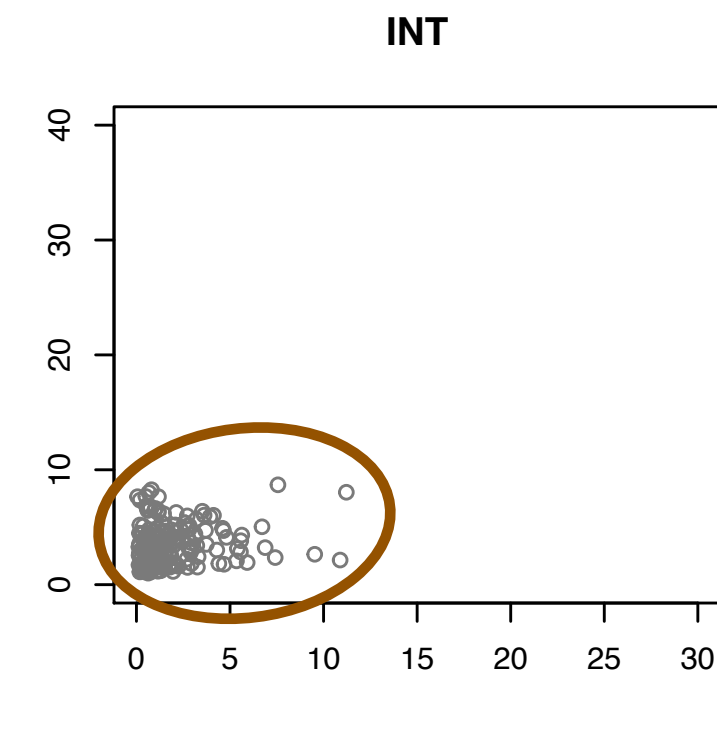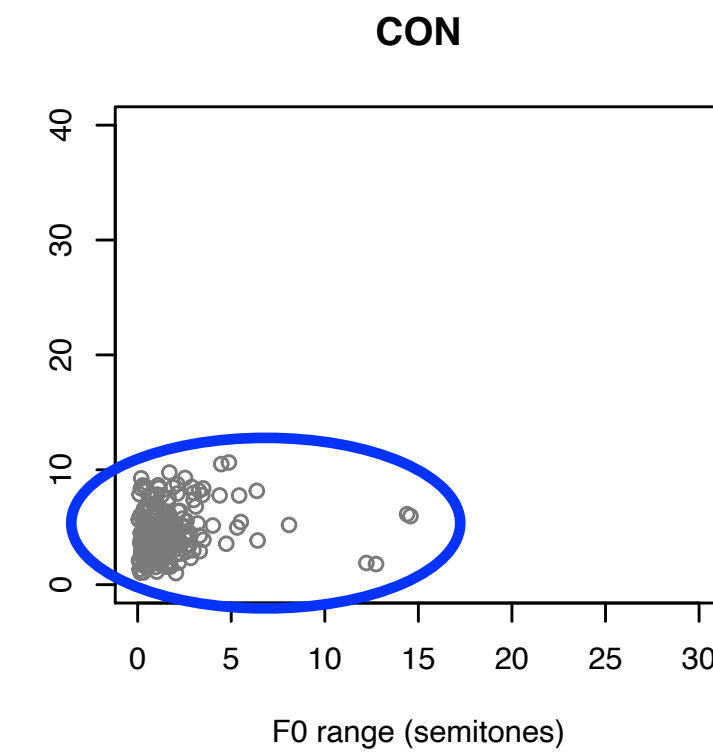# Chronological age ≠ fitness age

