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für empirische Ästhetik

Do you sing in tune?

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Perception of pitch accuracy when listening to sung melodies

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Does Marilyn sing in tune?

Musical errors

Contour error

Interval error

Tonality error

Sensitivity from early age and perception in adults: e.g., Dowling & Fujitani, 1970; Edworthy, 1985; Ferland & Mendelson, 1989; Hannon & Trainor, 2007; Gooding & Stanley, 2001; Plantinga & Trainor, 2005; Stalinski et al., 2008; Trainor & Trehub, 1992

Musical errors

166 performances

http://sldr.org/sldr000774/en

Computer
assisted method

3 criteria

Judges

1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9
Out of tune In tune

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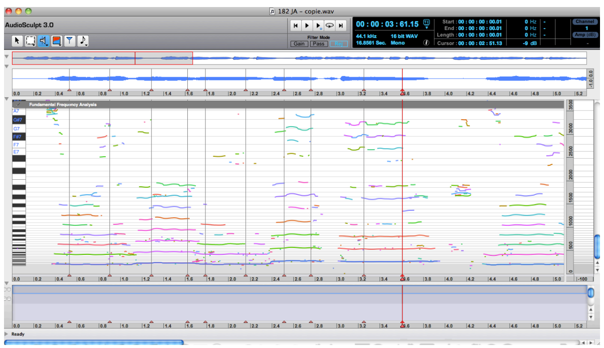
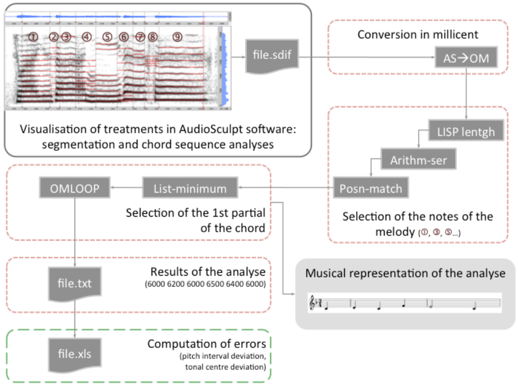
Musical errors - Judges

	Experts	Non experts
n	18	18
Gender	8 women	8 women
Age	*M* = 29.89; *SD* = 14.47	*M* = 33.06 ; *SD* = 9.57
Expertise	5 professional musicians 5 professional singers 4 music students 4 speech therapists	___
Musical or vocal practice	OK	___
Audiometry	___	OK
MBEA (Peretz et al., 2003)	___	OK
Production task « Happy Birthday »	___	OK

Musical errors - Computer assisted method





Manual segmentation

AudioSculpt (Ircam)

F0 information

AudioSculpt and OpenMusic (Ircam)

Quantification of errors

Excel (Microsoft)

Larrouy-Maestri & Morsomme (2013), *Logopedics Phoniatrics Vocology*.

Musical errors - Experts

Contour error

Interval error

Tonality error

Larrouy-Maestri et al. (2013), *Journal of Voice*.

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Musical errors - Layman listeners

Contour error

Interval error

Tonality error

Larrouy-Maestri et al. (2015). *PlosOne*

Musical errors – Conclusions

- Intervals are important in the definition of vocal pitch accuracy in a melodic context
- When you are an “experts”, you pay attention to interval deviation and number of modulations

➔ BUT…

Singing voice

- Never perfect!
- Does not mean that it is “out of tune”

➔ What is the limit between “in” and “out” of tune (i.e., tolerance)?

	< 50	= 50 cents	= 100 cents	> 100
Pitch discrimination	Several studies			
Musical conventions			e.g. musical notation, piano, …	
Measurement of performances		• Hutchins & Peretz (2012) • Pfordresher & Mantell (2014)	• Berkowska & Dalla Bella (2009) • Dalla Bella et al. (2007, 2009) • Pfordresher & al. (2007, 2009, 2010)	
Pitch perception		• Hutchins et al. (2012) • Warrier & Zatorre (2002)	• Burns & Wards (1978) • Zarate et al. (2012)	**In trained voices** • Larrouy-Maestri et al. (2014) • Sundberg et al. (1996, 2013) • Vurma & Ross (2006)

➔ Does it depend on the melody/type of error?

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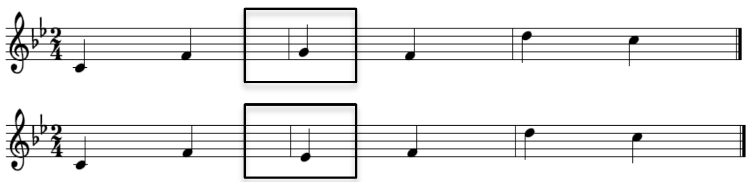
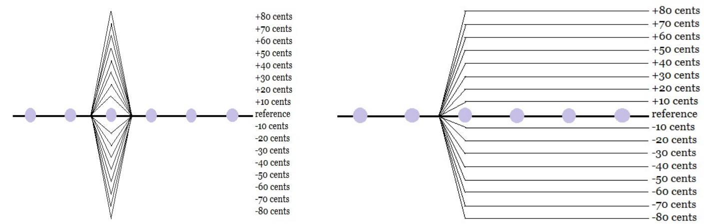
Tolerance - Material

