

Module VI.

Music, Speech and Emotion



Lesson 1.

Speech Prosody and Musical Intervals

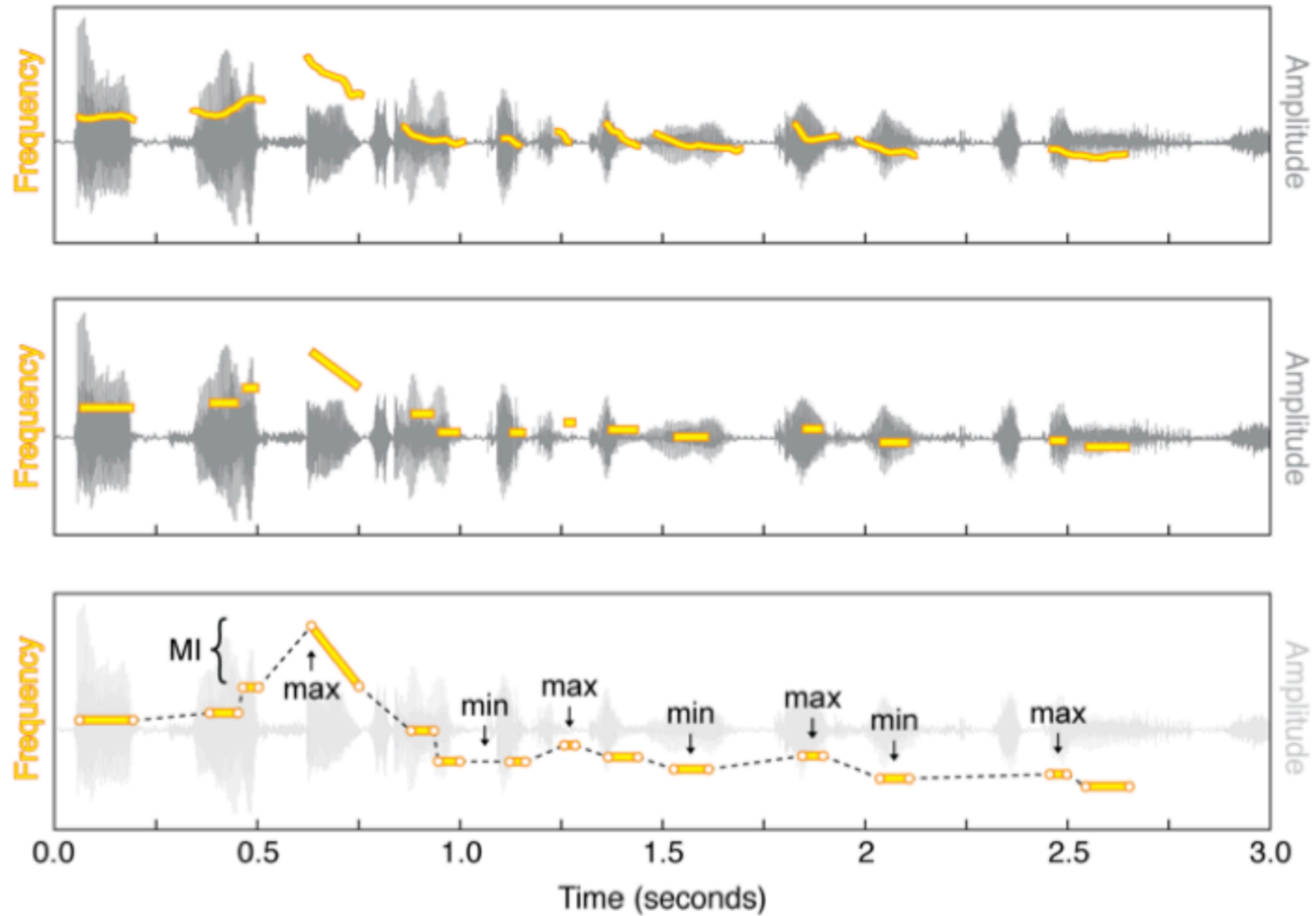


Lesson 1. Introduction to Emotion

A standard description of emotional states



Determining speech prosody



Speech prosody in different languages

English Monologue

“I applied for a job that would give me a good work experience. I was placed in a department that I like and my boss seems like a reasonable guy. My co-workers are also nice, although I don't really get together with them very often outside the office. Overall, I am very satisfied with my new position”

French Monologue

“Je viens de'être engage poste qui va me donner une bonne experience professionnelle. Je suis dans un département que j'aime et mon chef semble être une personne raisonnable. Mes collègues sont aussi très sympas bien que je ne sorte pas souvent avec eux. Globalement je suis très satisfait de mon nouveau travail.”

German Monologue

“Ich habe mich für einen Job beworben, in dem ich viel Erfahrung sammeln kann. Die Abteilung, in der ich eingesetzt werde, gefällt mir gut, und mein Chef scheint auch vernünftig zu sein. Meine Kollegen sind auch sehr nett, aber außerhalb der Arbeit treffe ich sie nicht sehr häufig. Insgesamt bin ich mit meiner neuen Stelle sehr häufig. Insgesamt bin ich mit meiner neuen Stelle sehr zufrieden.”

