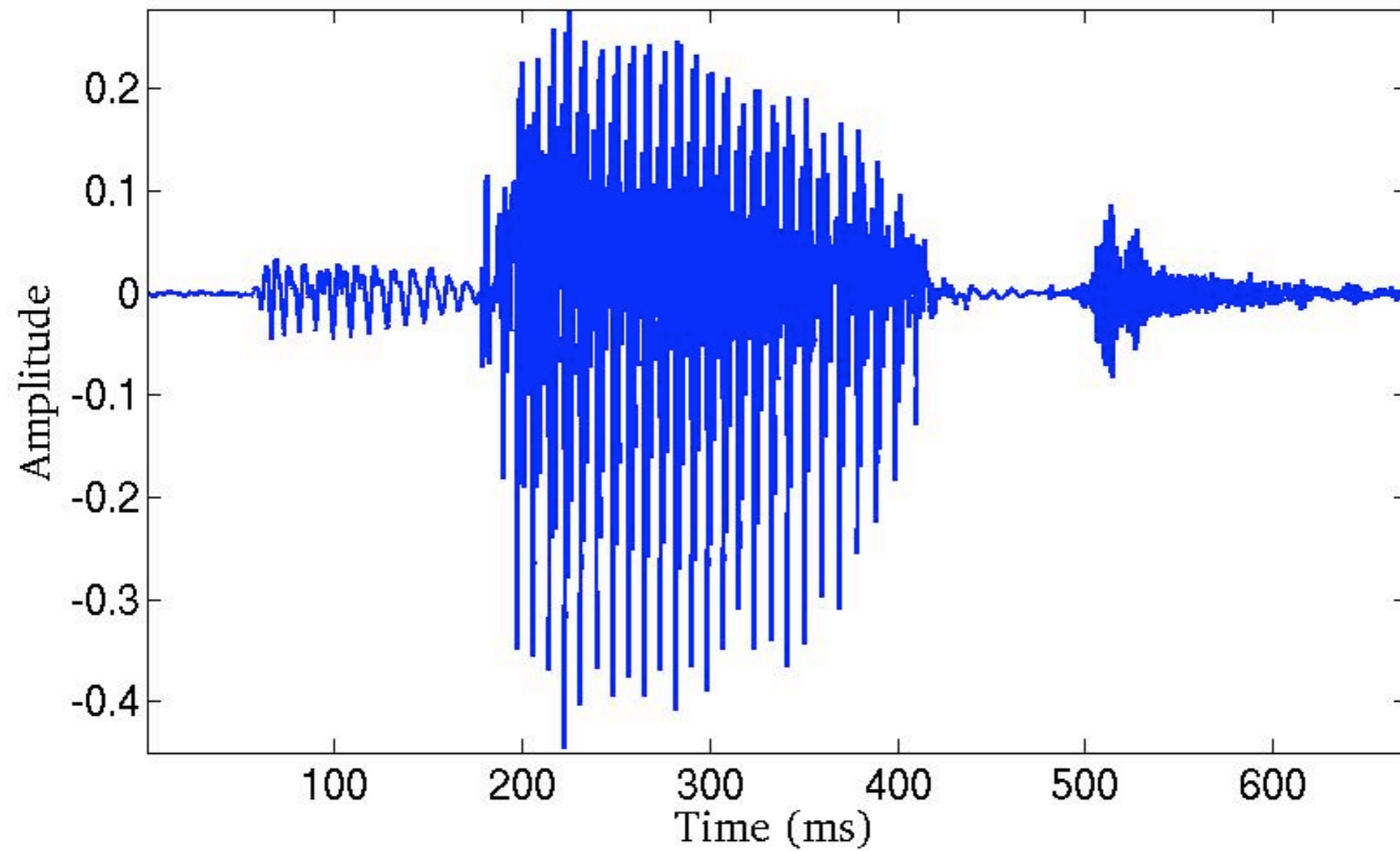
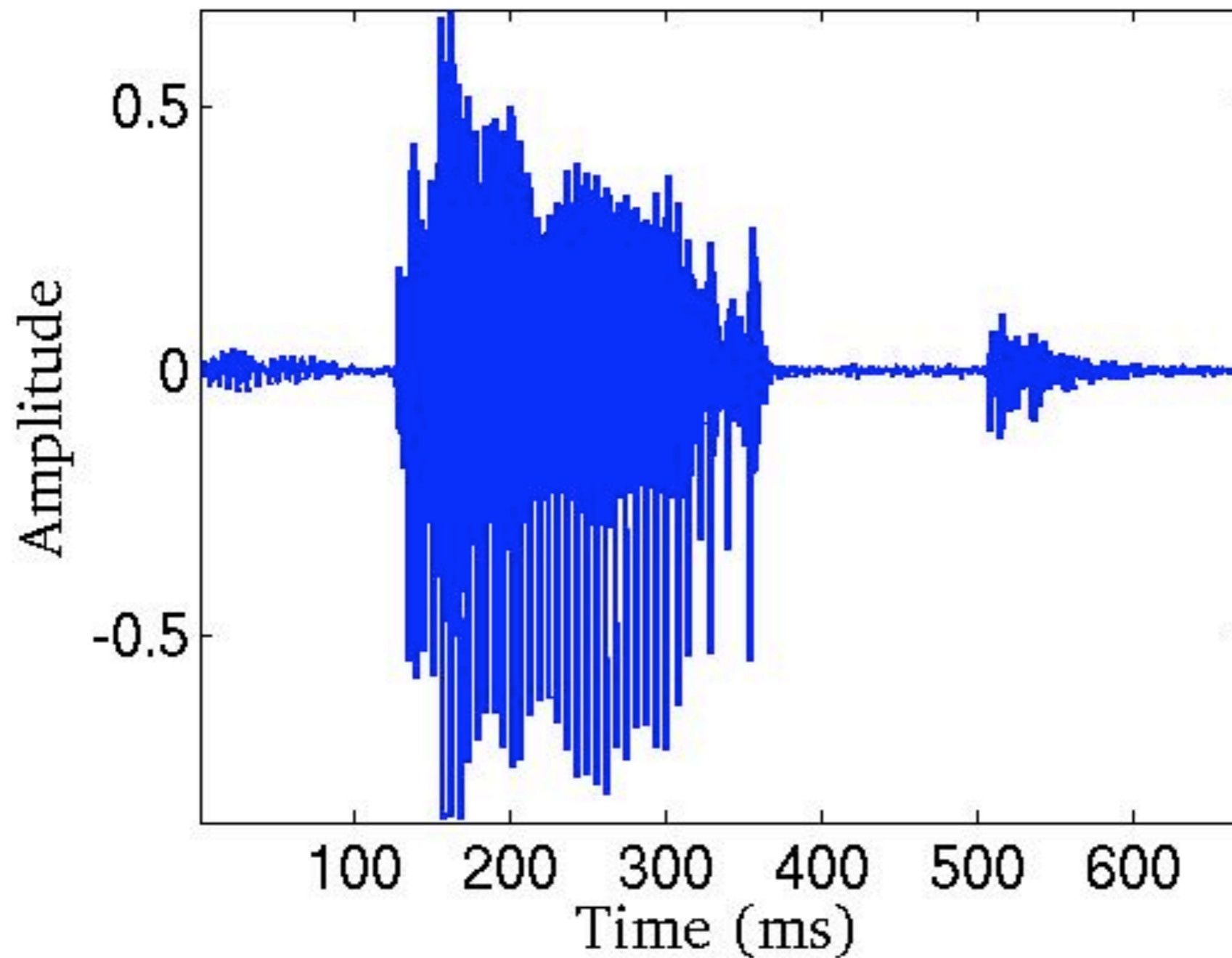