1. Interval direction (Ascending vs. Descending) and type of error (Interval vs. Tonal drift)





2. Size (2nd vs. 4th) and position (Middle vs. End) of the interval

3. Familiarity (and expertise of the listener)

399 participants from 13 to 70 years old (M = 29.81)
Familiarity ratings: $t(398) = 20.92$, $p < .001$

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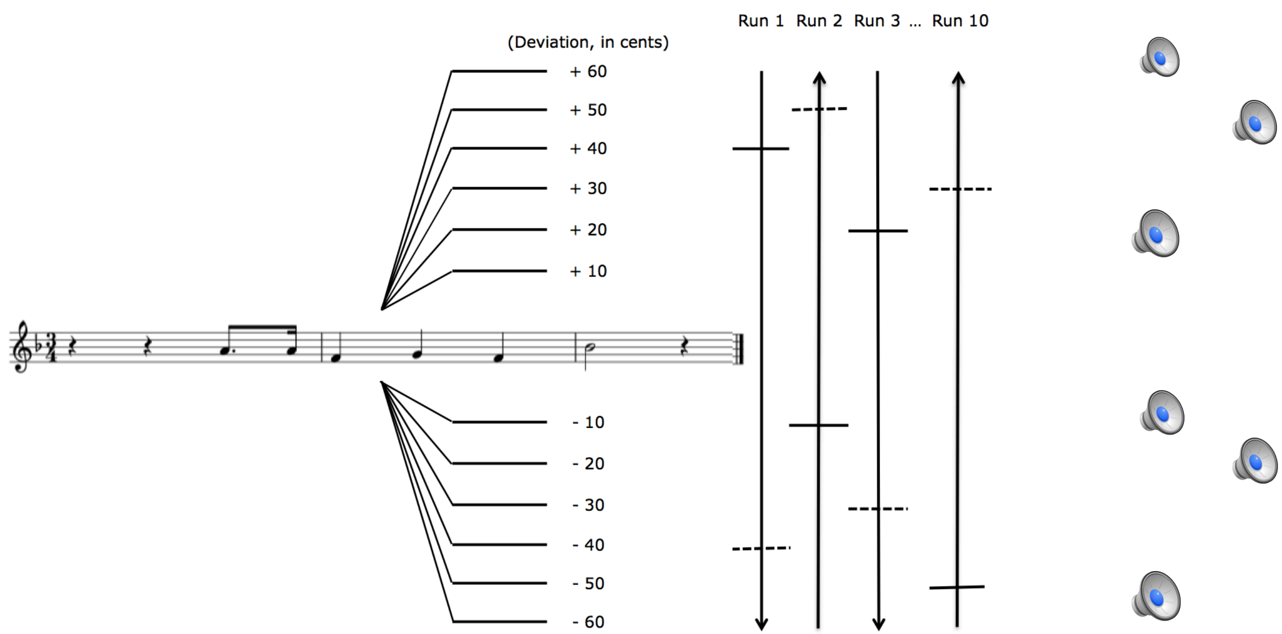
Tolerance – Procedure

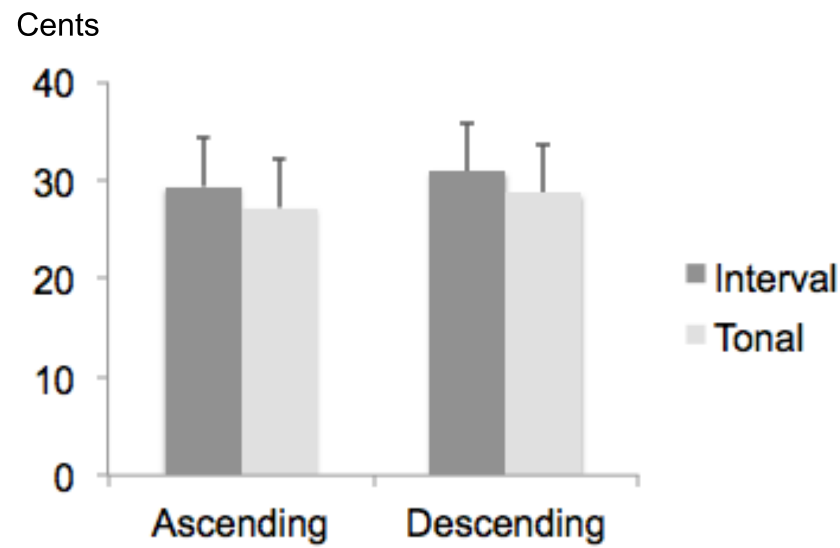
- Manipulation of one/sequence of tone(s)
- Methods of limits (Van Besouw, Brereton, & Howard, 2008)



- Test-retest paradigm (7 to 14 days)

Tolerance – Experiment 1

- Conditions
  - Interval direction (Ascending vs. Descending)
  - Type of error (Interval vs. Tonal drift)
- Participants
  - n = 30 non musicians
  - M = 23.33, SD = 3.53
  - Control tasks



No effect of Error type
$f(1, 114) = 1.74$, $p = .19$
No effect of Interval direction
$f(1, 114) = 0.68$, $p = .42$
No interaction
$f(1, 114) = 0.01$, $p = .98$