Mandarin Monologue

“一直以来，我期望第一份工作能够是一个好的开始。很幸运，我找到了一份自己喜欢的工作，而且还有一个还算不错的老板。同事们人都很好。不过下班后我很少参加他们的活动。总之，我对这份工作很满意。”

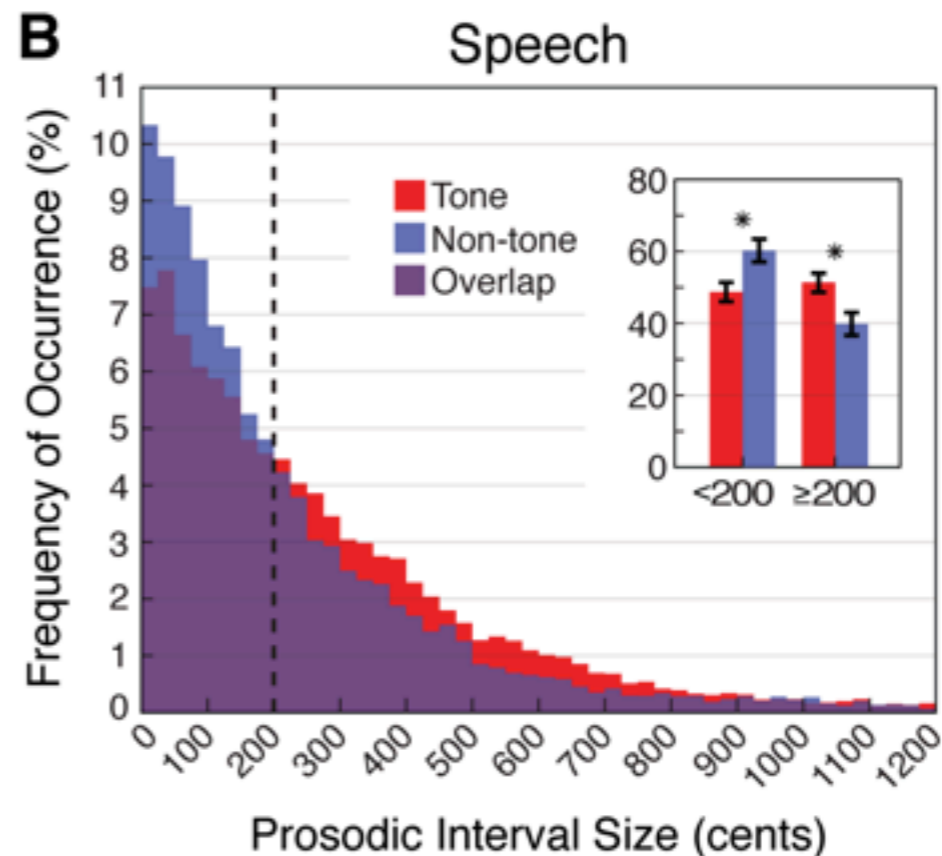
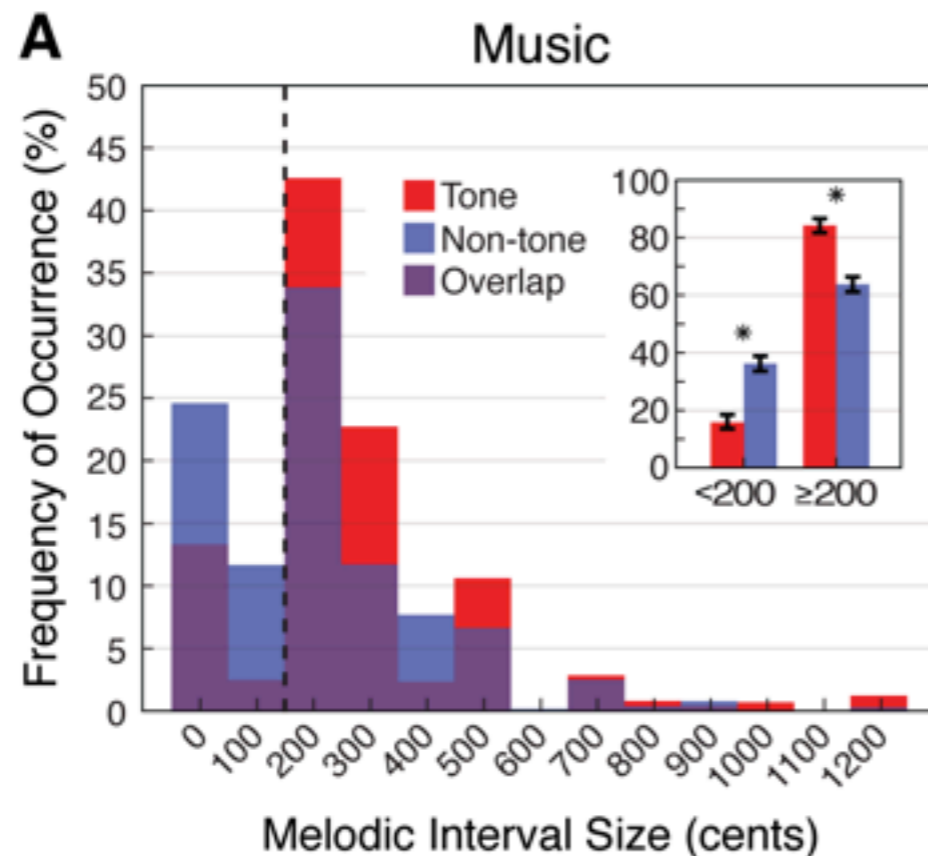
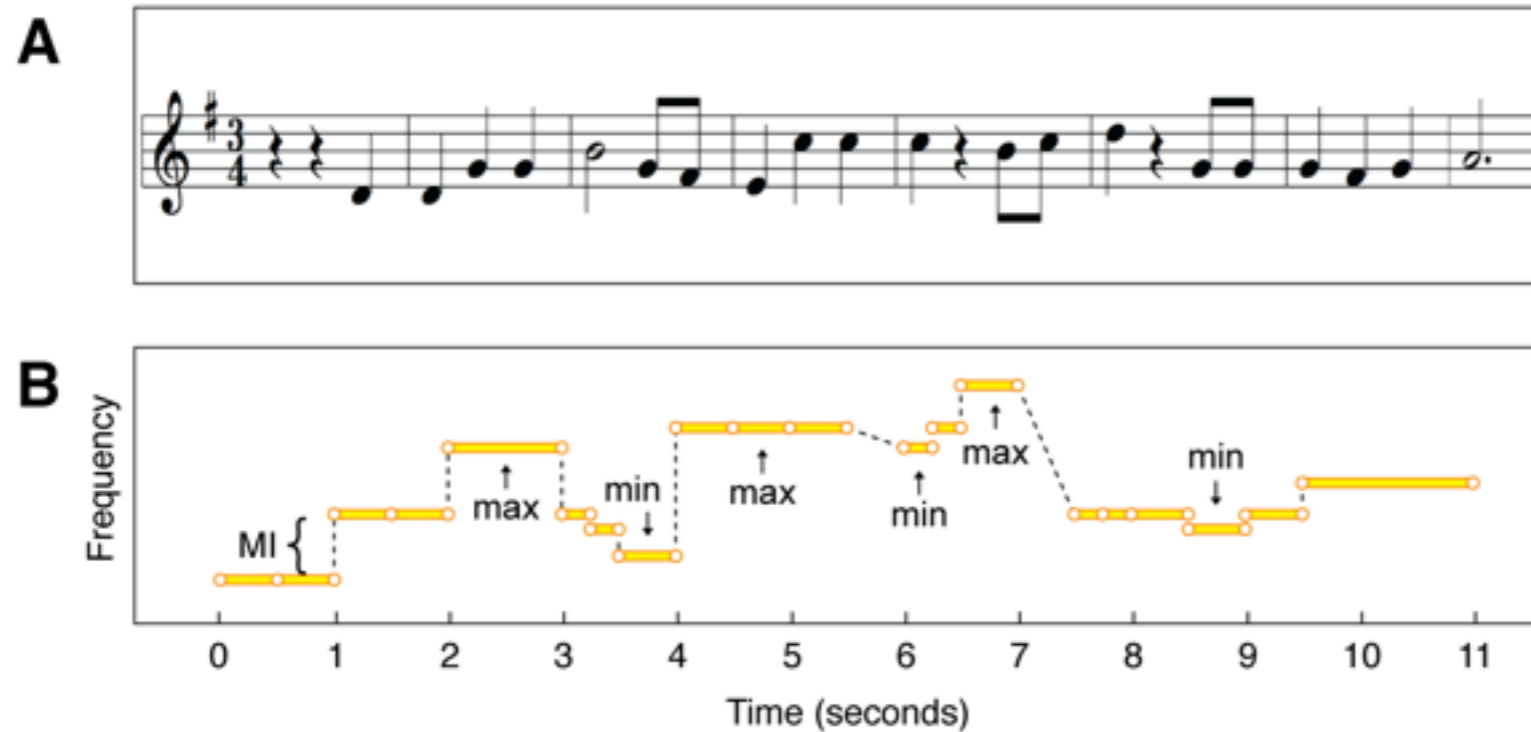
Vietnamese Monologue