**Can we recognize
speech ?**

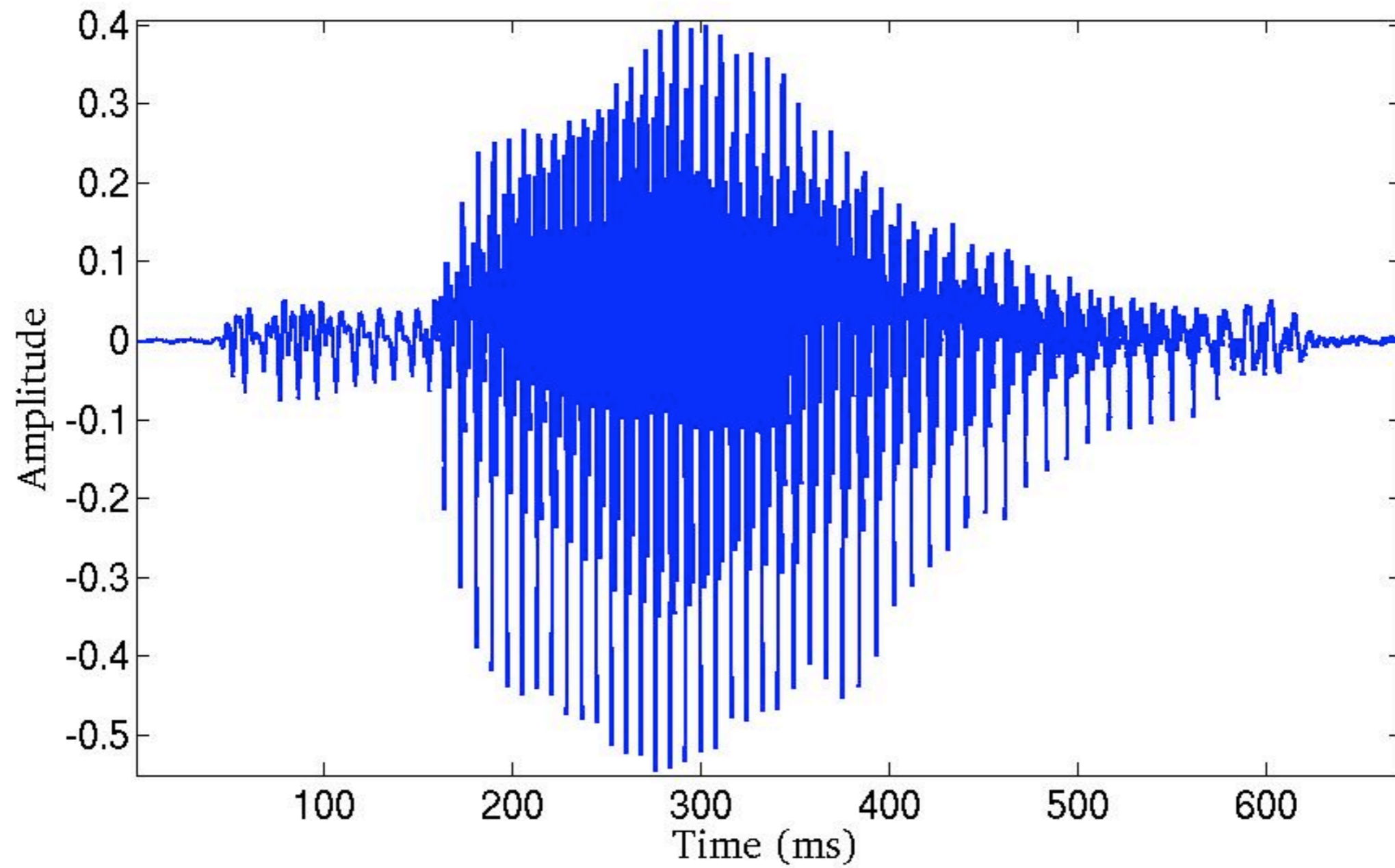
/Bat/ - male