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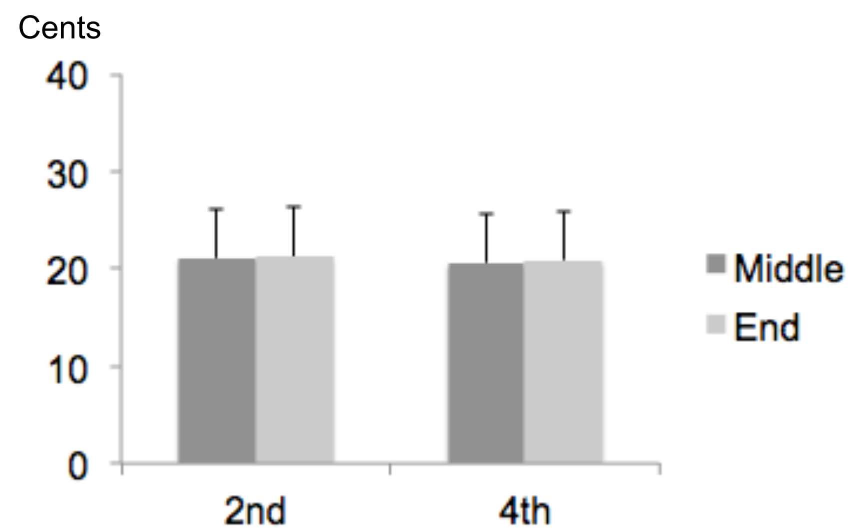
Tolerance – Experiment 2

- Conditions
  - Interval size (2nd vs. 4th)
  - Interval position (Middle vs. End)
- Participants
  - n = 28 non musicians
  - M = 20, SD = 4
  - Control tasks

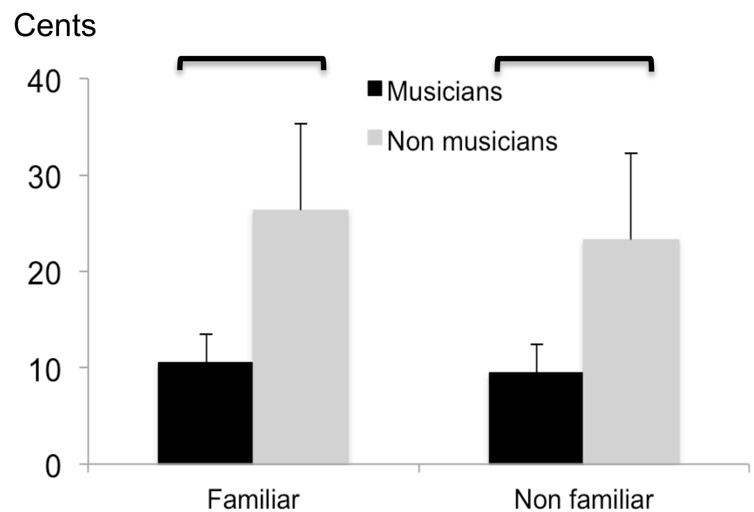
No effect of Size
$f(1, 108) = 0.19$, $p = .66$
No effect of Position
$f(1, 108) = 0.55$, $p = .82$
No interaction
$f(1, 108) = 0.003$, $p = .96$



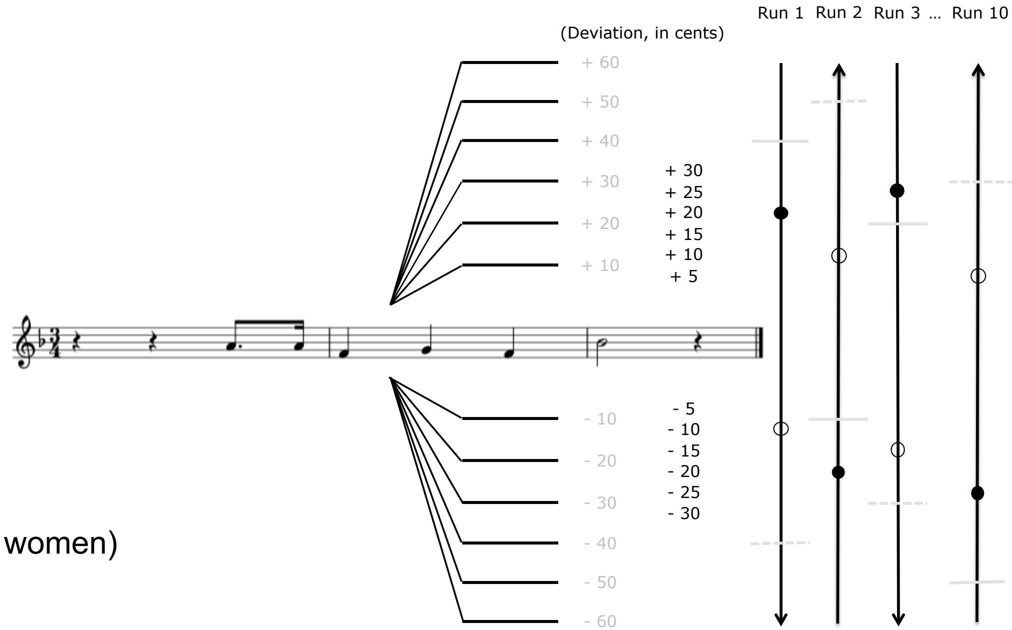
Tolerance – Experiment 3

- Conditions
  - Familiarity
  - Expertise
- Participants
  - n = 30 non musicians (M = 41, SD = 12)
  - n = 30 musicians (M = 41, SD = 11.85)
  - Control tasks

