Does Marilyn sing in tune?

Max-Planck-Institut
für empirische Ästhetik

In-tune versus out-of-tune
On the perception of pitch accuracy

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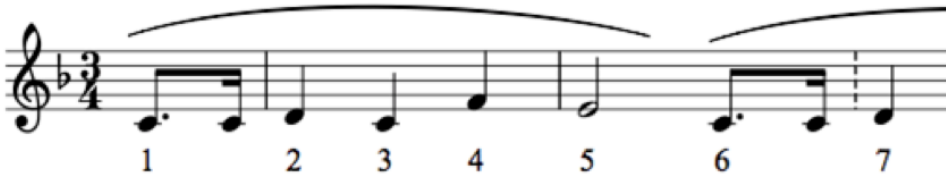
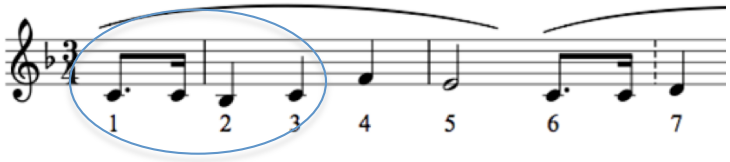
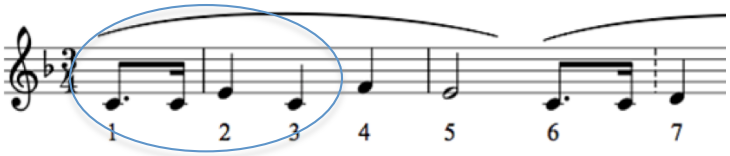
Musical errors



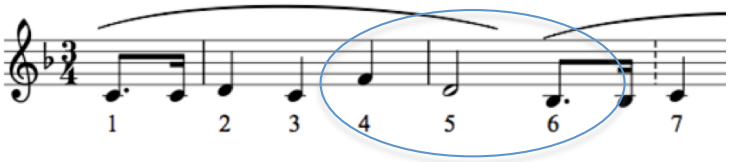
Contour error



Interval error



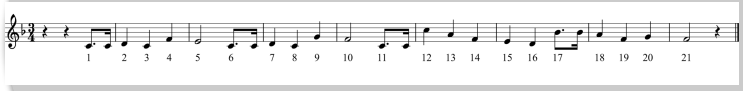
Tonality error



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

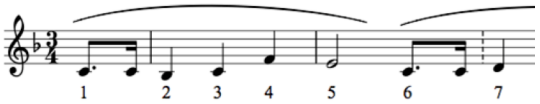


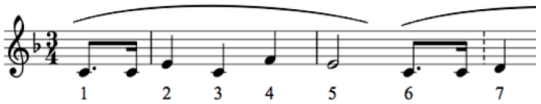
http://sldr.org/sldr000774/en

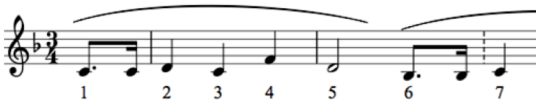
Computer
assisted method

3 criteria

Judges







1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9

Out of tune In tune

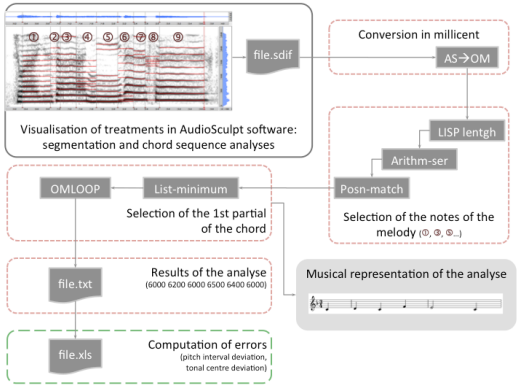
Musical errors - Judges

	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

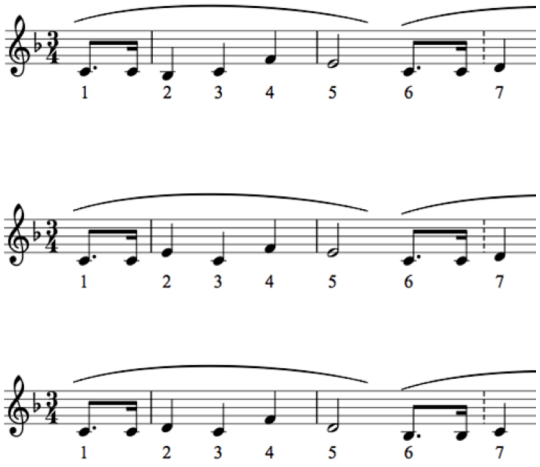
Manual segmentation

AudioSculpt (Ircam)



F0 information

AudioSculpt and
OpenMusic (Ircam)

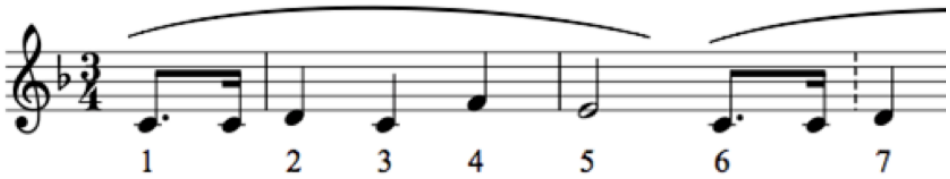


Quantification of errors

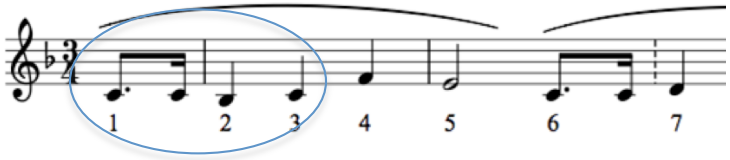
Excel (Microsoft)

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

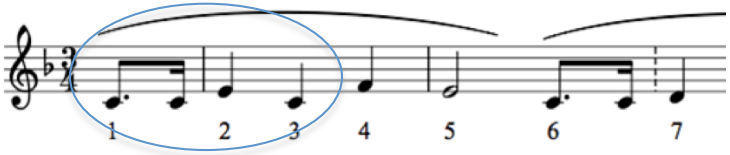
Musical errors - Experts



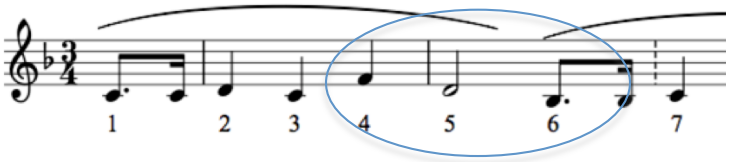
Contour error



Interval error

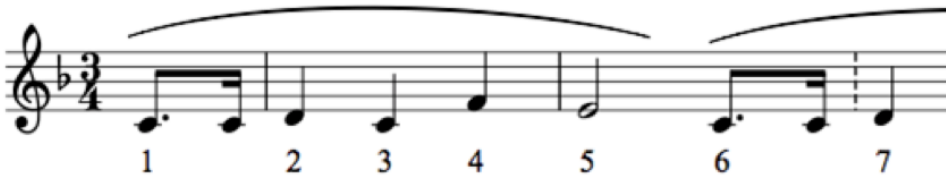


Tonality error

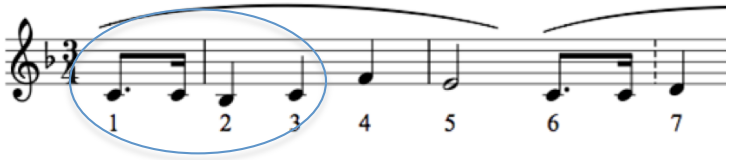


Larrouy-Maestri, Lévêque, Schön, Giovanni, & Morsomme (2013). *Journal of Voice*.

