



# Stress and singing accuracy: What is the relationship?

Evta-be

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Pauline Larrouy-Maestri, PhD

Logopédie de la voix  
Psychology Department  
Université de Liège, Belgium

# Stress and singing accuracy

# Singing accuracy

## Definition and evaluation

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### □ Definition

- ▣ Respect of the musical score
- ▣ Relation between the tones (Dalla Bella et al., 2007, 2009; Pfordresher et al., 2007, 2009, 2010)

### □ Evaluation

Subjective method	Objective method
Judges (experts)	Computer programs
Alcock et al., 2000a, 2000b; Hébert et al., 2003; Lévêque et al., 2012; Racette et al., 2006; Schön et al., 2004; Wise & Sloboda, 2008	Dalla Bella & Berkowska, 2009; Dalla Bella et al., 2007; Lévêque et al., 2009; Pfordresher & Brown, 2007; Pfordresher et al., 2010
Scales or detection of errors Global estimation	F0 extraction Computation of melodic errors

# Singing accuracy

## Melodic errors

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Contour errors



Pitch interval deviation



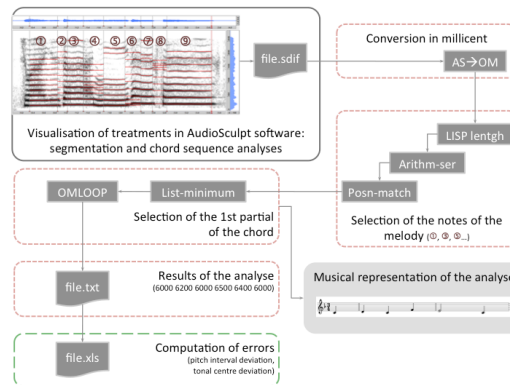
Modulations



# Singing accuracy

## Computer assisted method

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Manual  
segmentation  
AudioSculpt (Ircam)

F0 extraction  
AudioSculpt et OpenMusic  
(Ircam)

Computation of  
errors  
Excel (Microsoft)

# Singing accuracy

## Melodic criteria

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166 performances



<http://sldr.org/sldr000774/en>

Objective  
method  
3 criteria

Subjective  
method  
18 Experts



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

# Singing accuracy

## Melodic criteria

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- 81% of the variance is explained
  - Two criteria
    - Pitch interval deviation ( $\beta = 0.51 ; p < .001$ )
    - Modulations ( $\beta = 0.45 ; p < .001$ )
    - Contour errors (ns)
- ➔ **Singing in tune: respect of the size of the melodic intervals and of the tonality**

# Singing accuracy

## Possible causes

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- **Motivation** (Gould, 1969)
- **Perception** (Amir et al., 2005; Estis et al, 2009; Moore et al., 2007; Nikjeh et al., 2009; Watts et al., 2005)
- **Congenital amusia** (i.e. see Peretz's work)
- **Memory** (Dalla Bella et al., 2012; Estis et al., 2009, 2011)
- **Timbre translation** (Hutchins & Peretz, 2012; Pfordresher & Brown, 2007)
- **Production** (Joyner, 1969; Hutchins & Peretz, 2012; Hutchins, Larrouy-Maestri, & Peretz, in press)

**→ And stress/stage fright/performance anxiety?**



# Stress and singing accuracy

# Stress/Stage fright/Performance anxiety

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- Musical performance in front of an audience brings stress (Craske & Craig, 1984; Hamann & Sobaje, 1983; Kenny, 2011; Yoshie et al., 2008, 2009)

# Stress/Stage fright/Performance anxiety

## Definition(s)

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- Several terms
- Different kinds of anxiety