“Tôi kiếm được một việc mà tôi nghĩ sẽ học hỏi được nhiều kinh nghiệm. Tôi được xếp vào một phòng tôi thích và sếp tôi có vẻ là một ông sếp tốt. Đồng nghiệp của tôi cũng rất dễ thương, mặc dù tôi không đi chơi với họ sau giờ làm. Nhìn chung, tôi rất hài lòng với công việc mới của mình.”

Thai Monologue

“ตอนนี้ฉันได้งานใหม่แล้ว ฉันว่าจะไปได้ดี หวังเป็นงานที่ฉันชอบ เจ้านายก็ทำทางเป็นคนมีเหตุผล และเพื่อนร่วมงานก็น่ารัก แต่ฉันไม่ค่อย ได้ออก ไปไหนกับพวกเขาเท่าไร โดยรวมๆ ตอนนี้ฉันพอใจกับชีวิตฉันมากเลยทีเดียว”

Comparison of interval size in the speech and music of tone and non-tone language cultures



Lesson 2.

Introduction to Emotion



Faces



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A standard description of emotion

(B) Circumplex model



Lesson 3.

Emotions Elicited by Major
versus Minor Scales



The differences between major and minor scales

[Demonstration of major and minor etc.]

A Diatonic Modes

Ionian	Dorian	Phrygian	Lydian	Mixolydian	Aeolian	Locrian
P1	P1	P1	P1	P1	P1	P1
M2	M2	m2	M2	M2	M2	m2
M3	m3	m3	M3	M3	m3	m3
P4	P4	P4	tt	P4	P4	P4
P5	P5	P5	P5	P5	P5	tt
M6	M6	m6	M6	M6	m6	m6
M7	m7	m7	M7	m7	m7	m7
P8	P8	P8	P8	P8	P8	P8

“Major”

“Minor”

B Major and Minor Modes



Lesson 4.

An Empirical Analysis of Major
and Minor Music



Classical and folk Melodies Using Major vs. Minor Scales

A Major Melodies

Intervals	Classical (%)	Folk (%)
Unison/Octave	23.1	22.5
Minor Second	0.4	0.1
Major Second	11.6	15.4
Minor Third	0.9	0.0
Major Third	17.2	16.2
Perfect Fourth	8.7	8.5
Tritone	1.0	0.4
Perfect Fifth	21.6	21.3
Minor Sixth	0.7	0.0
Major Sixth	8.0	8.4
Minor Seventh	0.7	0.2
Major Seventh	6.2	6.9

B Minor Melodies

Intervals	Classical (%)	Folk (%)
Unison/Octave	22.8	20.5
Minor Second	0.6	0.1
Major Second	10.7	19.2
Minor Third	14.4	14.1
Major Third	0.7	0.2
Perfect Fourth	8.7	9.1
Tritone	1.4	0.2
Perfect Fifth	23.3	22.6
Minor Sixth	7.8	1.4
Major Sixth	1.2	2.5
Minor Seventh	3.6	7.2
Major Seventh	4.9	3.1

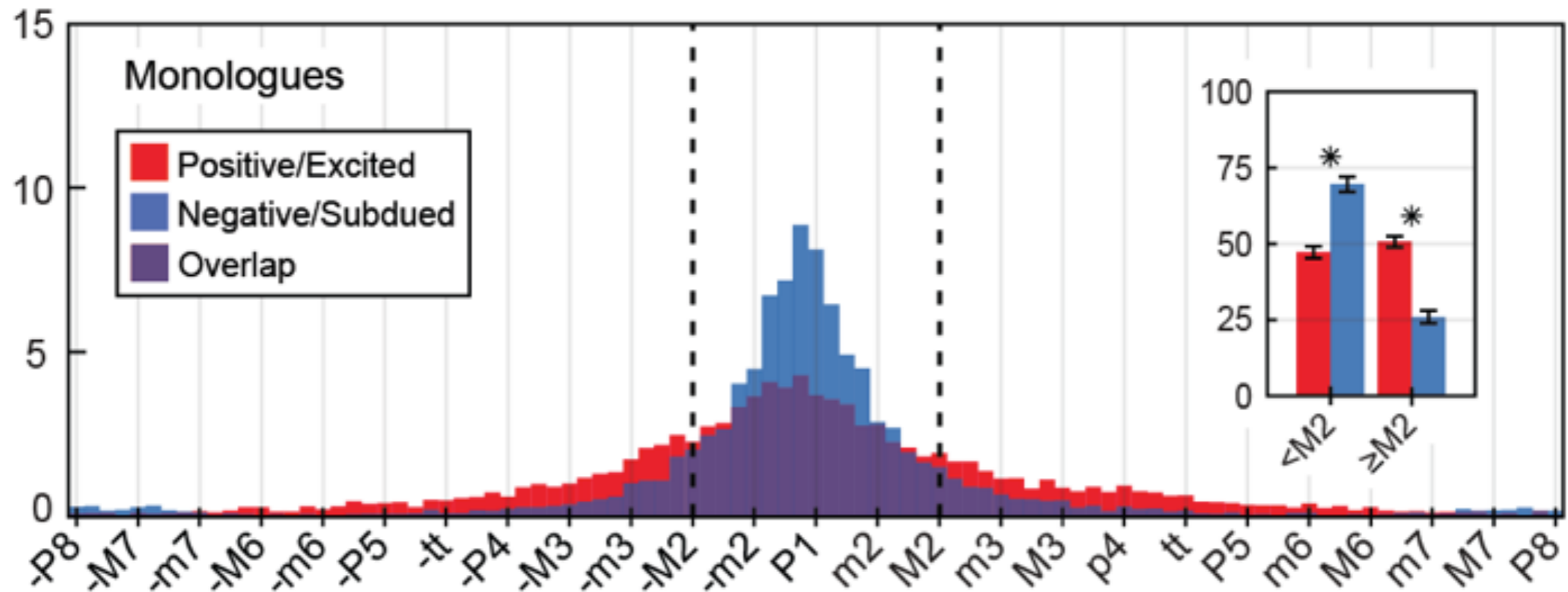


Lesson 5.