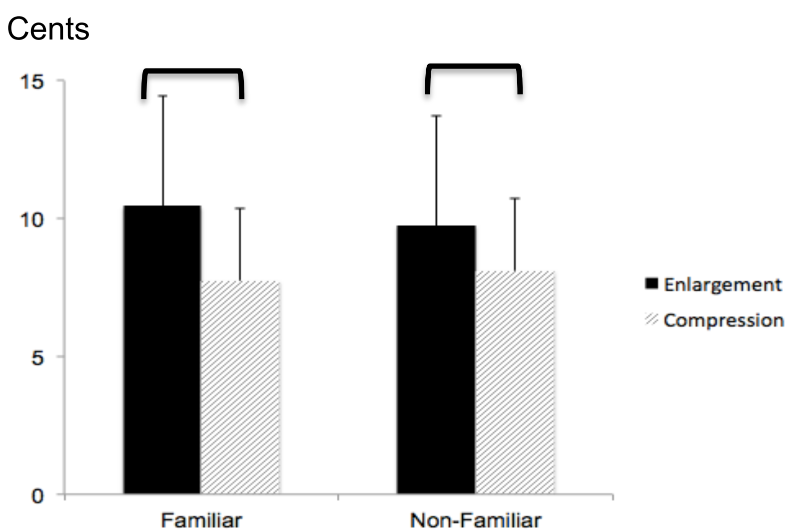
Effect of expertise
$f(1, 116) = 139.11$, $p < .001$, $\eta^2 = .54$
No effect of familiarity
$f(1, 116) = 2.74$, $p = .10$
No interaction
$f(1, 116) = .60$, $p = .44$



Tolerance – Bonus



n = 30 musicians (11 women)
M = 42, SD = 13.09



No effect of familiarity
$f(1, 116) = .25, p = .62$

Effect of the direction of the deviation
$f(1, 116) = 10.64, p < .01, \eta^2 = .08$

No interaction
$f(1, 116) = .77, p = .38$

Tolerance – Conclusions

- Consistency when categorizing melodies, whatever the familiarity, size, position, type of error
- Low tolerance (20-30 cents), particularly for music experts (~ 10 cents)

→ BUT…

Singing voice

- Trained singers
  - Complex signal (e.g. Larrouy-Maestri et al., 2014a; Sundberg, 2013) including vibrato (Ekholm et al., 1998; Garnier et al., 2007; Rothman et al., 1990)
  - Influence on the perception of pitch accuracy (Larrouy-Maestri et al., 2014b)

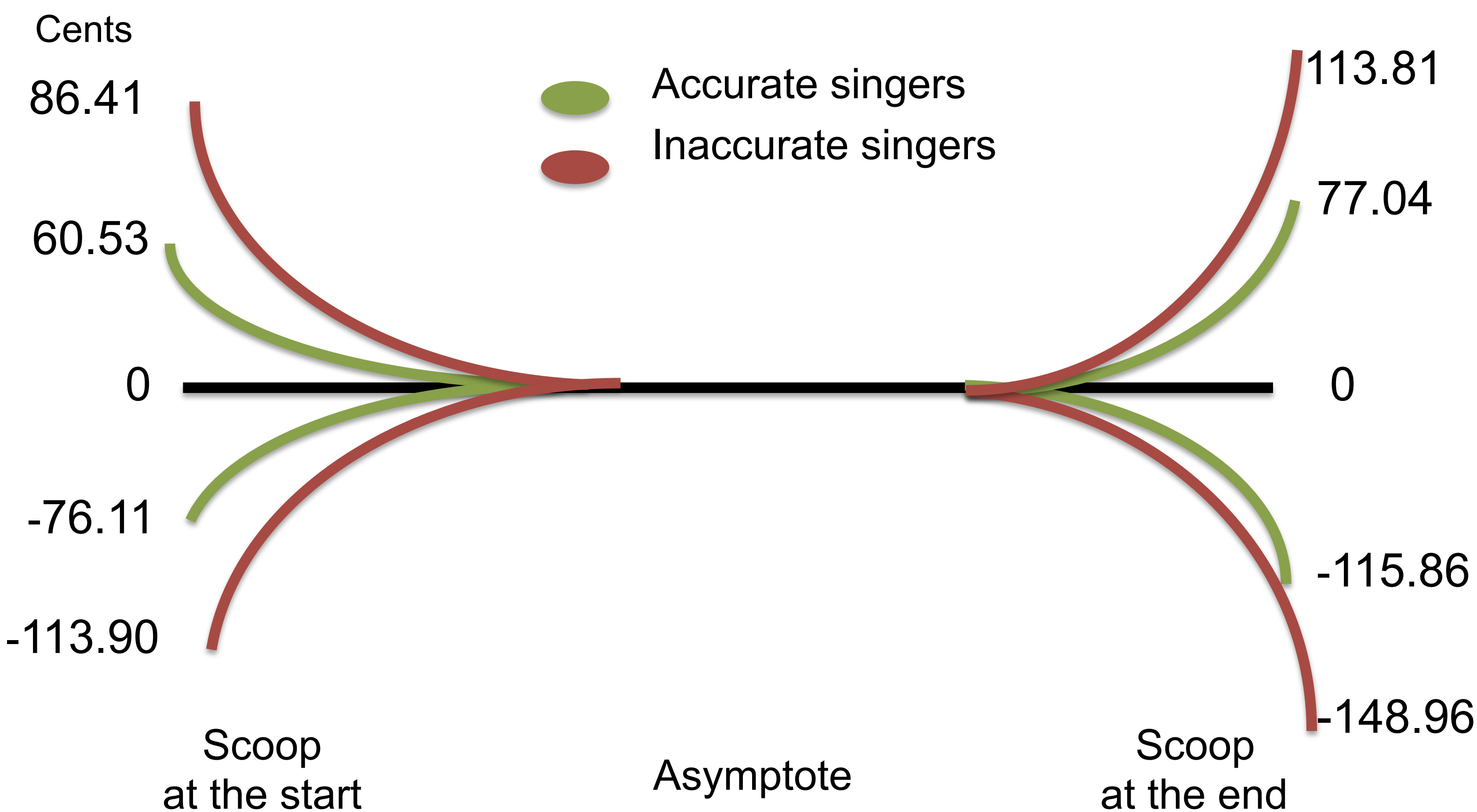
- Untrained singers
  - Something happens at the start
    - Stevens & Miles (1928)
    - Few studies (Hutchins & Campbell, 2009; Saitou, Unoki, & Akagi, 2005) + J. Mantell!