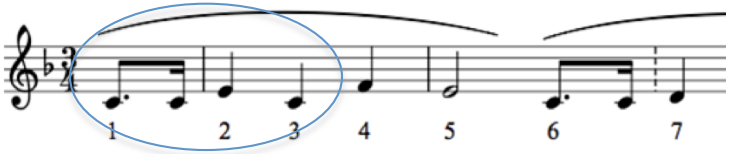
Musical errors - Layman listeners



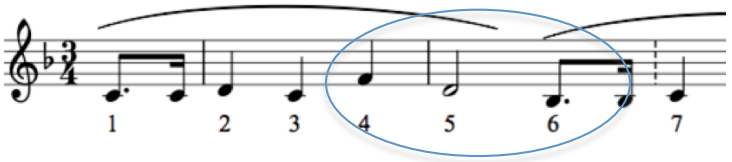
Contour error



Interval error

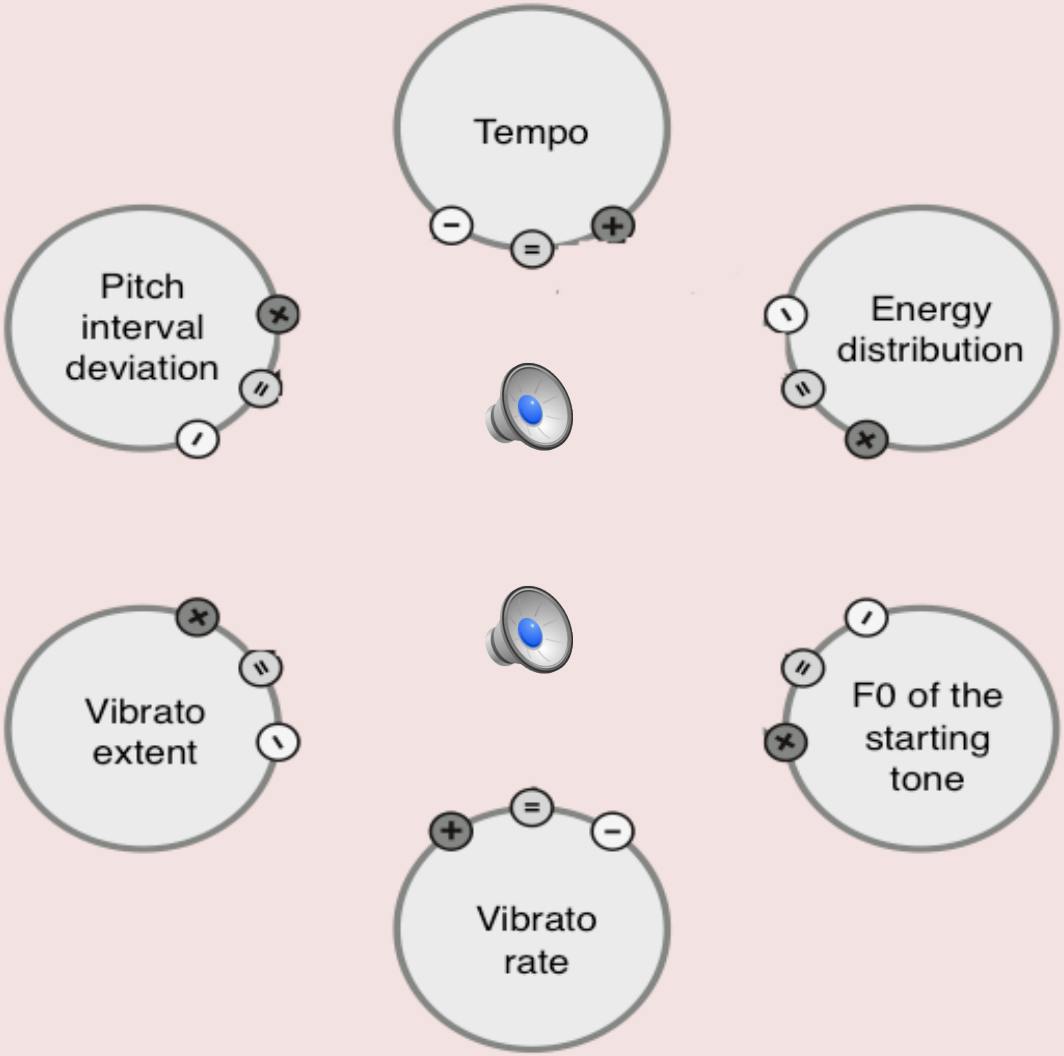


Tonality error



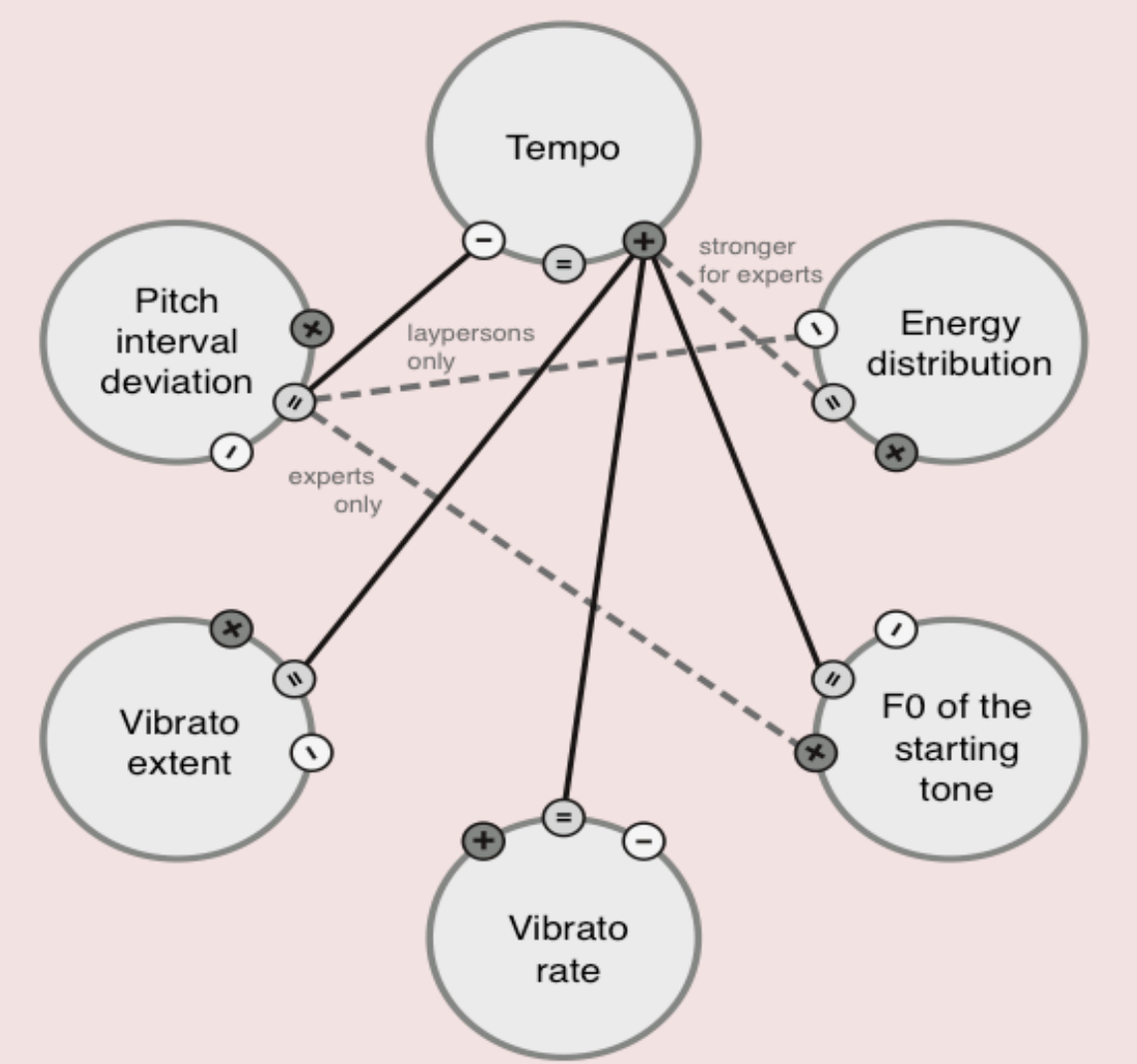
Larrouy-Maestri, Magis, Grabenhorst, & Morsomme (2015). *PlosOne*

The case of operatic singers - Definition



Larrouy-Maestri, Magis, & Morsomme (2014). *Journal of Voice*

The case of operatic singers - Evaluation



Larrouy-Maestri, Morsomme, Magis, & Poeppel (submitted)

Musical errors – Conclusions

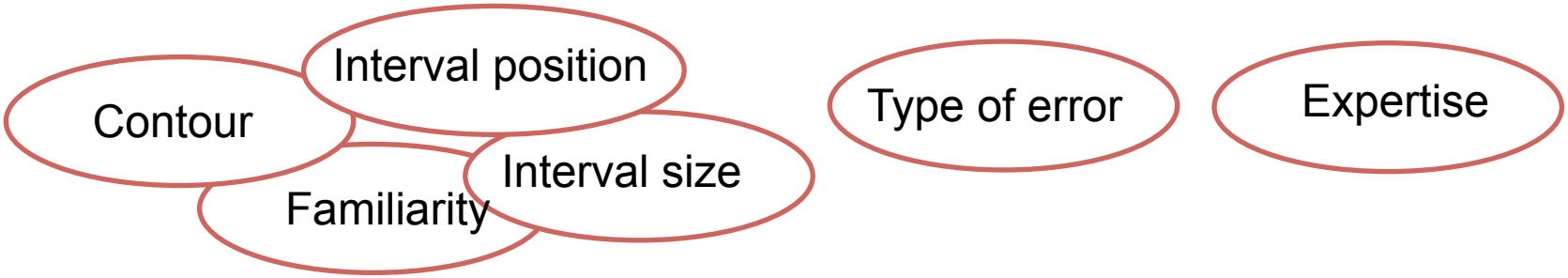
- Interval deviations
- + number of modulations if you are an expert

BUT…

- Singing voice: Never perfect!
- Does not mean that the performance is “out of tune”

➔Limit between “in” and “out” of tune?