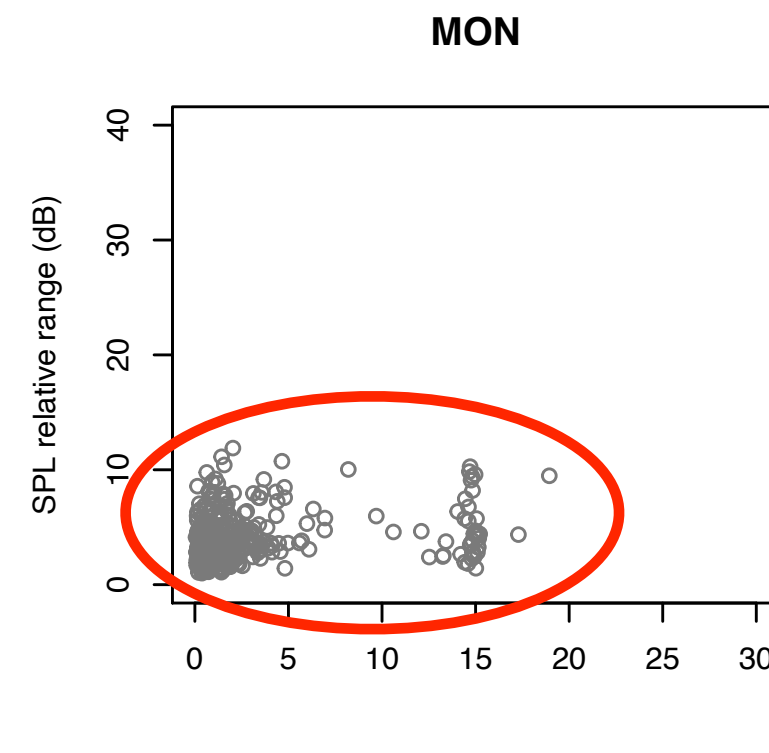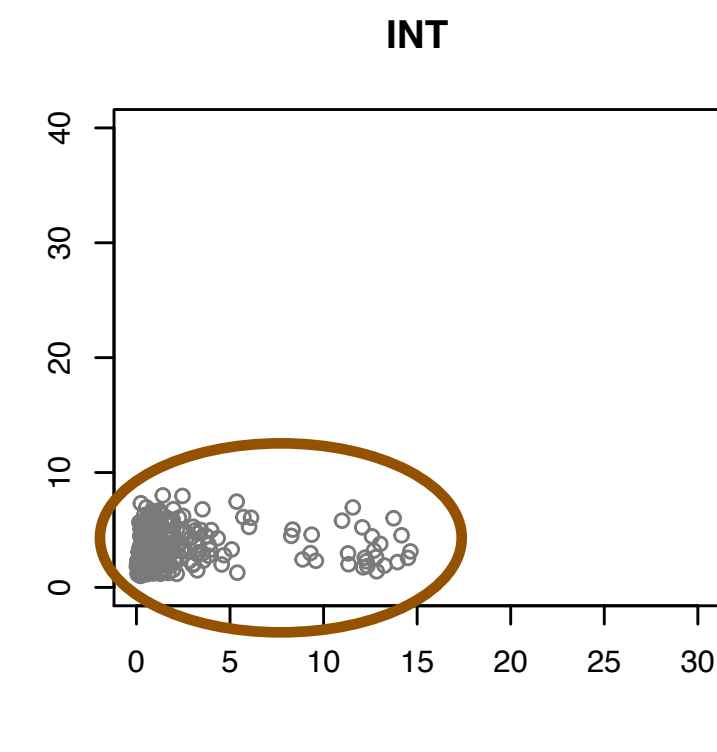## Similar chronological age