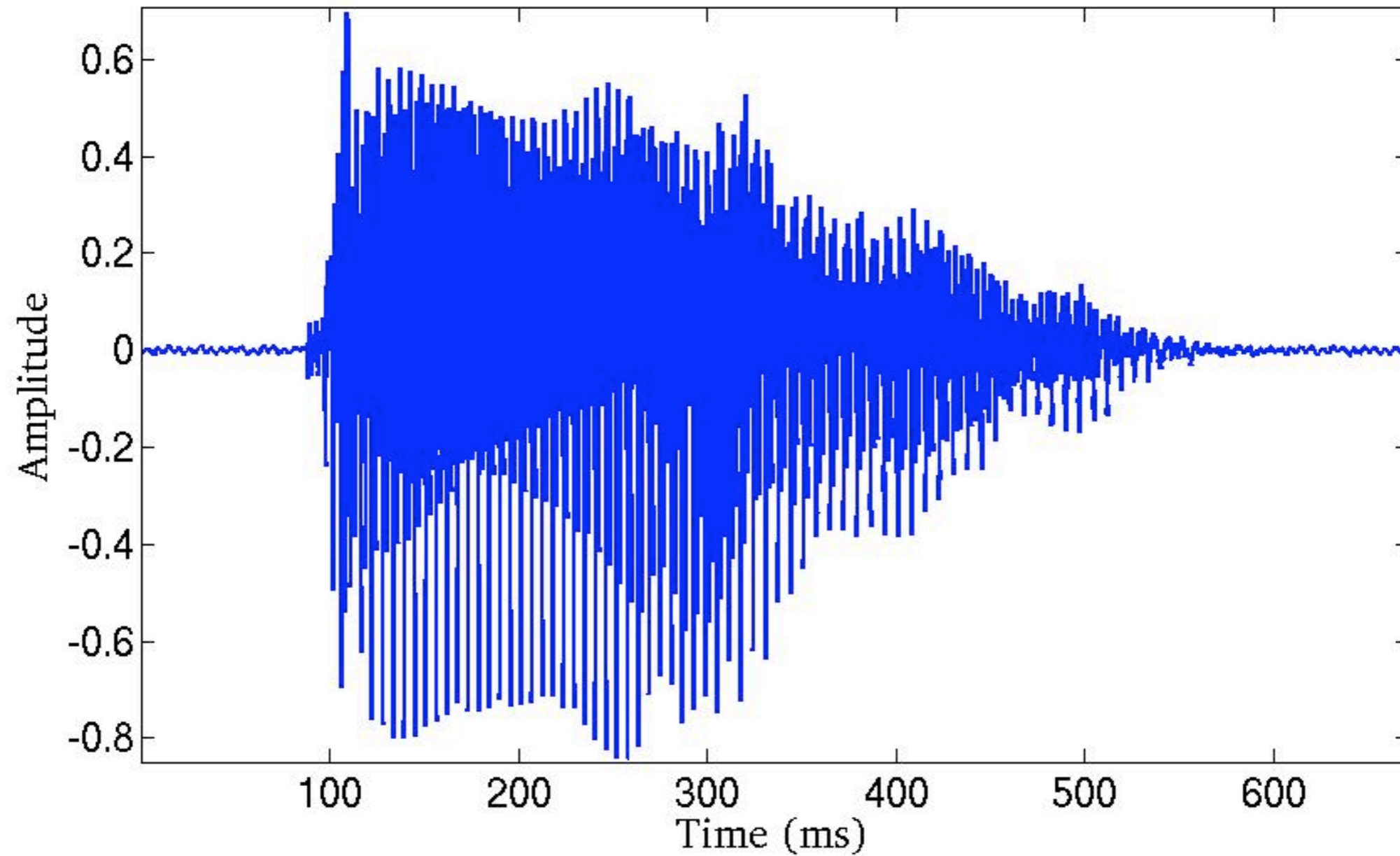
/Bat/ - female



/Boy/ - male



/Boy/ - female



How can we recognize ?