➔ Description of pitch fluctuations (i.e., scoops)

  - It might influence our perception

➔ Perception of scoops

Pitch fluctuations within tones - Description



Data analysis of Pfordresher & Mantell (2014): 12 “inaccurate” and 17 “accurate” singers
Melodies of 4 notes: 1854 tones

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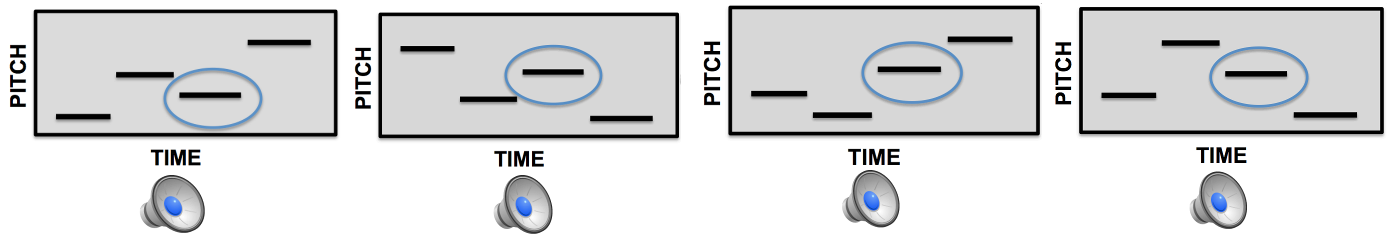
Pitch fluctuations within tones - Perception

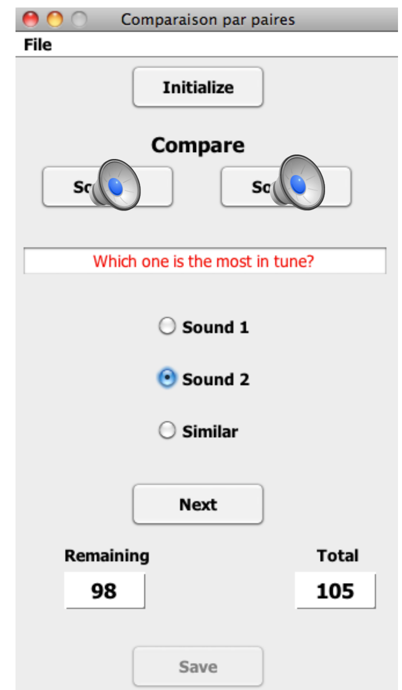
- Melodies



- Manipulations of one tone
  - Asymptote
  - Scoops at the start and/or at the end
- 102 undergrads in 4 Experiments
- For each melody
  - Pairwise comparison
  - Ranking from "most out of tune" to "most in tune"

➔ Reliability

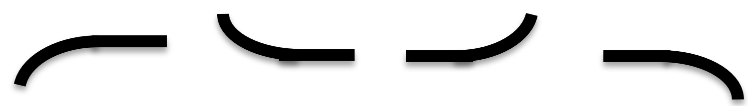
➔ Effect of one/several manipulations on the rating



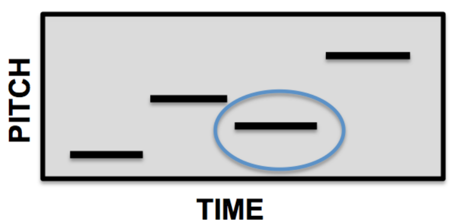
Pitch fluctuations - Do Scoops matter?