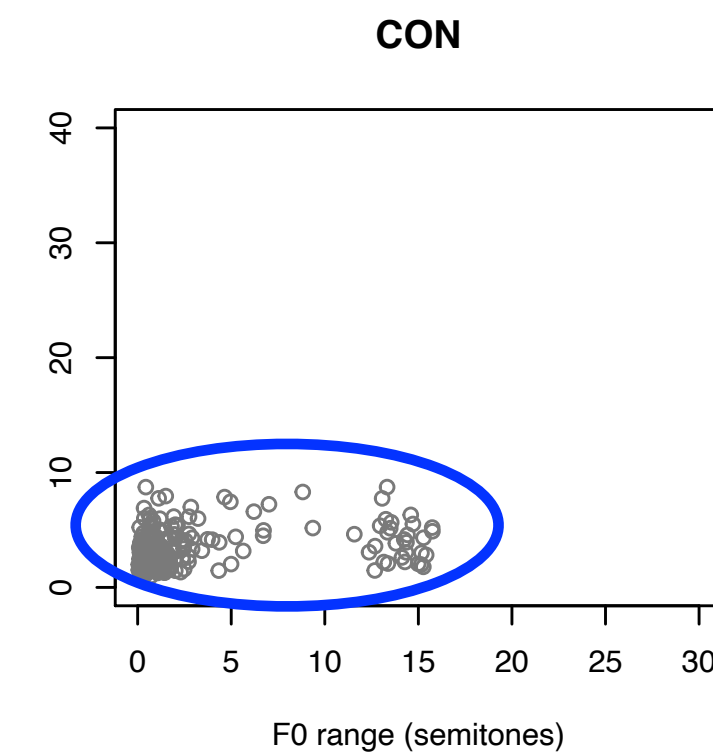
71 y.o.
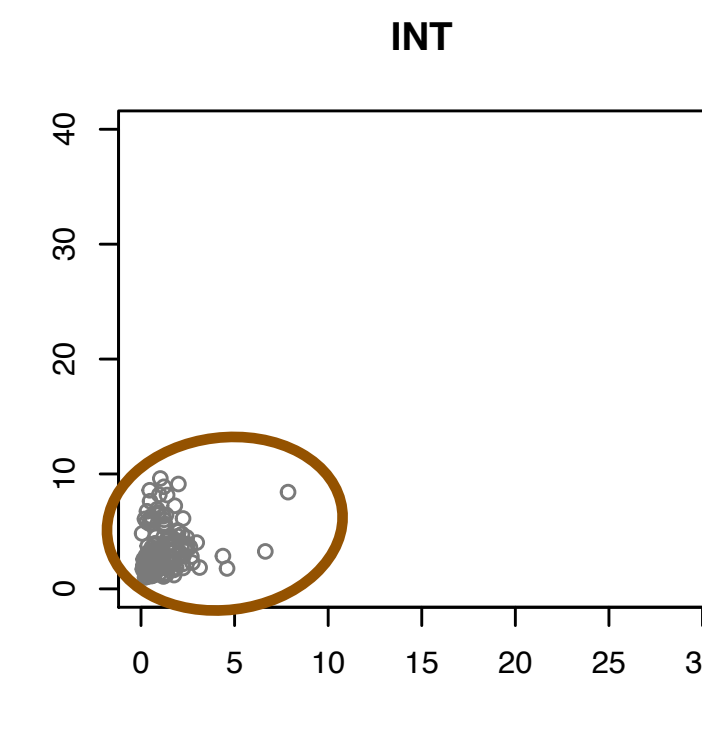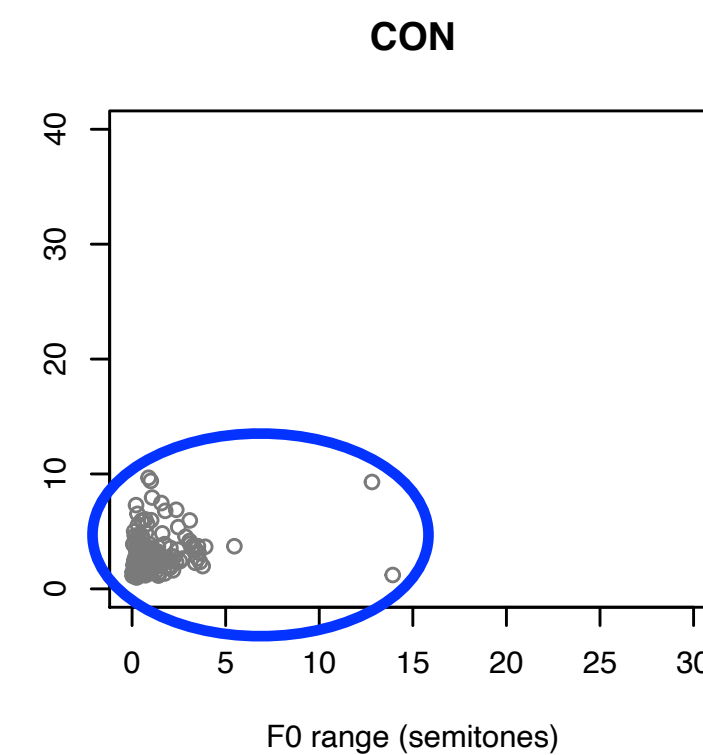
76 y.o.