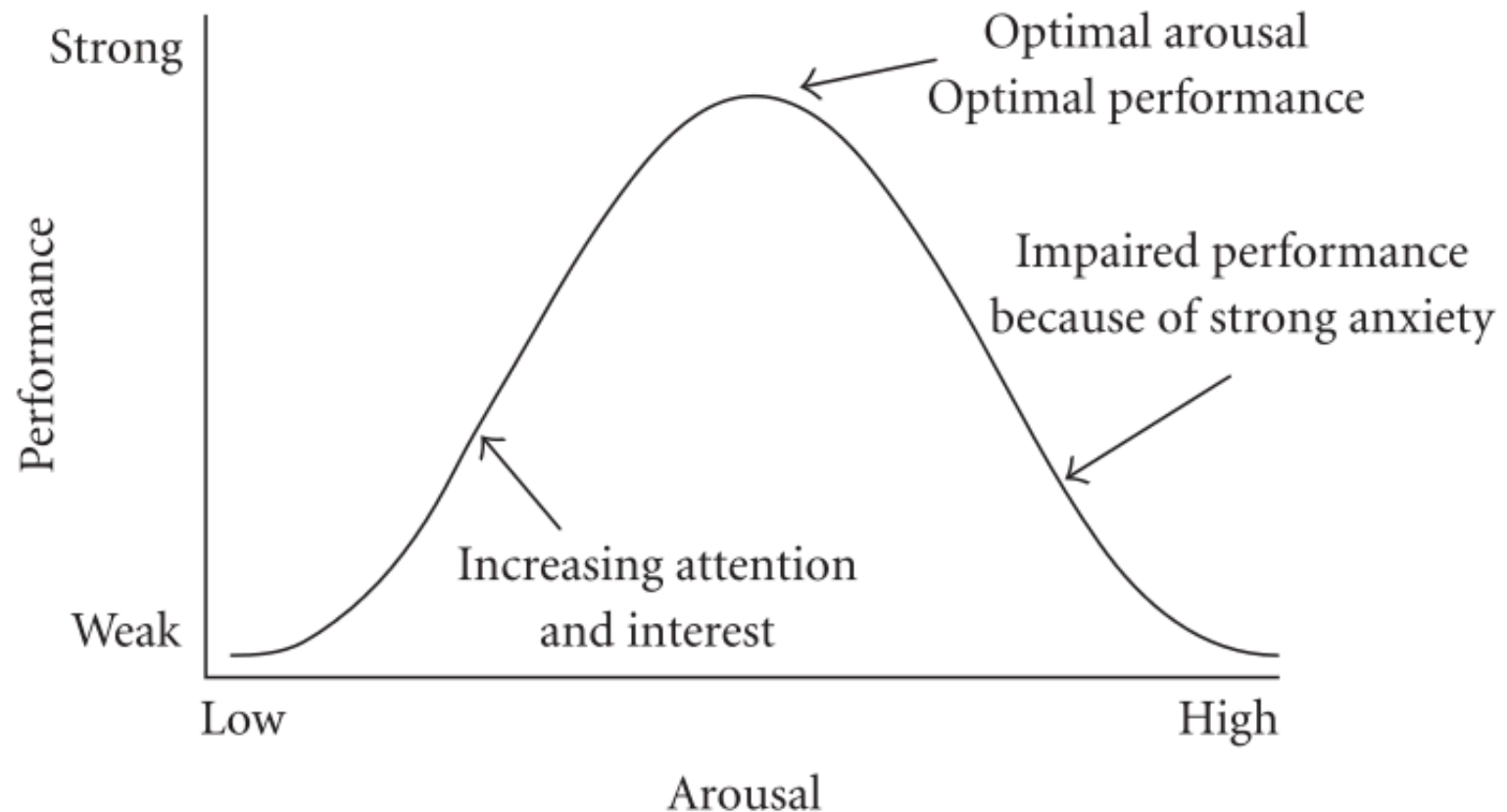
State Anxiety	Trait Anxiety
feeling at the time of a perceived threat	feeling across typical situations that everyone experiences
temporary	on a daily basis

- General definition of stress
  - **Organism's response** to a stressor such as an environmental condition or a stimulus.
  - **Body's method of reacting** to a challenge.
  - Arousal, activity, physical reaction, ...