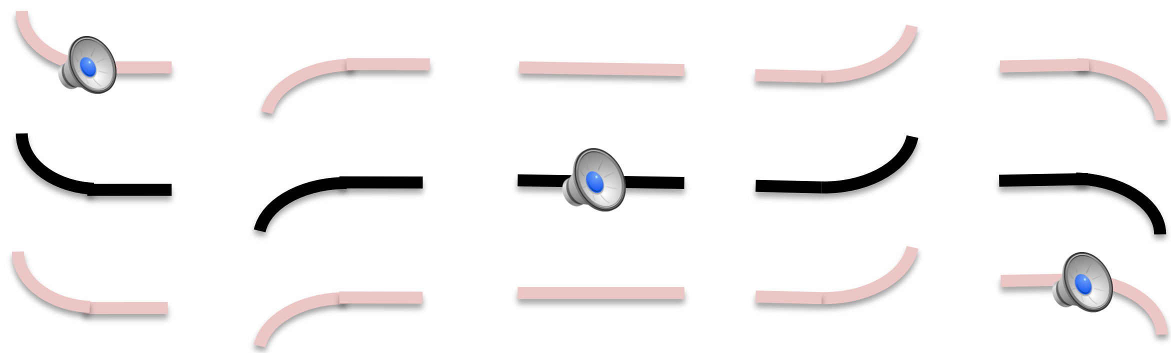
- Manipulation of the Asymptote: +/- 50 cents

- Manipulation of the Scoop
  - start vs. end
  - up vs. down

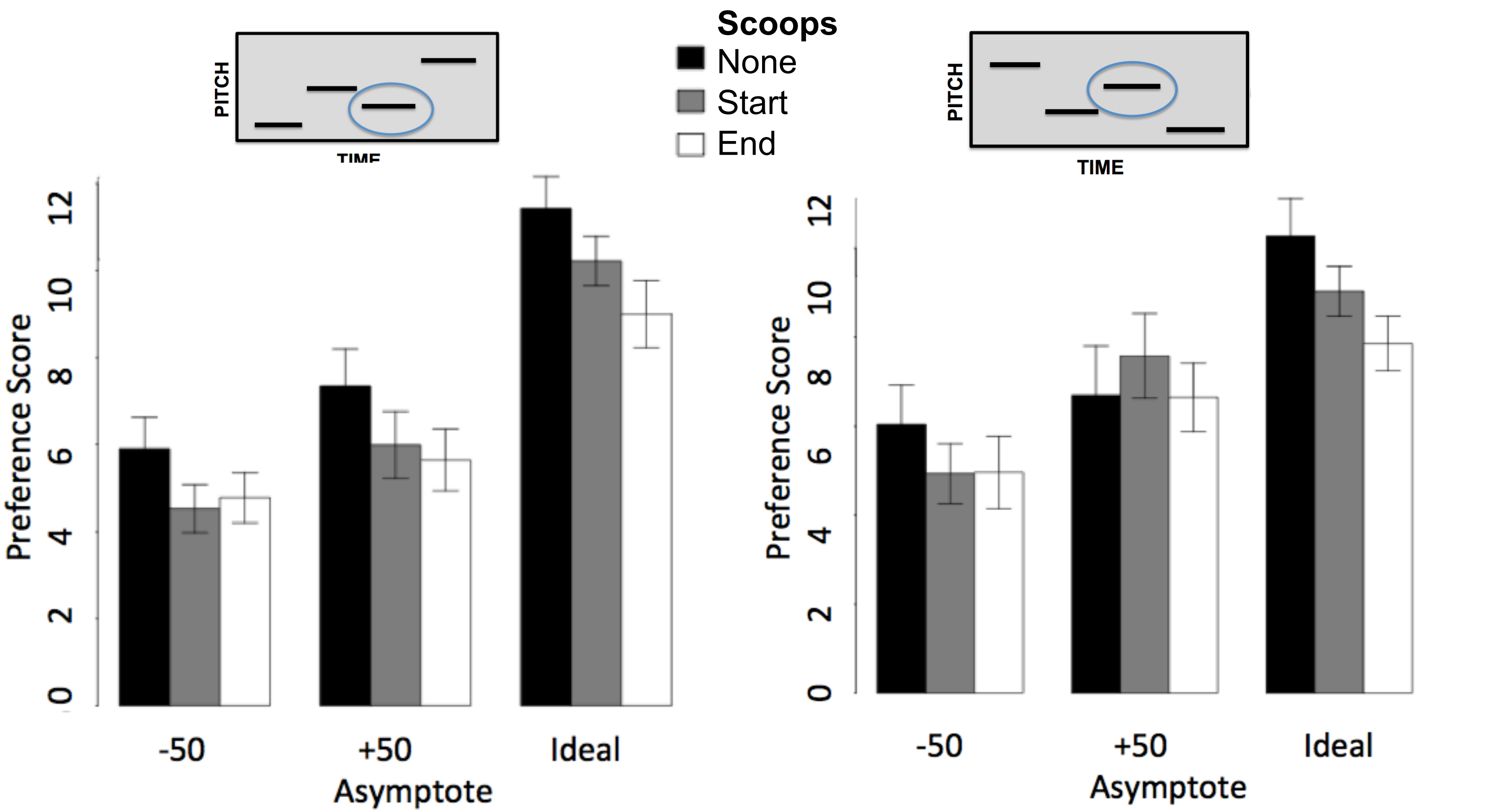


- Manipulation of the Asymptote and Scoop





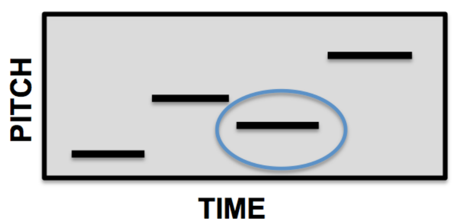
Pitch fluctuations - Do Scoops matter?