➔Is it consistent?

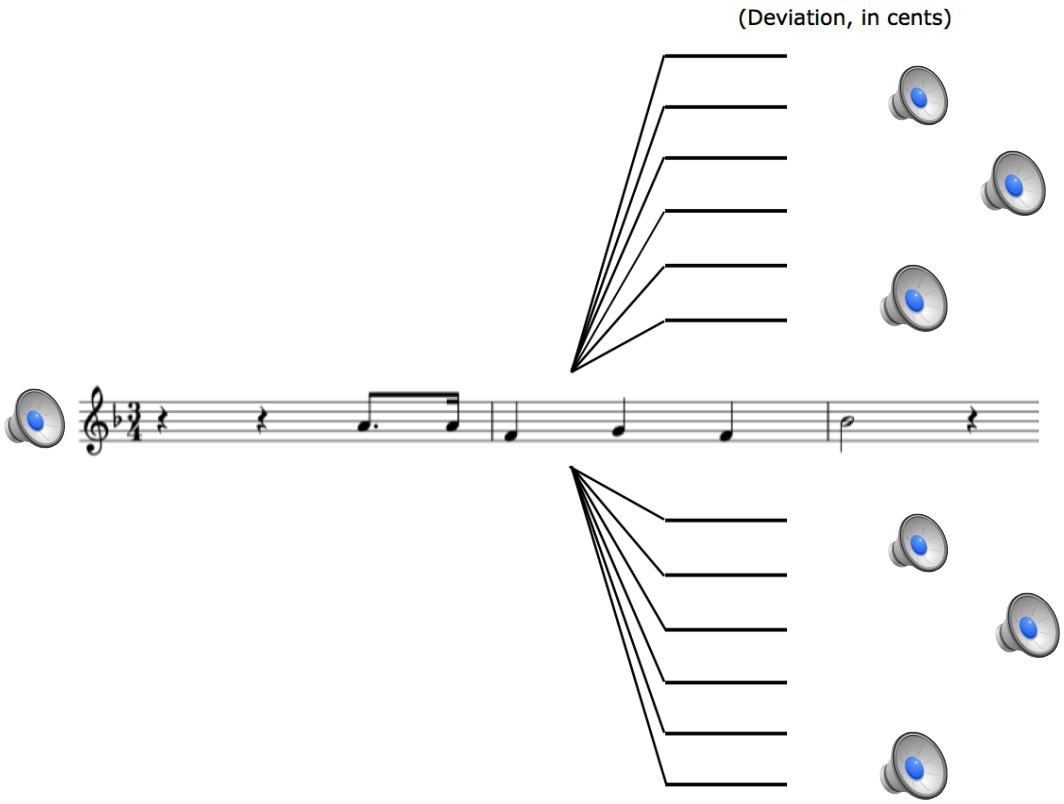


In-tune versus out-of-tune

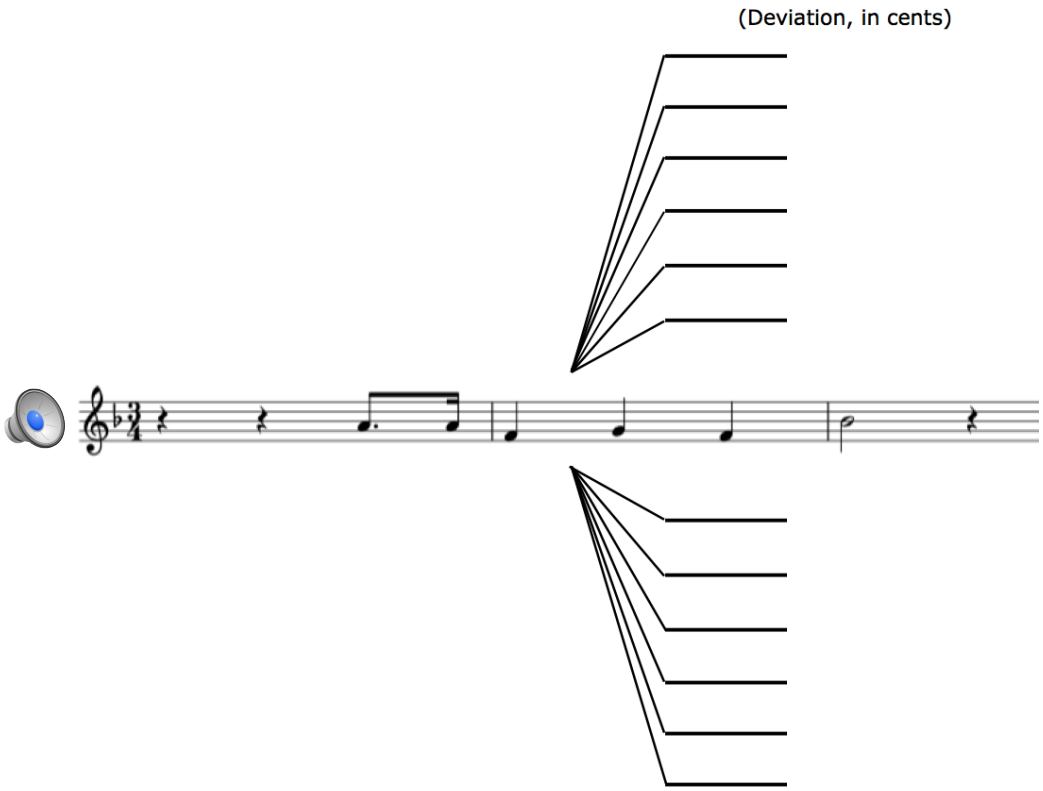
Listeners' tolerance

In preparation

Tolerance



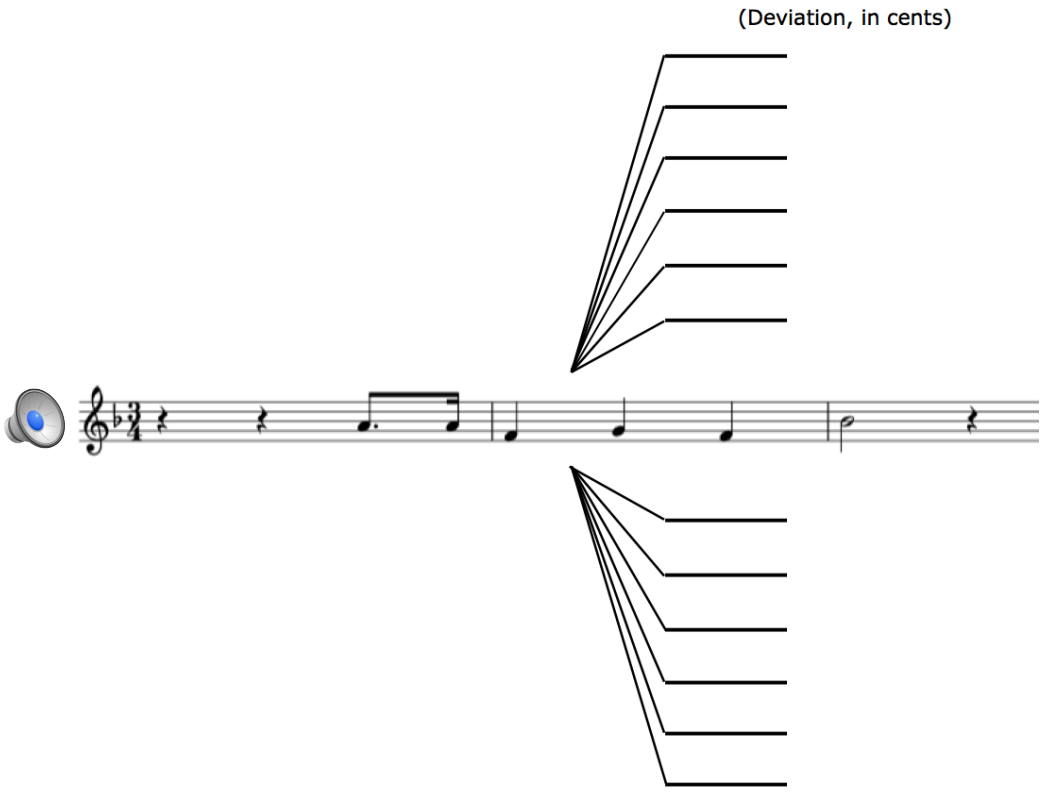
Tolerance - Background



Less than 50 cents

- Studies on pitch discrimination
- Online tests

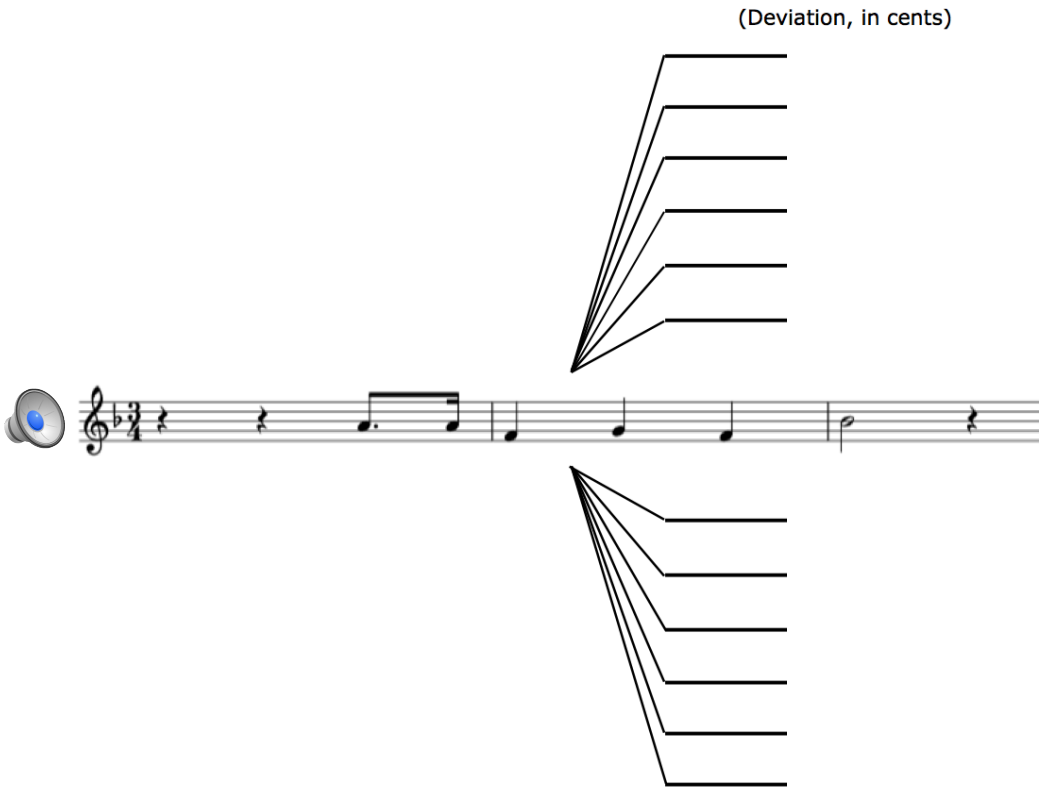
Tolerance - Background



50 cents

- Pitch perception
  - Huthins, Roquet, & Peretz (2012)