Chronological age ≠ fitness age

Similar chronological age

62 y.o.

60 y.o.
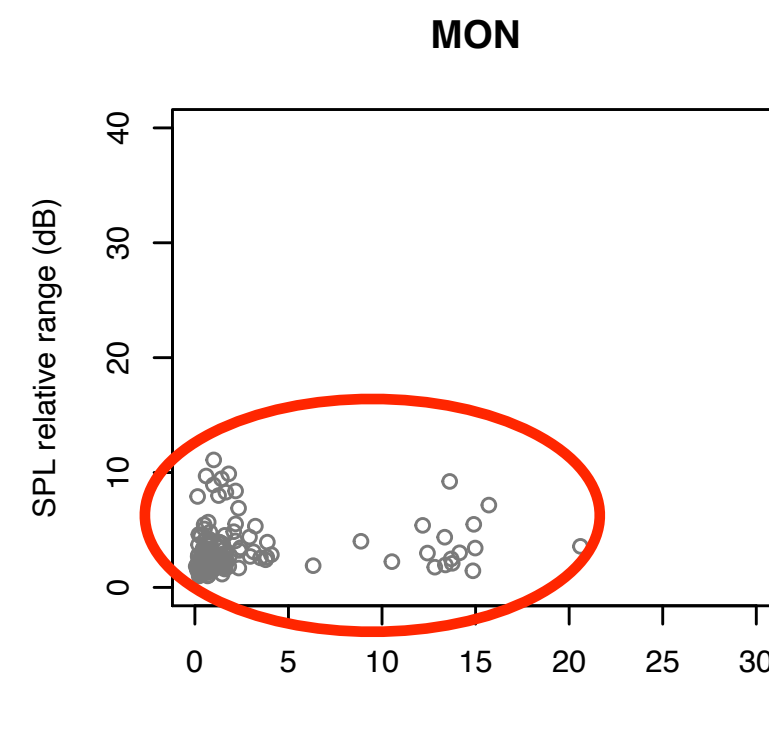
Chronological age ≠ fitness age

Correlation between F0 and SPL as signal of fitness?

Speaker	$\text{F0}\mu/\text{SPL}_{\text{abs}}$ correlations		
	MON	CON	INT
Clinton	$t(443)=8.15, p<.001, r=.36$	$t(267)=8.06, p=.003, r=.17$	$t(223)=3.76, p<.001, r=.24$
Fiorina	$t(148)=5.25, p<.001, r=.39$	$t(304)=8.06, p<.001, r=.41$	$t(390)=7.36, p<.001, r=.34$
Obama	$t(149)=6.27, p<.001, r=.45$	$t(121)=5.52, p<.001, r=.44$	$t(161)=4.97, p<.001, r=.36$
Sanders	$t(113)=2.94, p=.003, r=.26$	$p>.05$	$t(29)=7.89, p<.001, r=.82$
Trump	$t(952)=16.44, p<.001, r=.47$	$t(157)=5.03, p<.001, r=.37$	$t(172)=8.36, p<.001, r=.53$

Vocal disorder and perceived aging

Longitudinal study:
Vocal disorder
–
chronological age

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Vocal disorder and perceived aging
Perceived chronological age

- Speaker: Lula, 66 y.o.

- 4 stimuli

  - Pre condition -1 (- 6 months)

  - Condition 0

  - Post condition 1 (+ 6 months)

  - Post condition 2 (+ 6 months)

- Perception of age

  - 12 French speaking listeners

  - no knowledge of Portuguese

Perception de la qualité de voix 01 - pilot

Quel est l'âge du locuteur ?