Recognition

- Distance Measure
 - Euclidean Distance

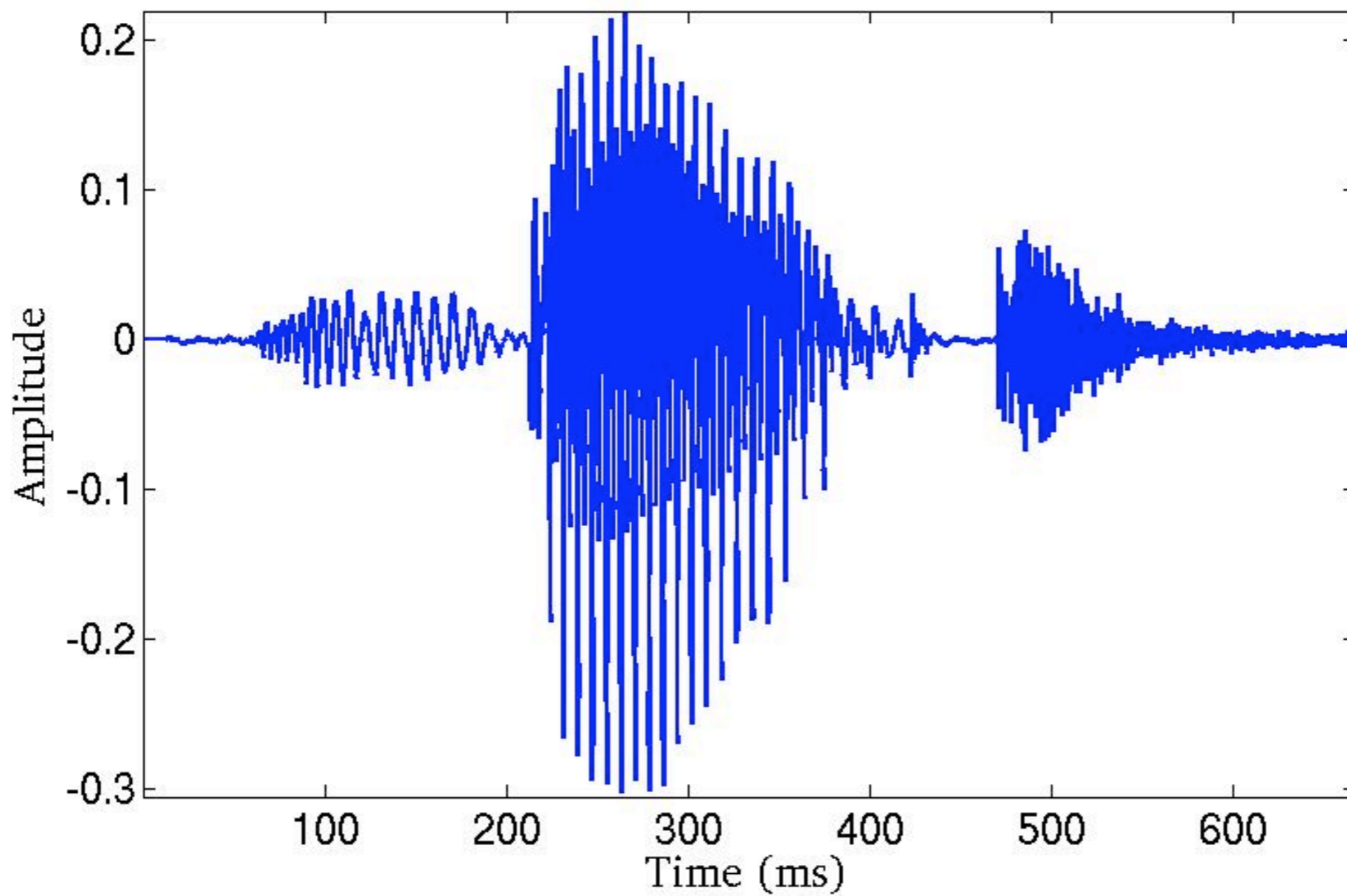
$$E = \sum_n (x[n] - y[n])^2$$

	/bat/- male	/bat/- female	/boy/ - male	/boy/ - female
/bat/- male	0	14.5	13.7	22.1
/bat/- female	14.5	0	17.6	26.1
/boy/ - male	13.7	17.6	0	23.9
/boy/ - female	22.1	26.1	23.9	0