  - Warrier & Zatorre (2002)
- Criteria for evaluation
  - Hutchins & Peretz (2012)
  - Pfordresher and Mantell (2014)

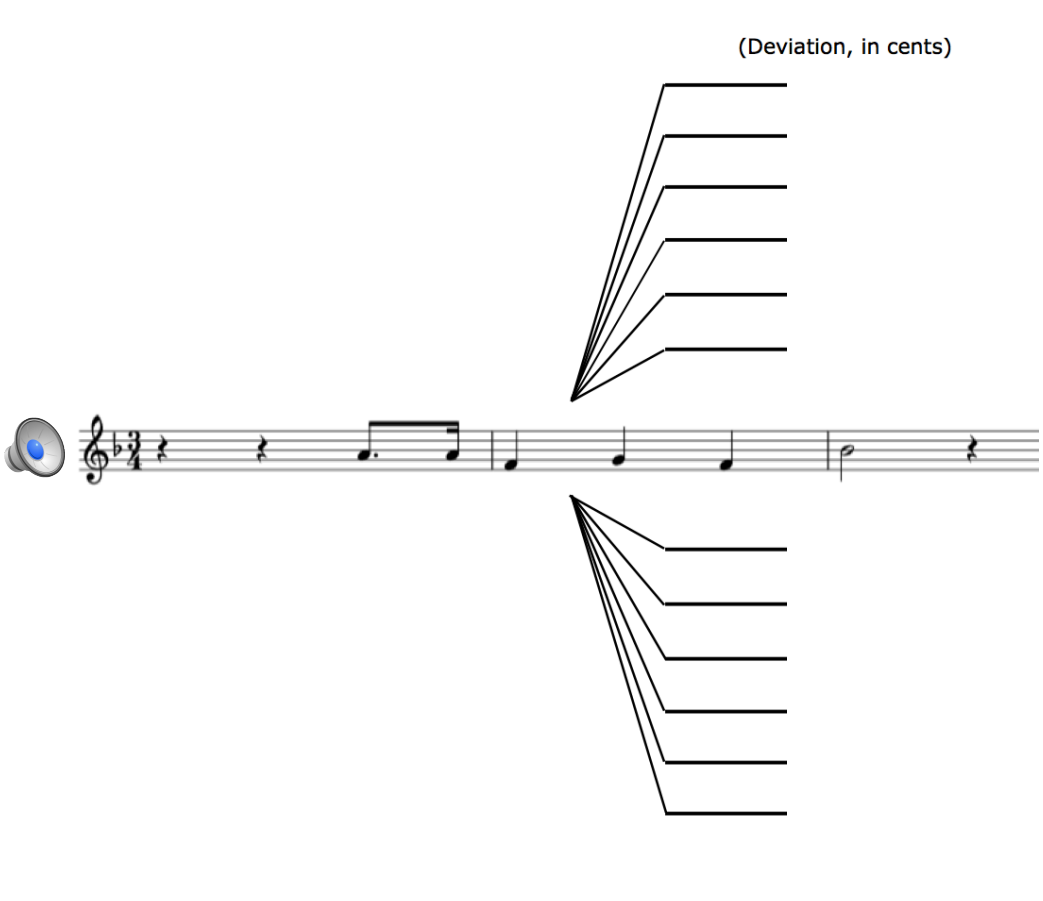
Tolerance - Background



100 cents

- Musical conventions
- Pitch perception
  - Burns & Wards (1978)
  - Zarate, Ritson, & Poeppel (2012)
- Criteria for evaluation
  - Berkowska & Dalla Bella (2009)
  - Dalla Bella, Giguère, & Peretz (2007)
  - Pfordresher et al. (2007, 2009)