Comparison of Major and Minor Music
with Speech in Different Emotional States

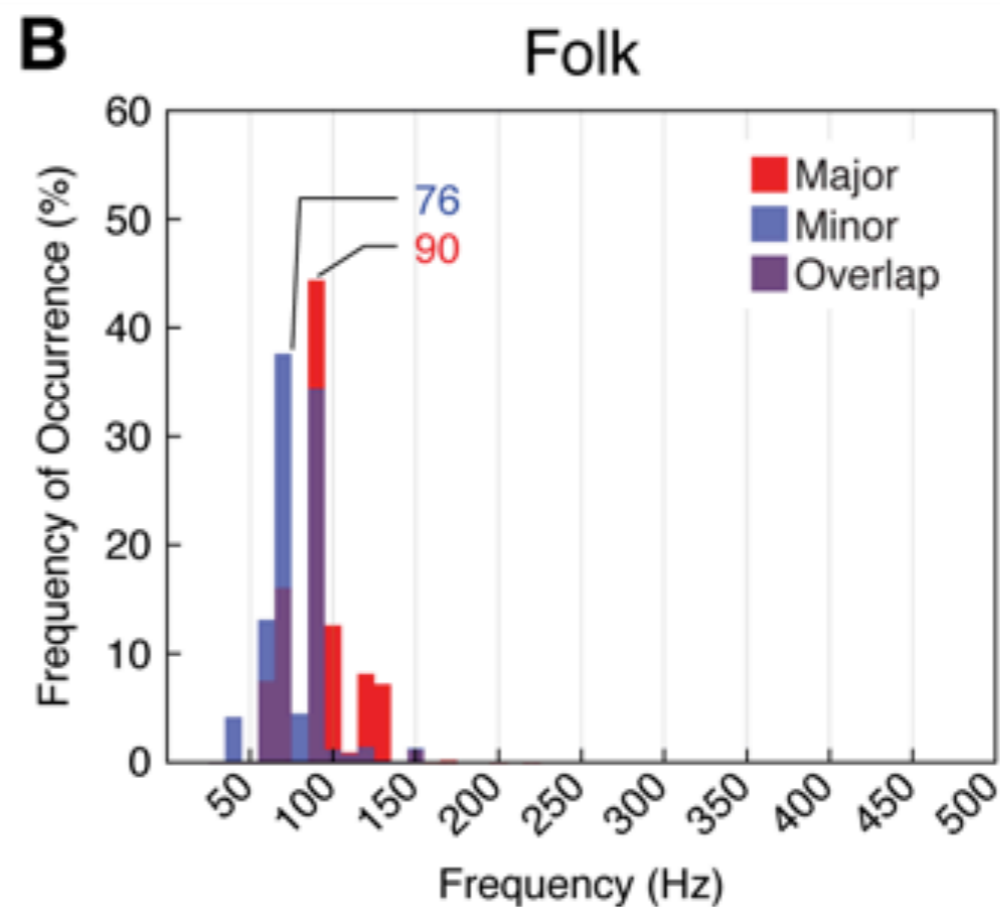