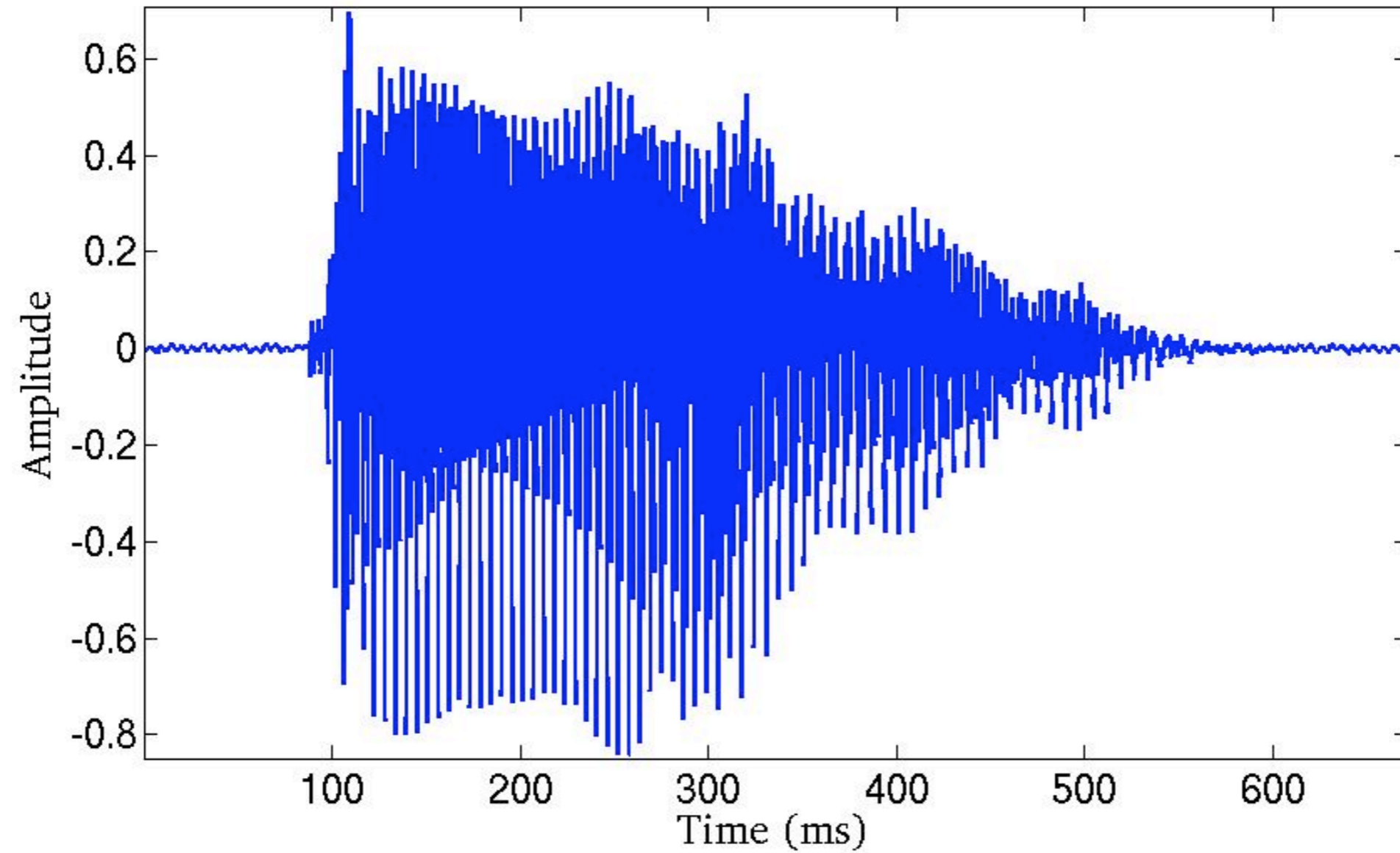
Good 1

Bad 4

/Beat/ - male



/Beat/ - female

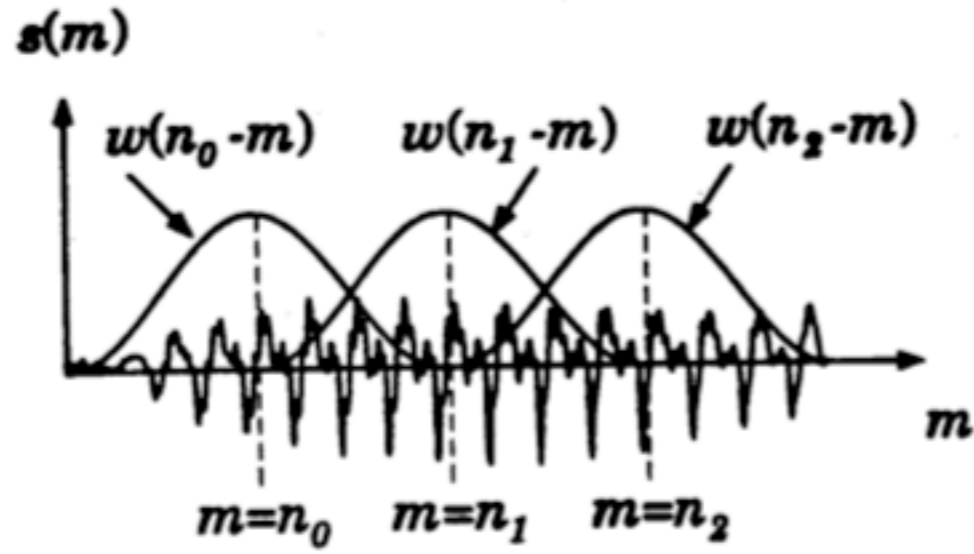


	/bat/- male	/bat/- female	/boy/ - male	/boy/ - female	/beat/ - male	/beat/ - female
/bat/- male	0	14.5	13.7	22.1	8.4	10.0
/bat/- female	14.5	0	17.6	26.1	13.9	15.0
/boy/ - male	13.7	17.6	0	23.9	13.2	14.2
/boy/ - female	22.1	26.1	23.9	0	21.7	22.5
/beat/ - male	8.4	13.9	13.2	21.7	0	9.2
/beat/ - female	10	15.0	14.2	22.5	9.2	0

Good 1

Bad 12

Can we improve ?