Tolerance - Background



More than 100 cents

- Pitch perception

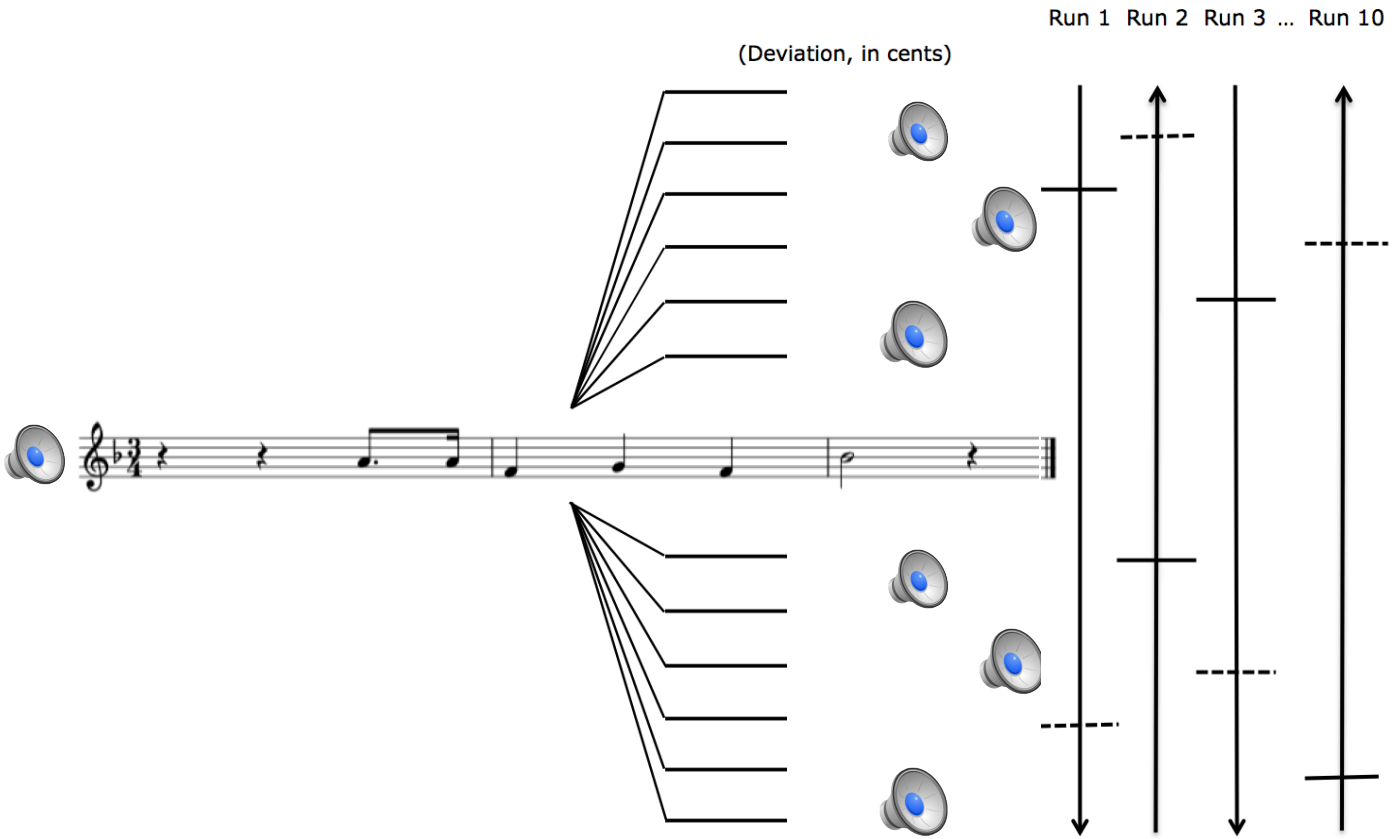
➔ Only for highly trained voices

Larrouy-Maestri et al. (2014)
Sundberg et al. (1996, 2013)
Vurma & Ross (2006)

Tolerance - Procedure

Methods of limits

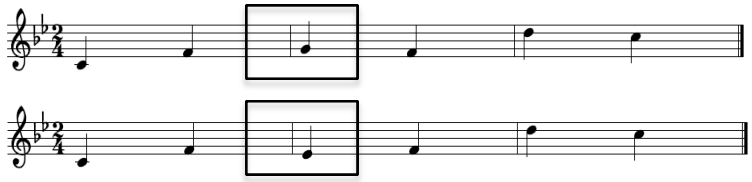
Van Besouw, Brereton, & Howard (2008)

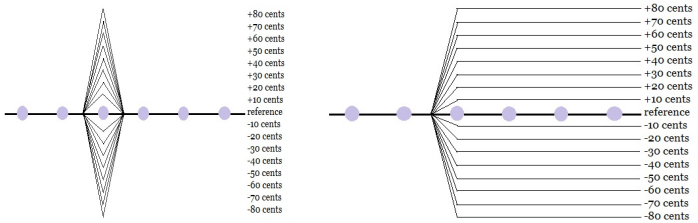


Test – retest paradigm

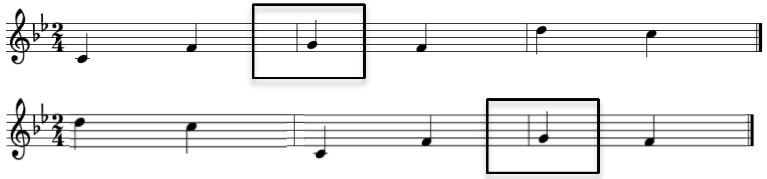
Tolerance - Material

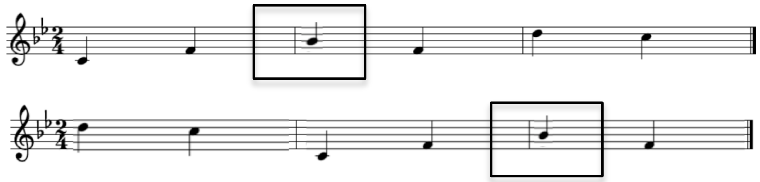
Exp1. Contour and type of error



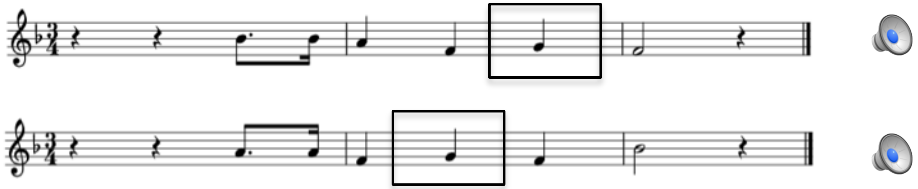


Exp 2. Size and position of the interval





Exp 3. Familiarity (and expertise of the listener)



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

Tolerance - Results

Exp1. Contour and type of error

n = 30 non musicians

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

➔ **Consistent**

Exp 2. Size and position of the interval

n = 28 non musicians

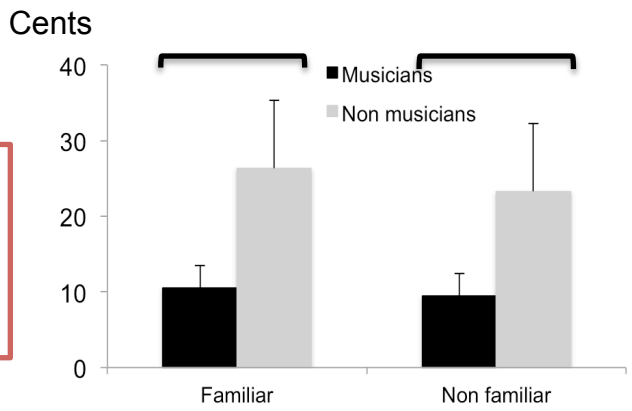
No effect of Size
f(1, 108) = 0.19, *p* = .66
No effect of Position
f(1, 108) = 0.55, *p* = .82
No interaction
f(1, 108) = 0.003, *p* = .96

➔ **Consistent**

Exp 3. Familiarity (and expertise)

n = 30 non musicians
30 musicians

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



Tolerance – Conclusions

- Low tolerance (25-40 cents)
- Particularly for music experts (~ 10 cents)
- Consistency of the tolerance, whatever the familiarity, contour, type of error, size, position

➔ **How pitch accuracy is perceived?**

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für empirische Ästhetik

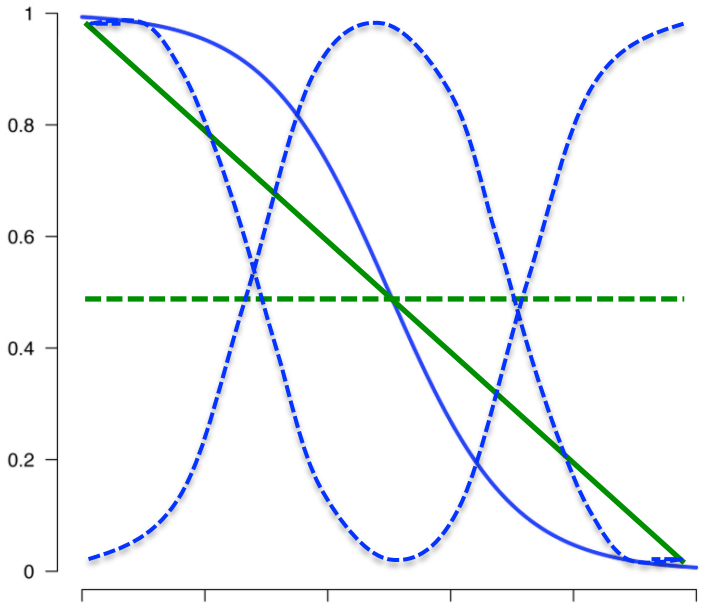
In-tune versus out-of-tune

On the perception of pitch accuracy

Larrouy-Maestri P., Franz S., & Poeppel D.