Faites glisser le curseur pour choisir l'age perçu

Vocal disorder and perceived aging

Perceived chronological age

	Pre condition	Severe Disorder	Mild Disorder	Rehabilitated voice
	- 6 months	0	+ 6 months	+12 months
average	53	60	53	58
median	54,5	61,5	52	57,5
min	33	30	44	52
max	65	77	65	72

Discussion

f0 and SPL changes with aging
Chronological age ≠ fitness age

- f0 and SPL

  - Signals not able to convey a precise cue related to age

- Difficult to distinguish speakers':

  - Chronological age

  - Fitness age

- Vocal attractiveness and charisma are not only based on perceive biological fitness

  - f0 conveys social cues too

f0 and intensity changes with aging
Chronological age ≠ fitness age

- One-to-many charismatic speech (MON and CON)

  - Large f0 and SPL ranges

  - Positive and high correlation between f0 and intensity

- Could be a signal of lower chronological age

  - Even in discrepancy with actual age

- Could be a signal of high biological fitness

- Could be a positive predictor for vocal attractiveness and effective charismatic leadership

f0 and intensity changes with aging
Chronological age ≠ fitness age

- One-to-many charismatic speech (MON and CON)

  - Narrow f0 and SPL ranges

  - Weakly positive (or negative) correlation between f0 and SPL

- Could be a signal of higher chronological age

  - In accord with actual age

- Could be a signal of low biological fitness

- Could be a negative predictor for vocal attractiveness and effective charismatic leadership

f0 and intensity changes with aging
Chronological age ≠ fitness age

- One-to-one speech (INT)

  - Lower f0

  - Narrow f0 and SPL ranges

- Positive and high correlation between f0 and intensity

- As a biological signal
  - High biological fitness
  - Danger, size, mating
  - Could be a positive predictor for vocal attractiveness and effective charismatic leadership
- As a social signal
  - Could show advanced chronological age (in accord with actual age)
  - Low biological fitness
  - Could be a negative predictor for vocal attractiveness and effective charismatic leadership

Vocal disorder and perceived aging

Effective in assessing perceptually of how much someone has aged
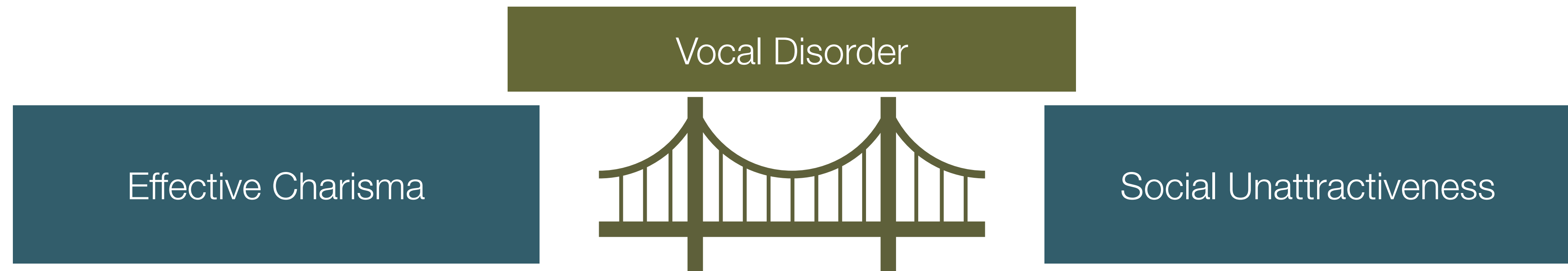
Vocal disorder and perceived aging
Impairs politicians' vocal attractiveness

- Flat f0 contour

- Reduced vocal f0 range

- Increased intensity

- Voice hoarseness

- Longer pauses

  - Convey hesitation

Vocal disorder and perceived aging
A possible career-ending factor for politicians

- Perceived aging in a voice

  - Weak biological fitness

  - Not reliable leadership

- Cultural misunderstanding of leaders' psychological traits

  - Stereotyped personality traits

  - Triggered emotions in listeners differ from leaders' goal

- Unexpected voting preference

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Thank you!

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