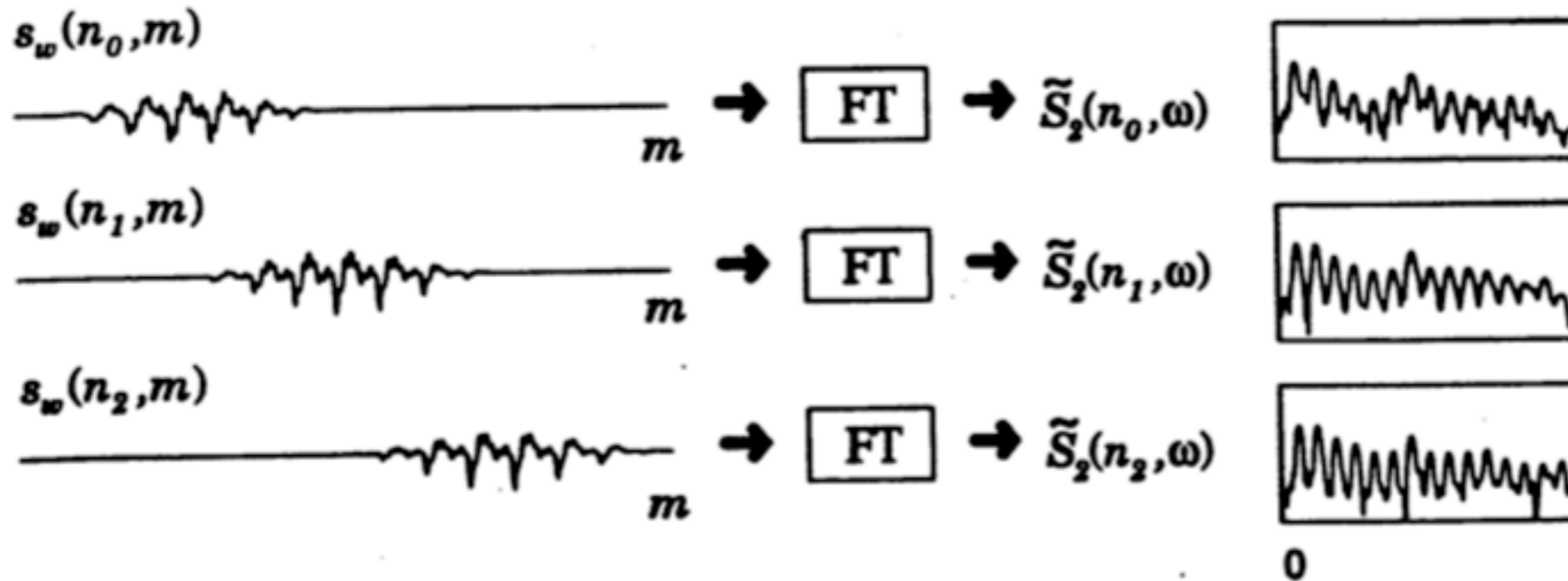


1D



2D

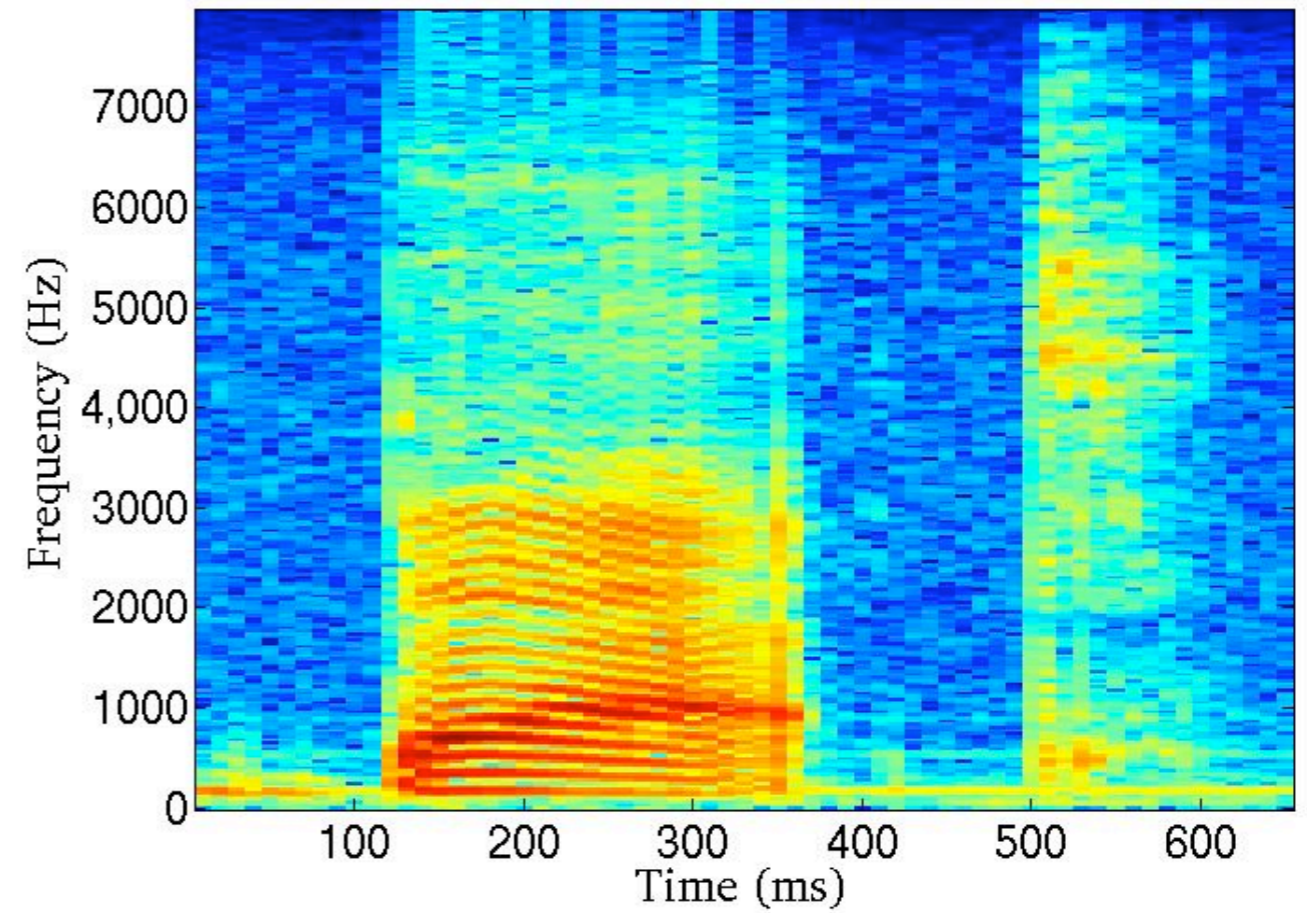