In progress

Process - Background



Categorical perception

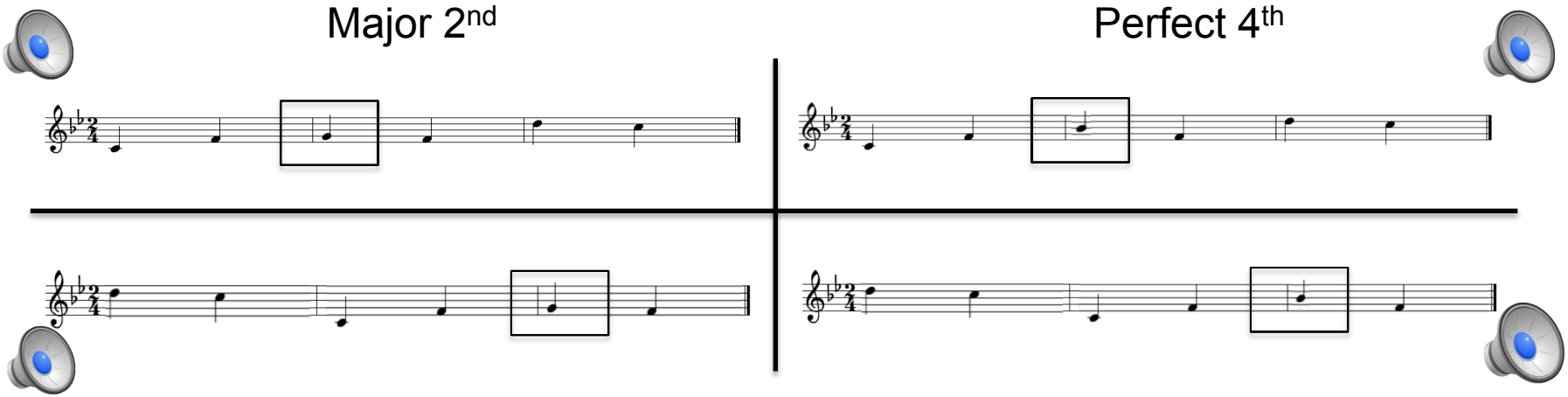
Transformation of varying sensory signals into categorical internal representations

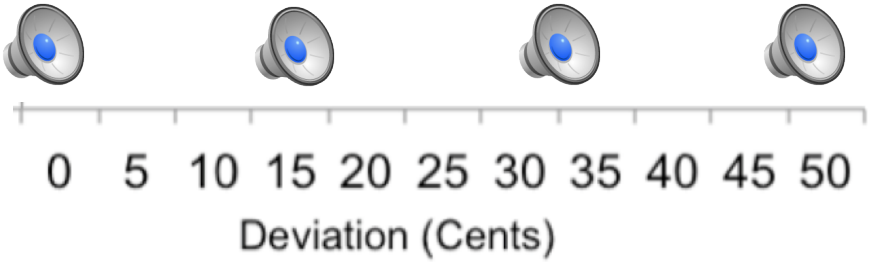
Continuous perception

Perception (sometimes linearly) of the variation of sensory signals

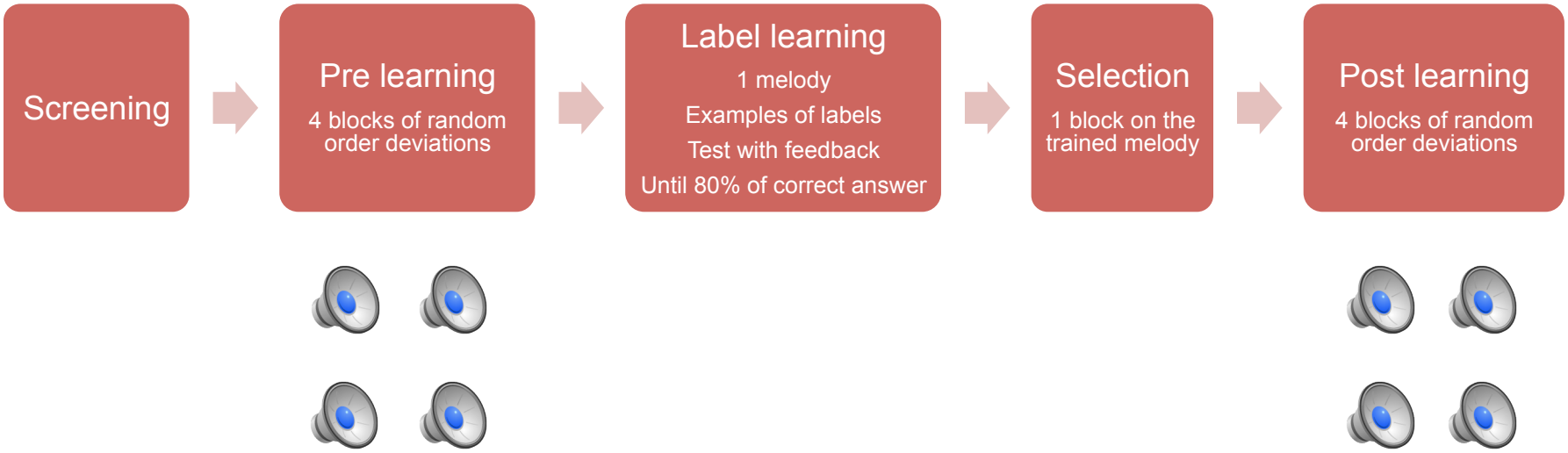
Gereral: Harnard, 1987; Goldstone & Hendrickson, 2010 (review); Liberman et al., 1957
Use of labels: Maier, Glage, Hohlfeld, Rasha, Rahman, 2014 (review)
In music: Burns & Ward, 1978; Burns & Campbell, 1994; McDermott et al., 2010; Siegel & Siegel, 1977; Zarate, Ritson, & Poeppel, 2012