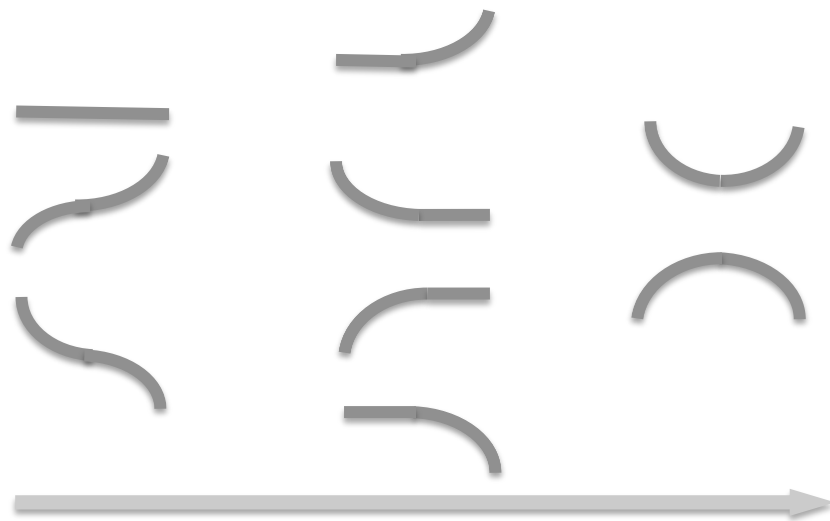


- ➔ Effect of **Asymptote** ($f(2,100) = 113.41$, $p < .001$), but also of **Scoops** ($f(1,50) = 35.03$, $p < .001$)
- ➔ None > Start > End: Perfect > Motor adjustment > Lack of stability

Pitch fluctuations – Averaging process?

- No manipulation of the Asymptote
- Manipulation of the Scoop
  - start and/or end
  - up and/or down



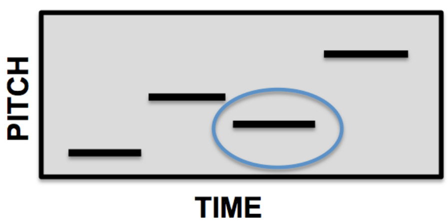


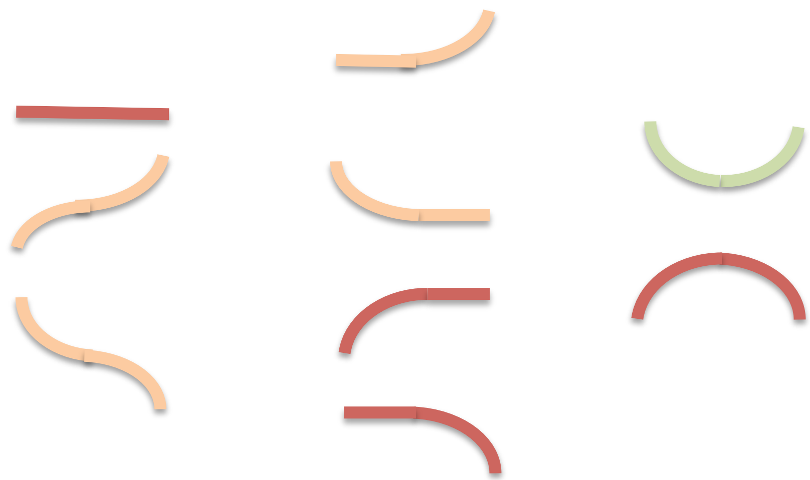
➔ Correlation between Deviation and Ratings (r = -0.42, $p < .01$)

Preference for low deviation

Pitch fluctuations – Sequential process?

- No manipulation of the Asymptote
- Manipulation of the Scoop
  - start and/or end
  - up and/or down