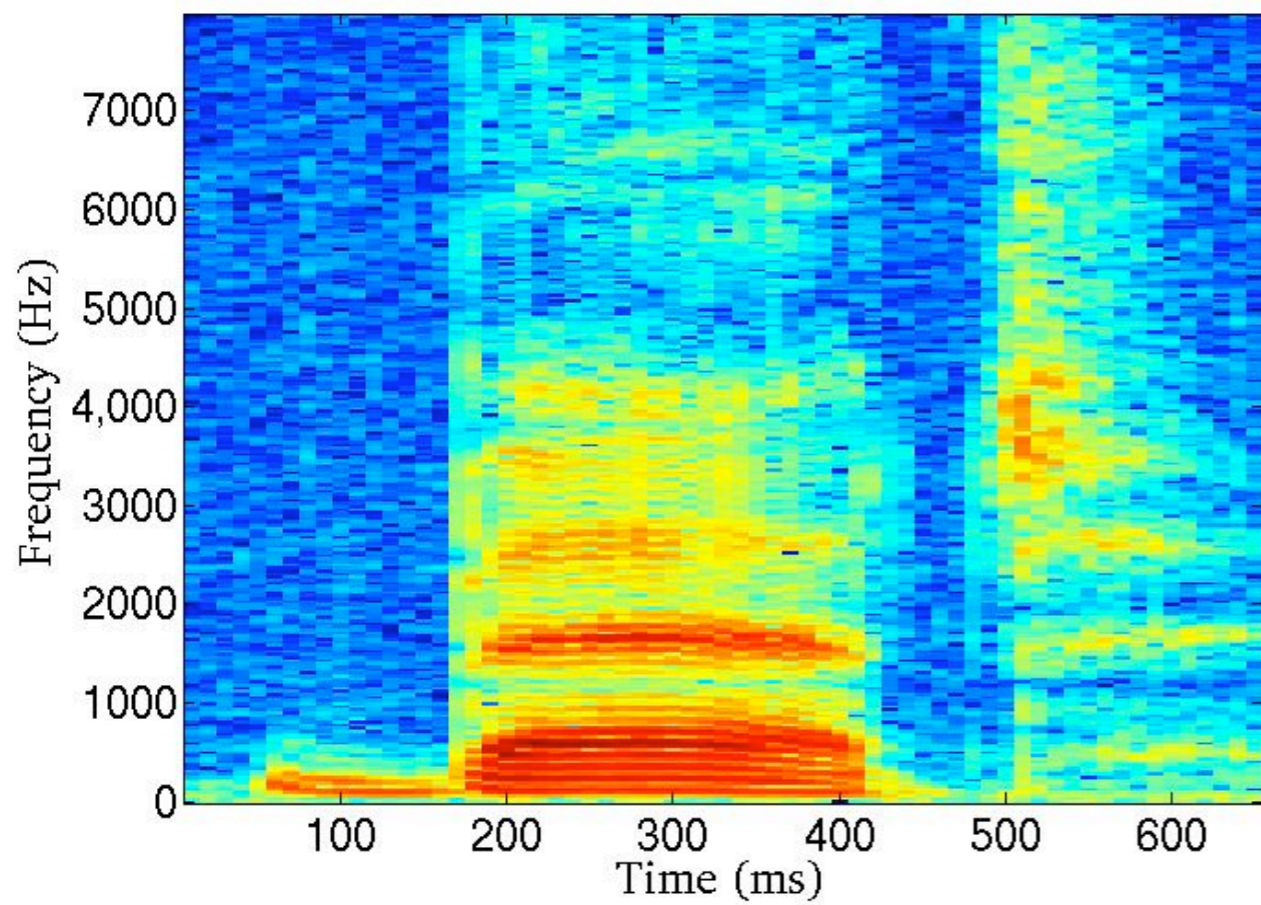
Time-frequency representation