Process - Material





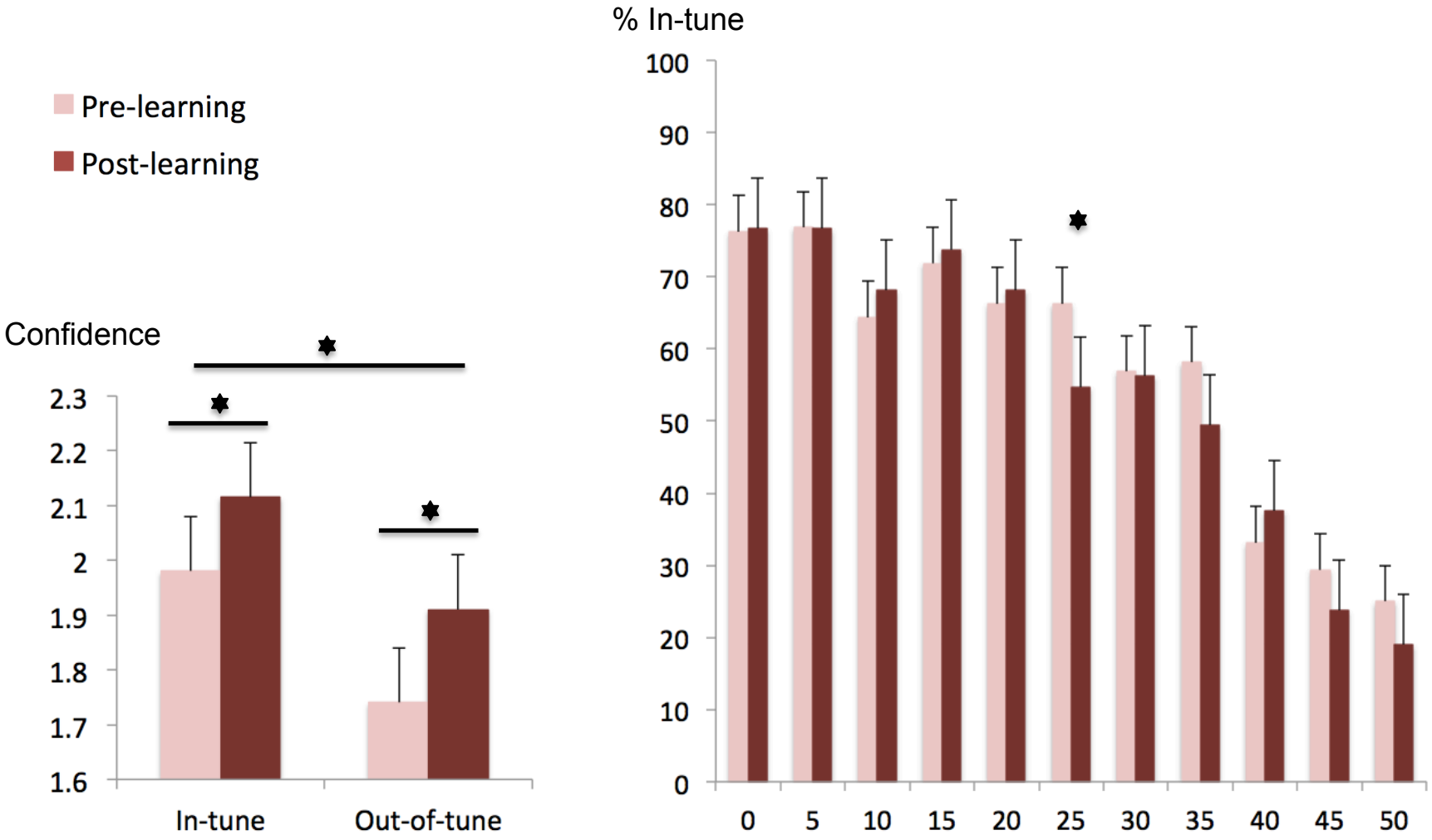
Process - Procedure



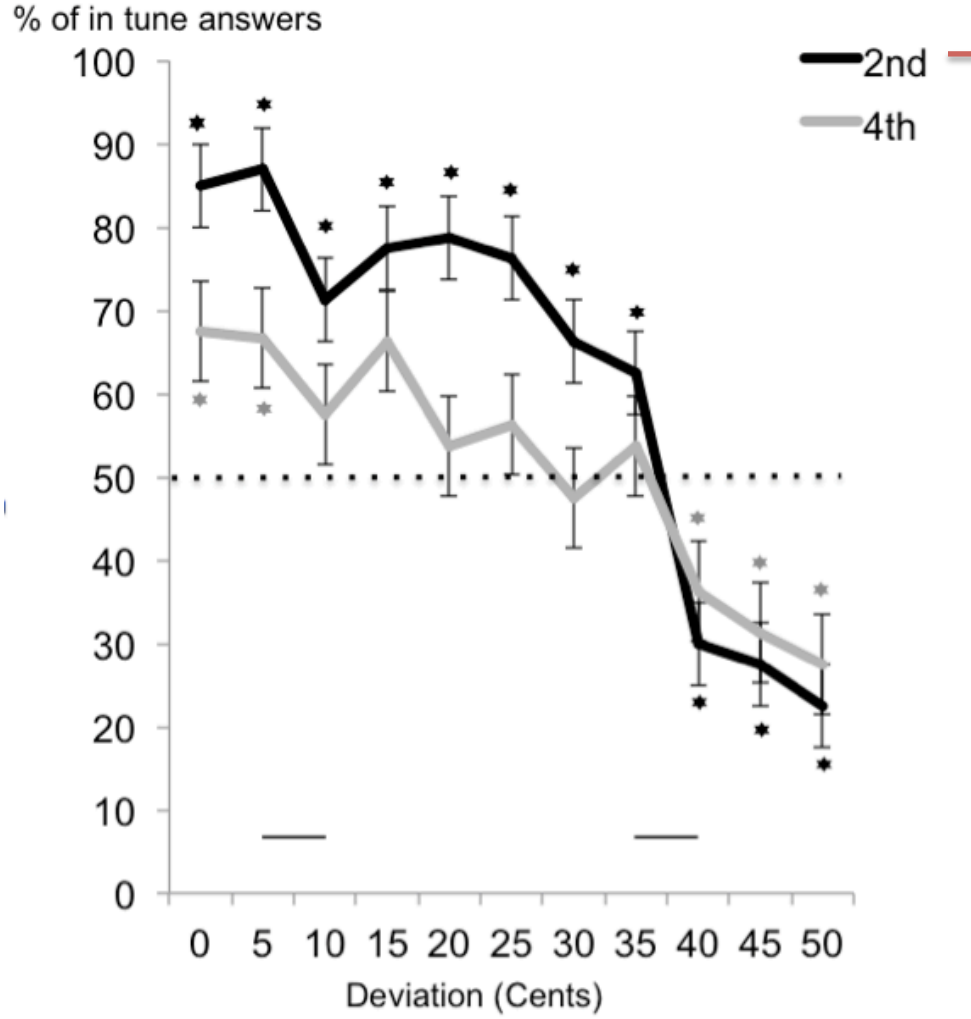
1. Identification task — In-tune | Out-of-tune

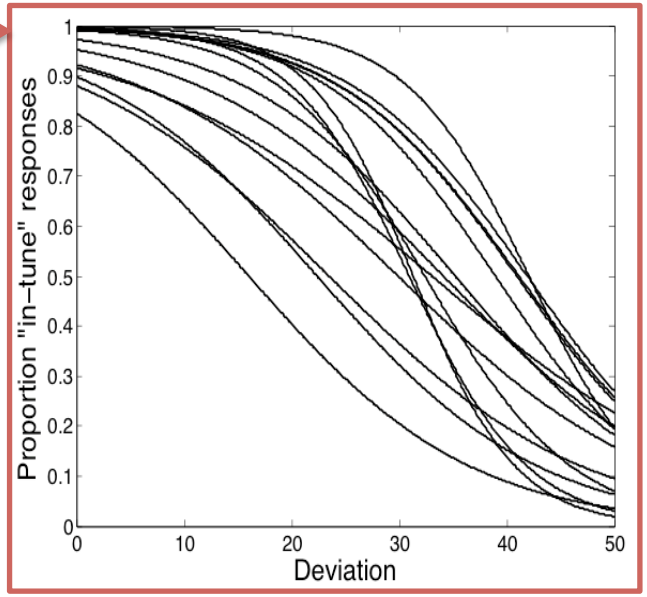
2. Confidence level — 0 | 1 | 2 | 3

Process – Effect of learning (n = 25)