# Stress/Stage fright/Performance anxiety

## Yerkes-Dobson inverted-U law

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# Stress/Stage fright/Performance anxiety

## Manifestation(s)

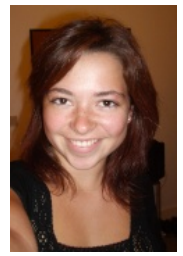
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- Physiological and psychological symptoms (Langendörfer et al., 2006)
  - Cognitive symptoms
  - Somatic symptoms
- Consequences on the voice
  - F0 increases with stress (Streeter et al., 1977; Scherer et al., 1977)
  - F0 decreases with stress (Brenner et al., 1979; Lively et al., 1993)
  - F0 linked with heart rate (Bermudez et al., 2012)

**→ What is the relationship between stress and singing voice?**

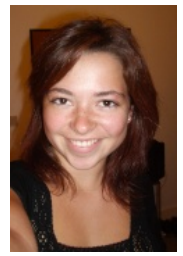
# What is the relationship?





- 31 music students of Conservatory
  - 2 music levels (formative versus summative)
    - 1<sup>st</sup> year: 18 students
    - 2<sup>nd</sup> year: 13 students
- Melody

80 :



- Stress level
  - Heart rate
  - Competitive State Anxiety Inventory – 2 Revised (CSAI-2R)  
(Cox et al., 2003; Martinent et al., 2010)
    - Intensity of cognitive and somative symptoms
    - Direction of these symptoms
- Evaluation of singing accuracy
  - Pitch interval deviation
  - Respect of tonal center

Learning

Habituation

Stressful condition

Nonstressful condition



# Results

## Stress level



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**TABLE 1.**

**Mean and Standard Error (in Parentheses) of the Stress Measurements (Heart Rate, CSAI-2R Questionnaire) for Each Music Level (First and Second), in the Stressful and Nonstressful Conditions**

	Stressful Condition		Nonstressful Condition	
	First Level	Second Level	First Level	Second Level
Heart rate (bpm)	108.78 (7.80)	119.31 (3.78)	91.76 (3.10)	87.30 (4.87)
CSAI-2R				
Somatic symptoms				
Intensity	23.65 (1.35)	23.89 (2.12)	13.65 (1.16)	12.78 (1.22)
Direction	-3.96 (1.57)	-6.11 (2.03)	0.10 (3.72)	8.75 (3.78)
Cognitive symptoms				
Intensity	29.63 (1.71)	24.00 (2.50)	15.25 (1.34)	13.67 (1.95)
Direction	-9.88 (1.88)	-6.67 (2.47)	0.63 (3.06)	9.17 (4.18)

### □ Comparison of conditions (Wilcoxon)

■  $p < .05$  for the two music levels

■  $p < .05$  for each variable measured

# Results

## Stress level



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**TABLE 3.**  
Mean and Standard Error (in Parentheses) for the Changes in the Stress Measurements (Heart Rate, CSAI-2R Questionnaire) Between the Nonstressful and the Stressful Conditions, for Each Music Level (First and Second)

	Descriptive Statistics		Comparison	
	First Level	Second Level	<i>U</i>	<i>P</i> Value
Heart rate (bpm)	17.02 (6.41)	32.01 (6.74)	62.00	0.114
CSAI-2R				
Somatic symptoms				
Intensity	10.00 (1.38)	11.11 (1.91)	87.50	0.687
Direction	-4.06 (3.67)	-14.86 (3.29)	40.50	0.010
Cognitive symptoms				
Intensity	14.37 (1.80)	10.33 (2.10)	63.50	0.129
Direction	-10.50 (3.73)	-15.83 (4.83)	78.50	0.416

Notes: Differences between the two music levels were computed with the Mann-Whitney *U* test.

- No difference between the two music levels
- BUT for the direction of the somatic symptoms

➔ **Examination: stress for everybody**

➔ **Validation of the experimental settings**

# Results

## Singing accuracy



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	1 <sup>st</sup> year (formative)	2 <sup>nd</sup> year (summative)
Precision of intervals	+	ns
Respect of the tonality	ns	-

- ➔ **Effects depend on the music level (challenge)**
- ➔ **Dissociation of the melodic criteria**



- Heart rate and singing accuracy?
  - NO
- Somatic symptoms and singing accuracy?
  - NO
- Cognitive symptoms and singing accuracy?
  - 1st year
    - Precision of intervals and intensity of symptoms:  $r(16) = .52; p = .04$
    - Precision of intervals and direction of symptoms:  $r(16) = .61; p = .01$
  - 2<sup>nd</sup> year
    - Respect of tonality and intensity of symptoms:  $r(12) = .77; p < .01$