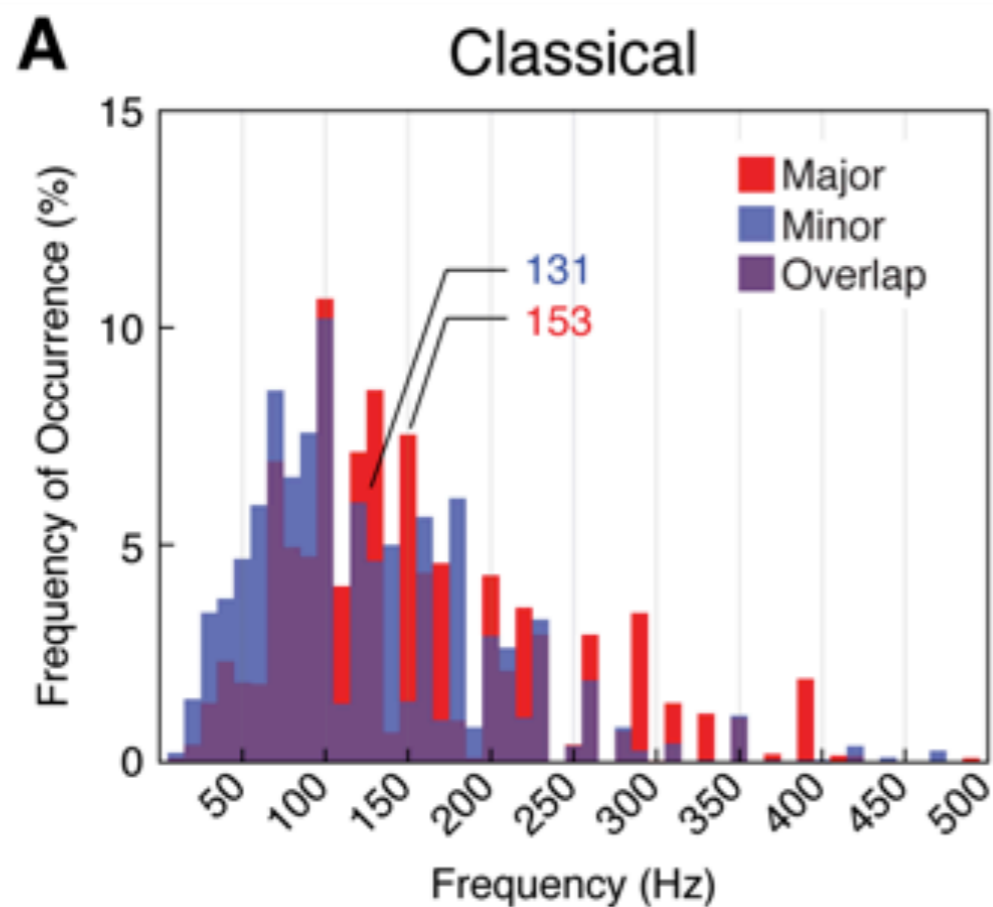
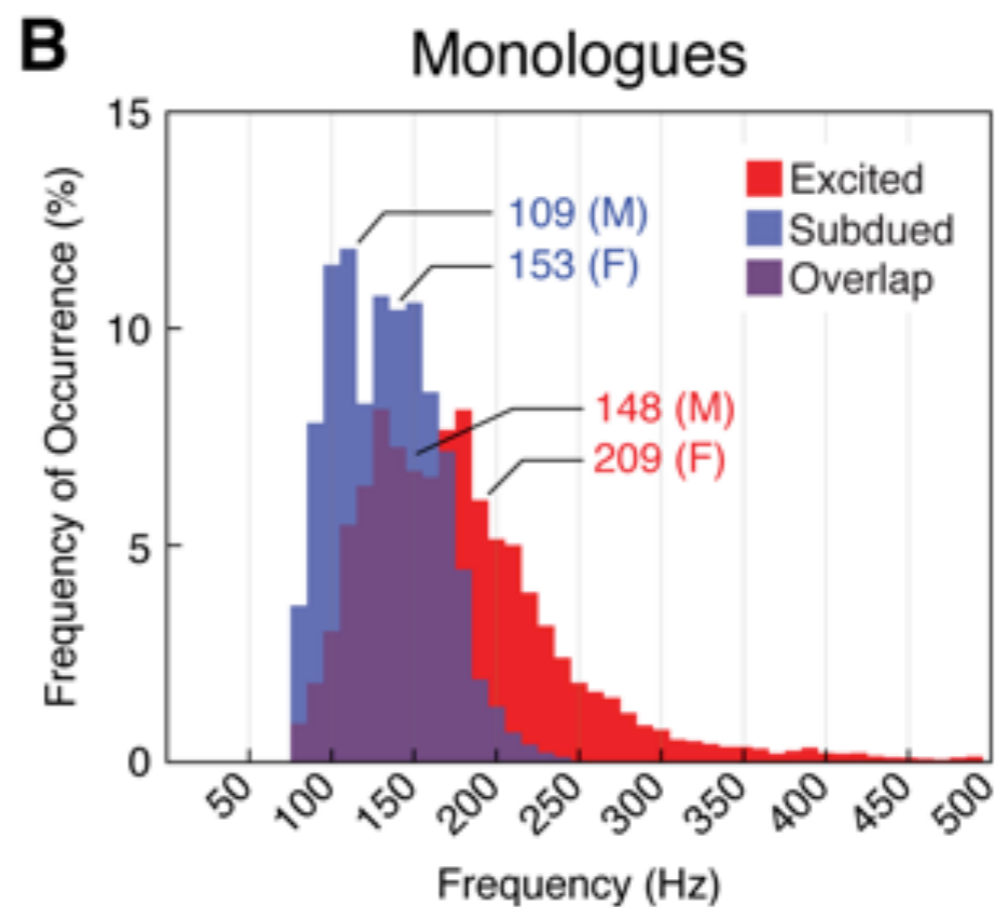
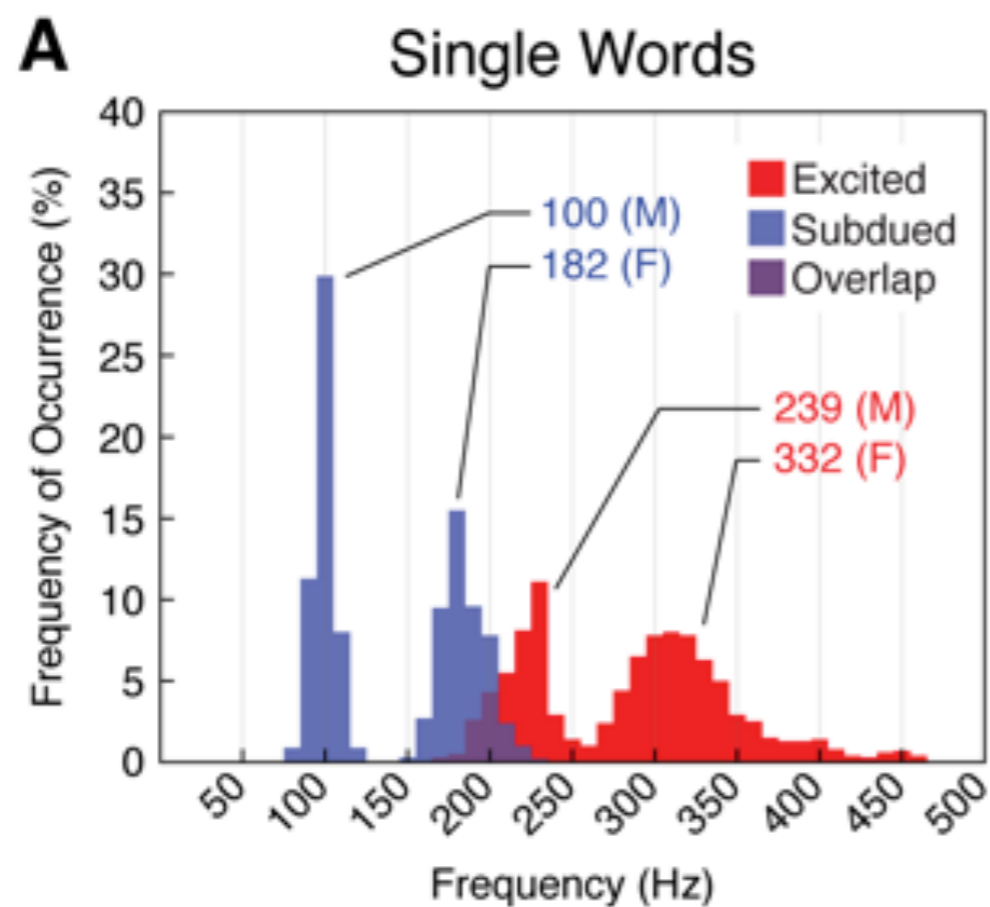