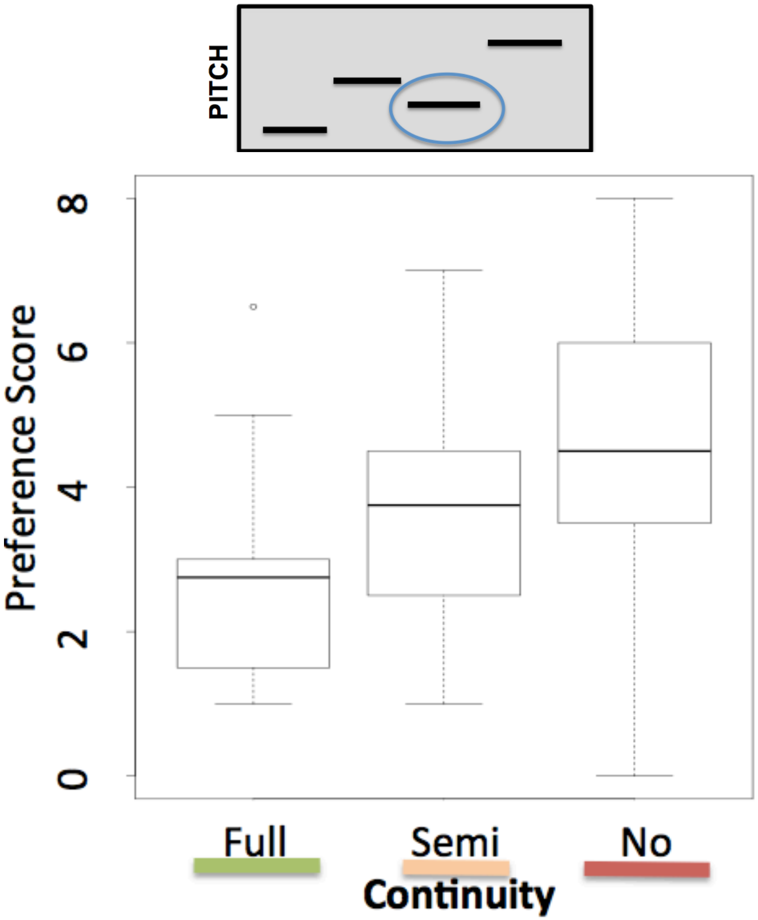


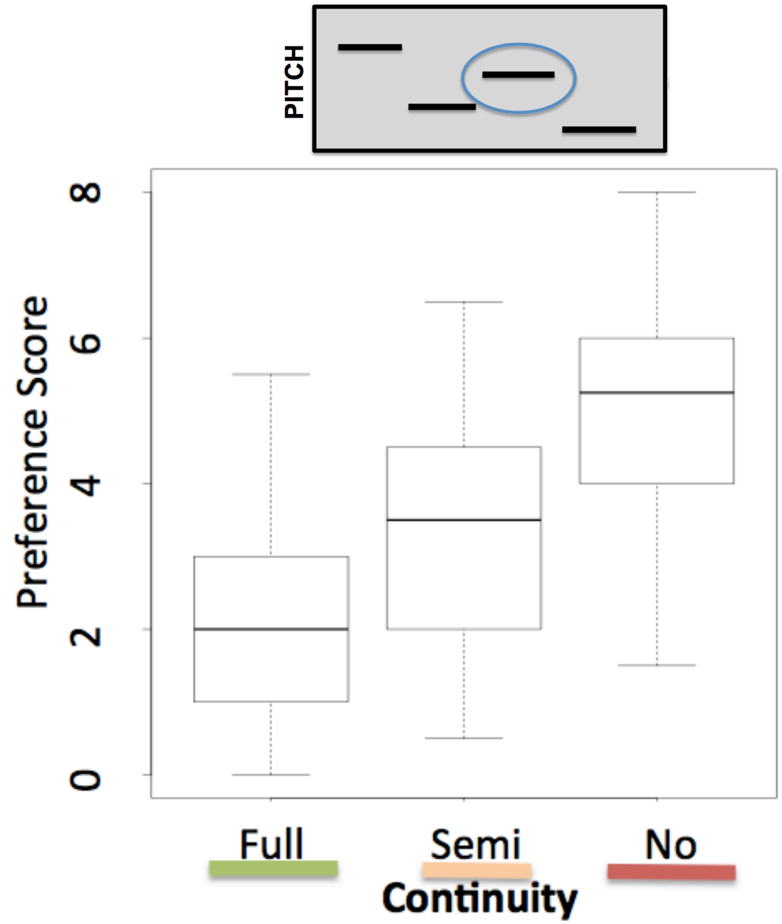
No continuity

Semi continuity

Full continuity

Pitch fluctuations – Sequential process?





➔ Clear preference for NO continuity ($f(2,102) = 66.66$, $p < .001$)

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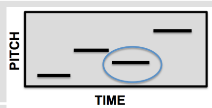
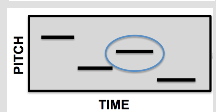
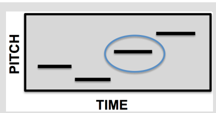
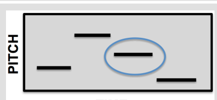
Pitch fluctuations – Sequential vs. Averaging?

- New manipulations: Asymptote AND Start/End
- Same procedure with new participants

	Continuity	Compensation
	*ns*	***
	**	*ns*
	*	**
	*	***
All melodies	***	***

* <.05
** <.01
*** <.001

Pitch fluctuations – Conclusions

- Scoops in singing performances
- Influence of Scoops on melodic perception
    - Tolerance regarding motor constraints
    - Glides (i.e., continuity) make the melody sounds "out of tune"
- Both averaging/sequential processes seem important

➔ BUT…

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Peter Pfordresher


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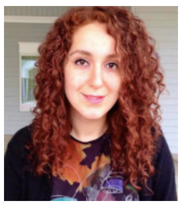
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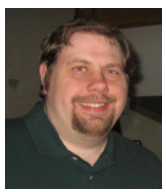
Paul Kovacs

fnrs FREEDOM TO RESEARCH

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ULg


Simone Franz

Thank you for your attention!