- Stress level
  - Higher during solfeggio examination
  - Whatever the music level
  - Perception of symptoms particularly negative for the 2<sup>nd</sup> music level
- Effect on singing accuracy
  - Positive for 1st music level
  - Negative for the 2nd music level

**→ Relationship between perception of symptoms and singing accuracy**

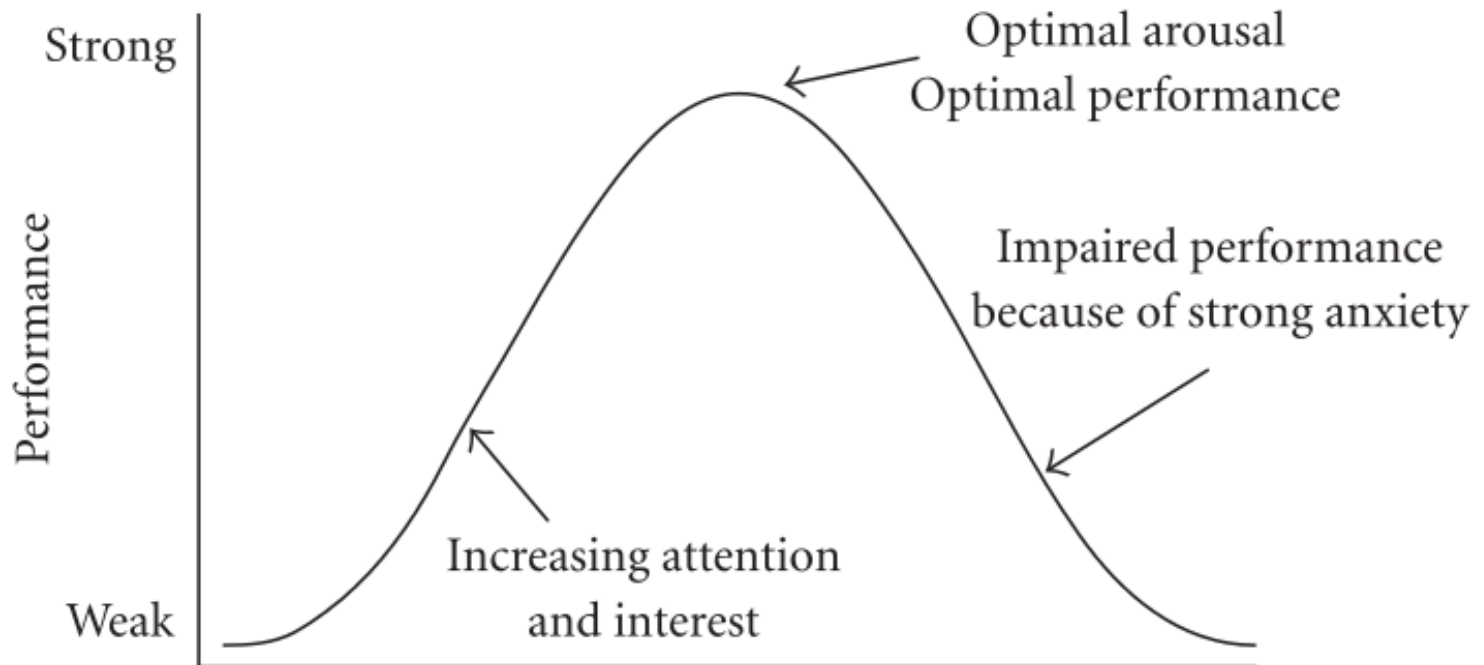
# Discussion

## Stress and singing accuracy

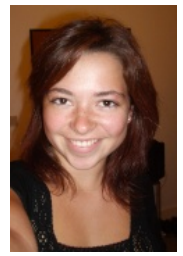


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- Adaptation of the Yerkes-Dobson inverted-U law



**Perception of symptoms  
(Facilitative ... Debilitative)**



## □ Pedagogical context

- Focus on the respect of the tonal center
- Awareness about the influence of symptom perception
- Decrease the “challenge” of the situation