Speech uttered in different emotional states



*Note that there are no musical intervals as such in speech





Lesson 6.

Expression of Emotion in Eastern
and Western Music



Similarity of Classical Eastern and Western Scales

A Twelve-tone system of Carnatic music

Interval Name(s)	Abbreviation(s)	Frequency Ratio	JI (Cents)	12-TET (Cents)
- Sa	S	1 : 1	0	0
- Shuddha Ri	R1	16 : 15	112	100
- Chathusruthi Ri or Shuddha Ga	R2 or G1	9 : 8	204	200
- Shatsruthi Ri or Sadharana Ga	R3 or G2	6 : 5	316	300
- Anthara Ga	G3	5 : 4	386	400
- Shuddha Ma	M1	4 : 3	498	500
- Prati Ma	M2	45 : 32	590	600
- Pa	Pa	3 : 2	702	700
- Shuddha Dha	D1	8 : 5	814	800
- Chathusruthi Dha or Shuddha Ni	D2 or N1	27 : 16	906	900
- Shatsruthi Dha or Kaisiki Ni	D3 or N2	9 : 5	1018	1000
- Kakali Ni	N3	15 : 8	1088	1100
- Sa	Ś	2 : 1	1200	1200

B Chromatic scale of Western music

Interval Name(s)	Abbreviation(s)	Frequency Ratio	JI (Cents)	12-TET (Cents)
- Perfect Unison	P1	1 : 1	0	0
- Minor Second	m2	16 : 15	112	100
- Major Second	M2	9 : 8	204	200
- Minor Third	m3	6 : 5	316	300
- Major Third	M3	5 : 4	386	400
- Perfect Fourth	P4	4 : 3	498	500
- Tritone	tt	7 : 5	583	600
- Perfect Fifth	P5	3 : 2	702	700
- Minor Sixth	m6	8 : 5	814	800
- Major Sixth	M6	5 : 3	884	900
- Minor Seventh	m7	9 : 5	1018	1000
- Major Seventh	M7	15 : 8	1088	1100
- Perfect Octave	P8	2 : 1	1200	1200

Similarity of Eastern ragas and Western Modes

A Carnatic Indian ragas

Emotional Theme	Name of raga	Interval Names (abbr.) (↑ = ascending) (↓ = descending)	Number of melodies examined
Positive / excited	<i>Bilahari</i>	↑ S, R2, G3, P, D2, Ś ↓ Ś, N3, D2, P, M1, G3, R2, S	51
	<i>Mohanam</i>	↑ S, R2, G3, P, D2, Ś ↓ Ś, D2, P, G3, R2, S	42
Negative / subdued	<i>Naadana-amakriya</i>	↑ N3, S, R1, G3, M1, P, D1, N3 ↓ N3, D1, P, M1, G3, R1, S, N3	5
	<i>Punnaag-avaraali</i>	↑ N2, S, R1, G2, M1, P, D1, N2 ↓ N2, D1, P, M1, G2, R1, S, N2	39
	<i>Varaali</i>	↑ S, G1, R1, G1, M2, P, D1, N3, Ś ↓ Ś, N3, D1, P, M2, G1, R1, S	57

B Western Modes

Emotional Theme	Name of mode	Interval Names (abbr.) (↑ = ascending) (↓ = descending)	Number of melodies examined
Positive / excited	Major	↑ P1, M2, M3, P4, P5, M6, M7, P8 ↓ P8, M7, M6, P5, P4, M3, M2, P1	566
Negative / subdued	Minor	↑ P1, M2, m3, P4, P5, m6, m7, P8 ↓ P8, m7, m6, P5, P4, M3, M2, P1	376