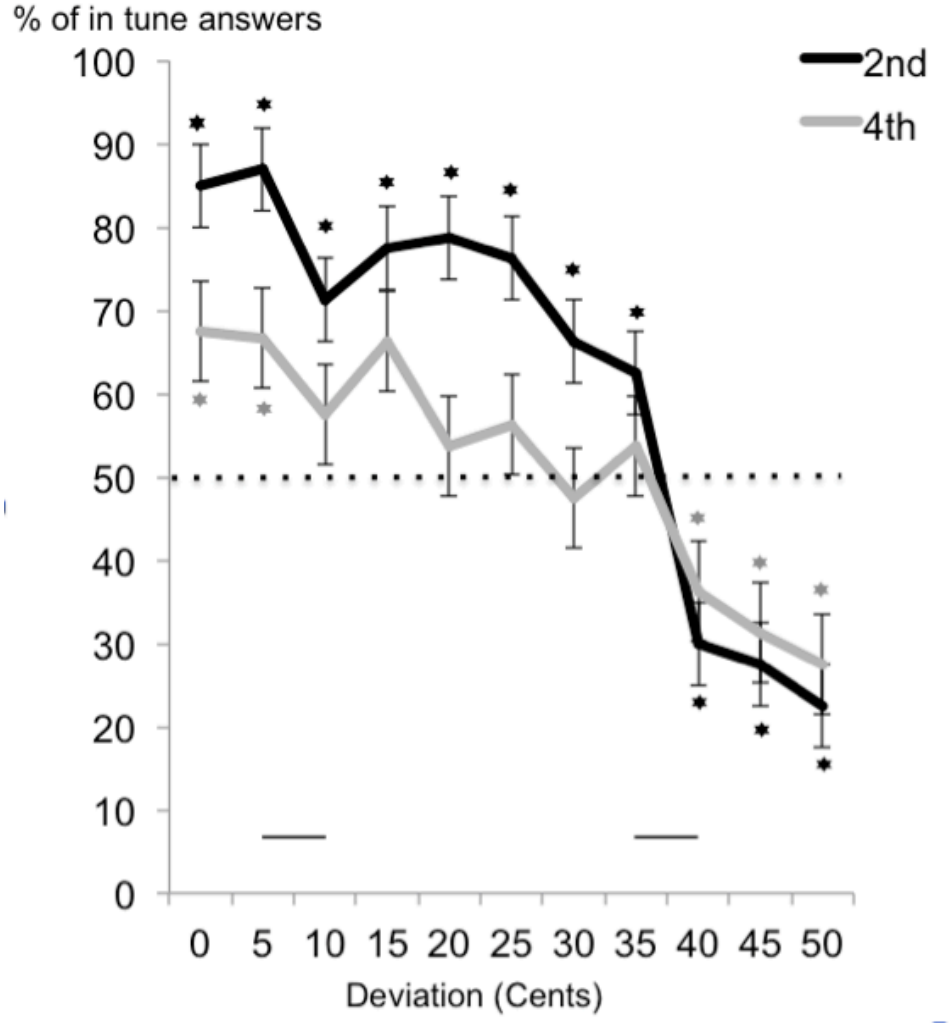


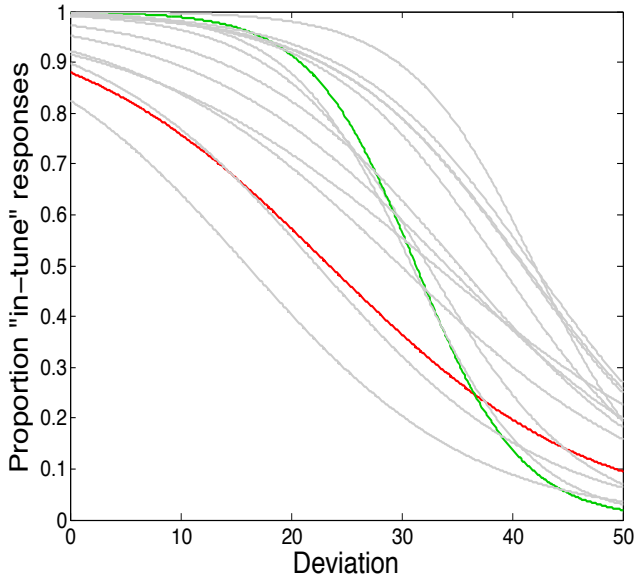
Process – Identification task (n = 20)





Process – Identification task (n = 20)

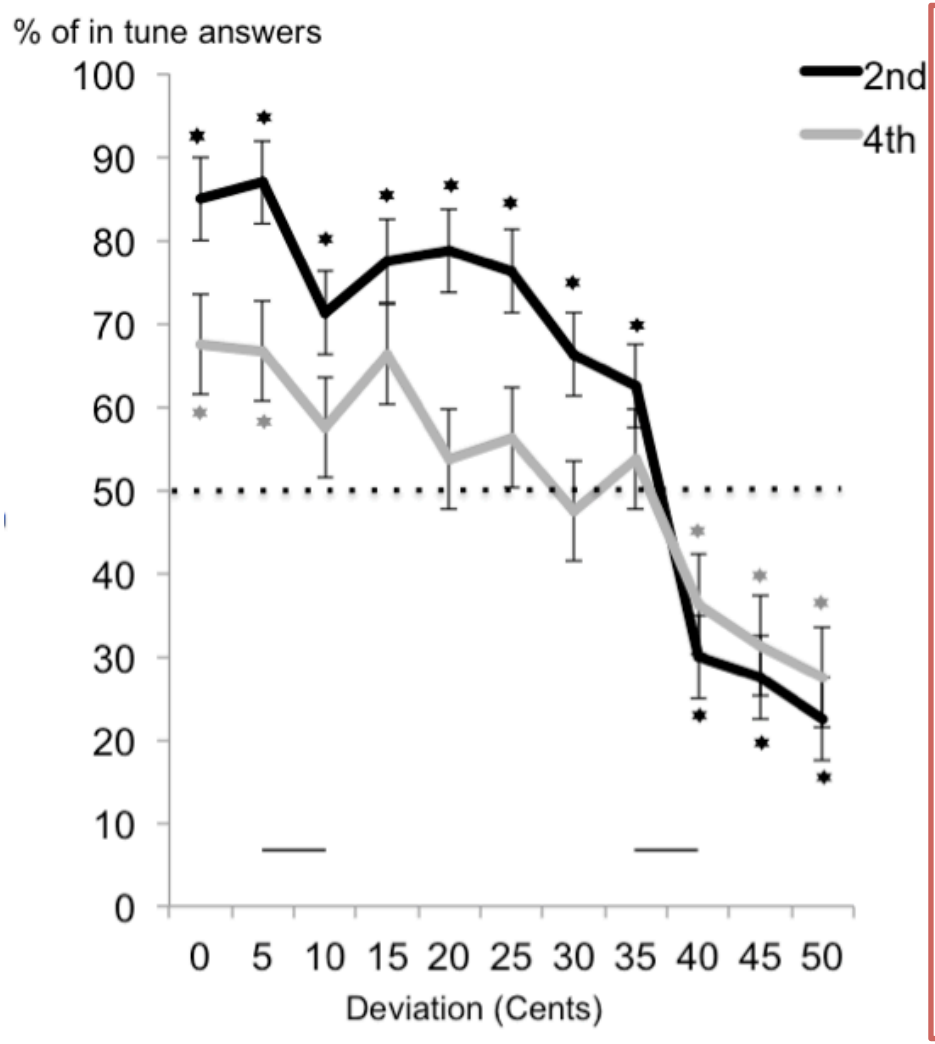


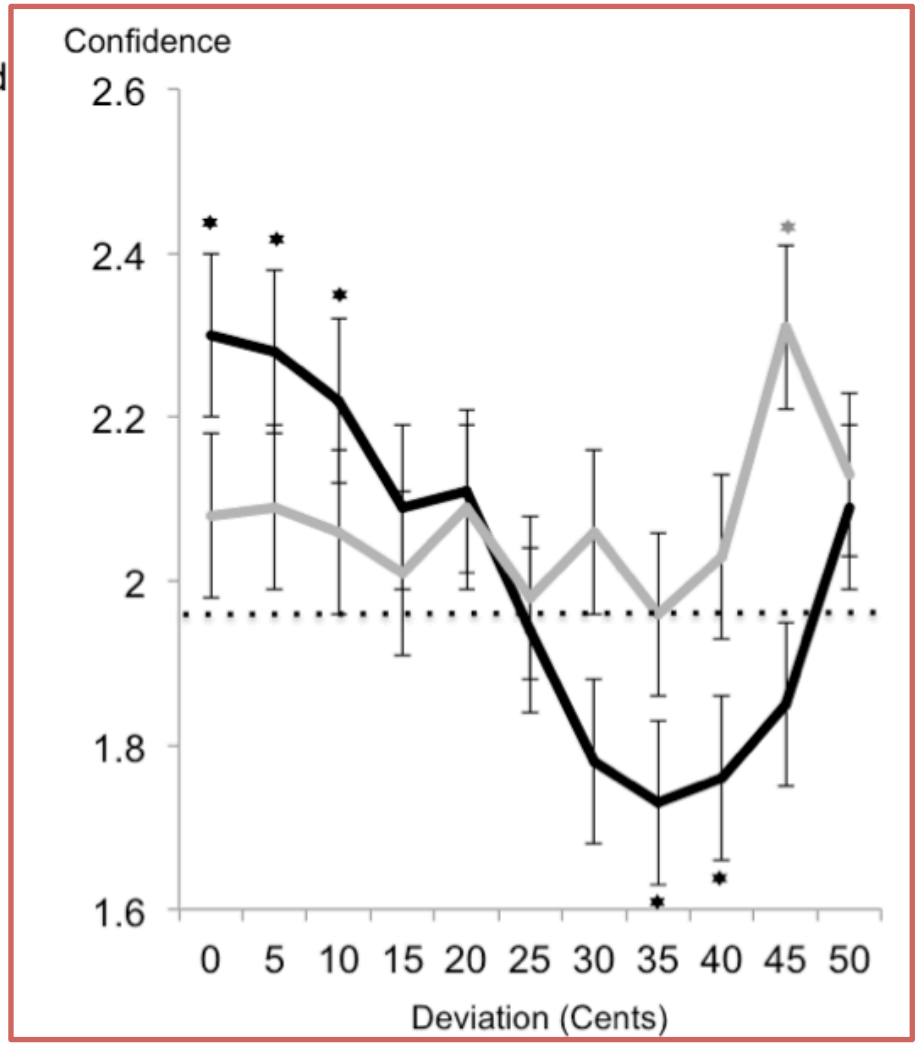


No effect of

- Formal musical training
- Informal musical training
  - Active/passive listening
  - Concerts
- Difficulty of the task
- Enjoyment of the voice

Process – Confidence task (n = 20)





Process – Conclusion (provisory)

➔Combination of categorical and continuous perception when listening to melodies

1. Individual differences regarding the mechanism
   - ➔ Development
   - ➔ Disorders

2. Similar conclusions in other domains
   - ➔ Relevant comparison(s)

Max-Planck-Institut
für empirische Ästhetik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Yohanna Lévêque


David Magis


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Ministère de la Communauté française

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fnrs FREEDOM TO RESEARCH


Ellen Blanckaert


Dominique Morsomme


Marie-Reine Ayoub


Laura Gosselin

Thank you for your attention!