## □ Fundamental research

- Take into account the stress experienced when performing
- Dissociation of melodic errors

## □ Open the door to future passionating studies

- Stress and prosody (actors)
- Stress and trained voices (singers)
- Coping strategies



- Collaboration with the theatre *ALENA*
  - Professional and non professional actors
  - Ecological settings
- Recordings during contrasted conditions
  - Rehearsal
  - First show
  - Other show
- Examination of the stress level
- Acoustical analyse of the prosody
  - Pitch, intensity and rate variations in speech
- ➔ **Stress and speaking accuracy?**





- Operatic voices are complex (Larrouy-Maestri et al., 2014a)
  - ▣ Performance parameters (tempo, pitch accuracy, SPL)
  - ▣ Quality parameters (vibrato rate and extent, singer formant)
  - ▣ Perturbation parameters (jitter, shimmer, NHR)
- Specific definition of singing accuracy (Larrouy-Maestri et al., 2014b)
  - ▣ Importance of performance and quality parameters
  - ▣ All in interaction

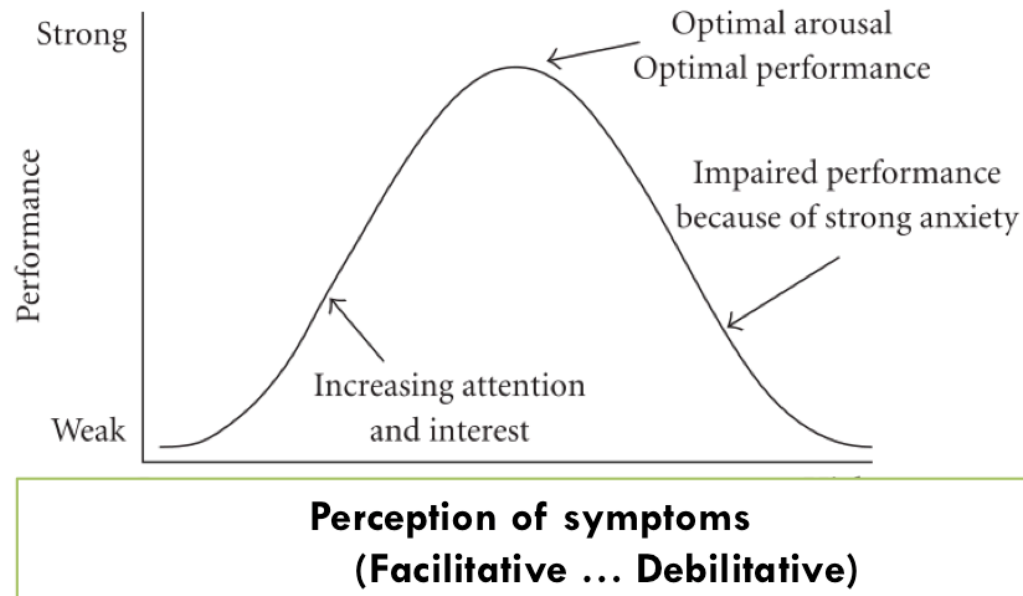
## ➔ Effects of stress on these particular voices?

Larrouy-Maestri, P., Magis, D., & Morsomme, D. (2014a). Effects of melody and technique on acoustical and musical features of Western operatic singing voices. *Journal of Voice*.

Larrouy-Maestri, P., Magis, D., & Morsomme, D. (2014b). The evaluation of vocal pitch accuracy: The case of operatic singing voices. *Music Perception*.



- We know:
  - ▣ How to measure the quality of a performance
  - ▣ How to measure the perception of stress

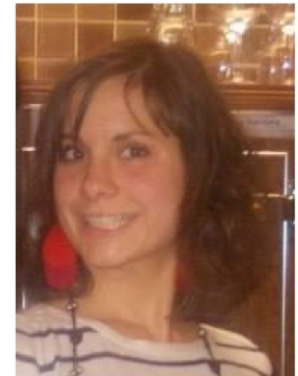


→ We can examine the effects of coping strategies !

# Stress and singing voice

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Thank  
you



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