A Interval prevalence in Carnatic Indian melodies

Bin Center (cents)	Approx. Interval	Positive/excited raga melodies	Negative/subdued raga melodies	Degrees of freedom	t-statistic	P-values
Tonic Intervals						
Positive/excited raga > Negative/subdued raga						
900 *	M6	19.9%	0%	192	39.66	2x10 ⁻⁹⁴
400 *	M3	16.8%	0.9%	192	27.36	3.5x10 ⁻⁶⁸
200 *	M2	17.5%	7.3%	192	11.87	0
0/1200 *	P1/P8	19%	14.9%	192	4.75	3.9x10 ⁻⁶
700	P5	17.8%	16.7%	192	1.34	0.18
Positive/excited raga < Negative/subdued raga						
100 *	m2	0%	15.9%	192	-23.56	1.5x10 ⁻⁵⁸
800 *	m6	0%	12.3%	192	-19.39	4.1x10 ⁻⁴⁷
300 *	m3	0%	8%	192	-7.3	6.7x10 ⁻¹²
600 *	tt	0%	6.6%	192	-9.64	0
500 *	P4	3.7%	7.4%	192	-3.58	4.4x10 ⁻⁴
1100 *	M7	4.5%	7.3%	192	-3.29	1.2x10 ⁻³
1000 *	m7	0.8%	2.6%	192	-4.23	3.6x10 ⁻⁵
Melodic Intervals						
Positive/excited raga > Negative/subdued raga						
200 *	M2	55%	23.2%	192	12.47	0
300 *	m3	19.3%	8.7%	192	8.37	1.2x10 ⁻¹⁴
500 *	P4	3.5%	1.5%	192	6.31	1.8x10 ⁻⁹
700 *	P5	0.7%	0.4%	192	2.15	0.032
0	P1	11.5%	11.1%	192	0.38	0.71
900	M6	0.1%	0%	192	1.78	0.076
>1200	>P8	0%	0%	192	1.33	0.18
Positive/excited raga < Negative/subdued raga						
100 *	m2	8.3%	48.7%	192	-17.87	1.1x10 ⁻⁴²
400 *	M3	1.3%	5.5%	192	-9.03	2.2x10 ⁻¹⁶
600 *	tt	0%	0.4%	192	-3.68	3x10 ⁻⁴
800 *	m6	0%	0.2%	192	-1.9	0.058
1000	m7	0.1%	0.1%	192	-0.08	0.94
1100	M7	0%	0.1%	192	-0.72	0.41
1200	P8	0%	0.1%	192	-0.82	0.49

B Interval prevalence in classical Western melodies

Bin Center (cents)	Approx. Interval	Major melodies	Minor melodies	Degrees of freedom	t-statistic	P-values
Tonic Intervals						
Major > Minor						
400 *	M3	18.1%	0.8%	202	32.42	0
900 *	M6	8.4%	1.4%	202	16.12	0
1100 *	M7	7.7%	5.3%	202	5.06	5.1x10 ⁻⁷
0/1200	P1/P8	20.2%	19.7%	202	0.68	0.5
Minor < Major						
300 *	m3	0.9%	15.6%	202	-36.98	0
800 *	m6	0.6%	7.8%	202	-20.97	0
1000 *	m7	0.7%	3.4%	202	-9.56	0
700	P5	19.2%	20.6%	202	-2.01	0.05
600	tt	1.2%	1.6%	202	-1.53	0.13
500	P4	10.1%	10.4%	202	-0.46	0.65
200	M2	12.6%	12.8%	202	-0.43	0.67
100	m2	0.4%	0.6%	202	-1.29	0.2
Melodic Intervals						
Major > Minor						
200 *	M2	33.8%	26.9%	940	5.94	4.0x10 ⁻⁹
400 *	M3	7.4%	5.5%	940	3.66	2.7x10 ⁻⁴
0	P1	11.1%	10.7%	940	0.4	0.69
500	P4	8%	7.6%	940	0.69	0.49
900	M6	1.4%	1.2%	940	1.06	0.29
>1200	>P8	1%	0.9%	940	0.64	0.52
1200	P8	1.3%	1.2%	940	0.37	0.71
1000	m7	0.4%	0.4%	940	0.62	0.53
Minor < Major						
100 *	m2	21%	28.2%	940	-7.12	2.2x10 ⁻¹²
300 *	m3	9.8%	11.1%	940	-2.01	0.044
800 *	m6	1.3%	2%	940	-2.76	5.9x10 ⁻³
600 *	tt	0.5%	1.1%	940	-3.01	2.7x10 ⁻³
700	P5	3%	3.3%	940	-0.92	0.36
1100	M7	0.1%	0.1%	940	-0.12	0.9

Demonstration of Carnatic singing

The Main Points

- Speech prosody is the analog of changes in musical intervals in a melody
- Tone language cultures use larger intervals in both speech and music
- Excited and subdued emotions in music and speech is conveyed by modulated the size of the intervals used, explaining major vs. minor music
- This tendency is evident in both classical Eastern and Western music



Summing up:

- Musical tonality and its attraction can be largely explained by biological importance of recognizing conspecific vocalization
- The phenomena that can be rationalized on this basis are octave similarity, many aspects of scales, the genesis of emotion elicited by music and similarities and differences in music across cultures
- Any animal that vocalizes harmonically could in principle appreciate music but are unlikely to go very far in this direction because the limited social interactions compared to humans