/Bat/

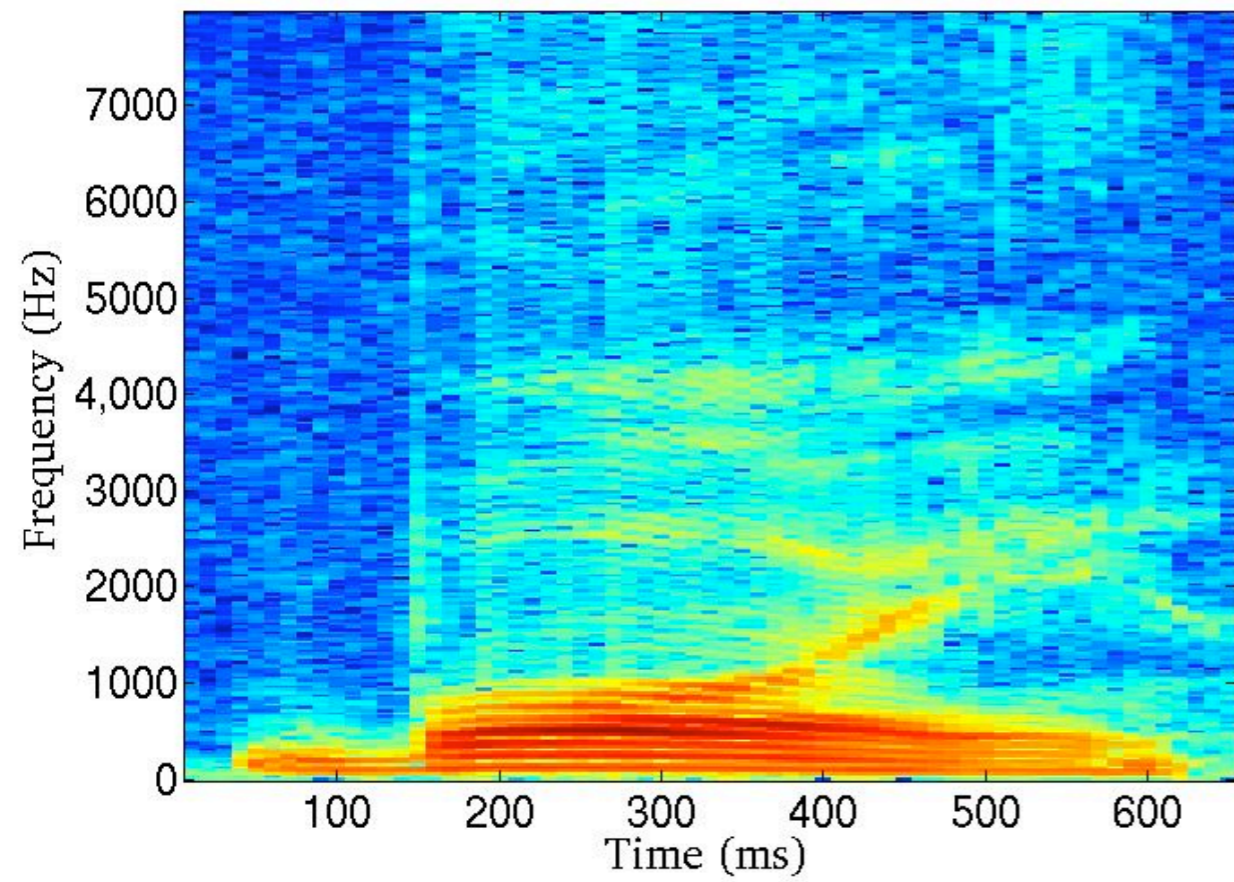
Male

Female

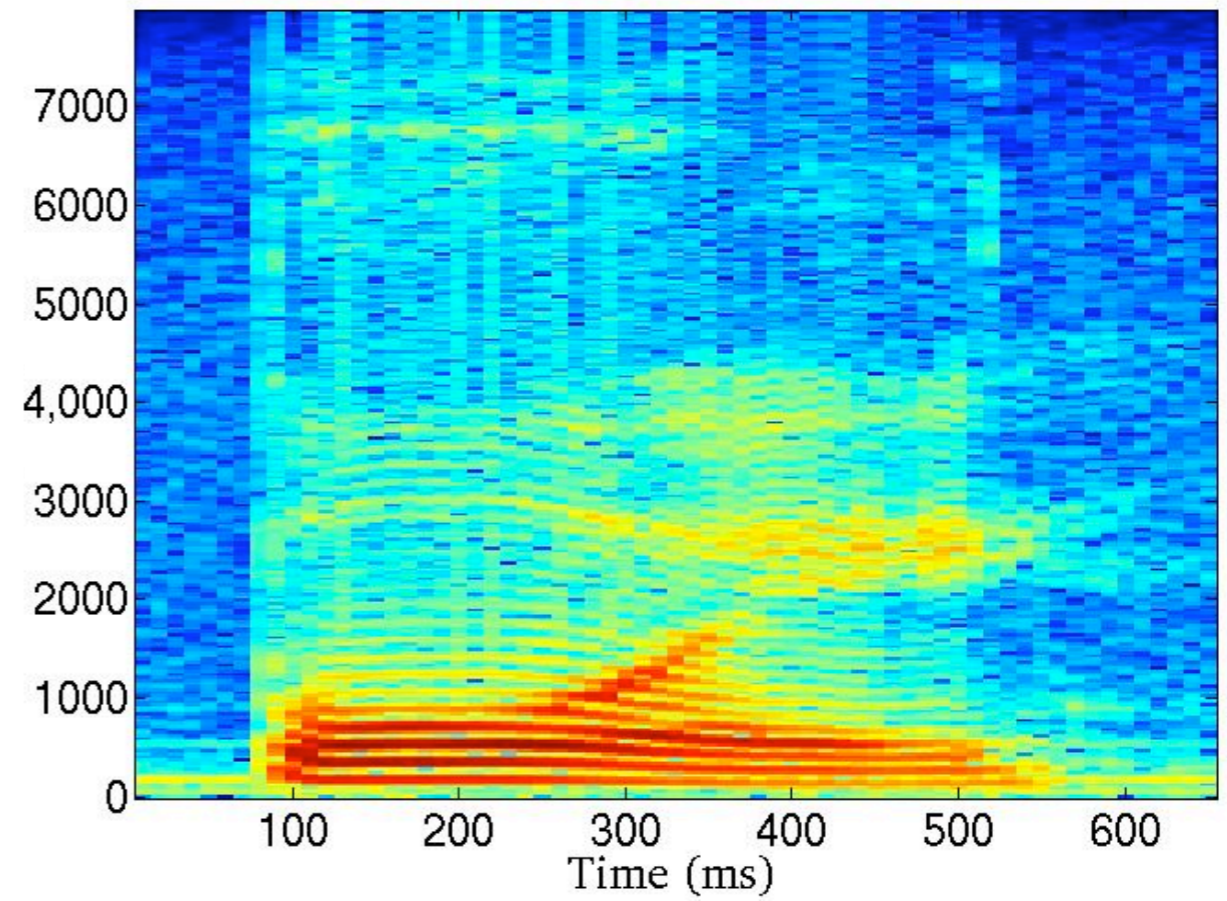


/Boy/

Male

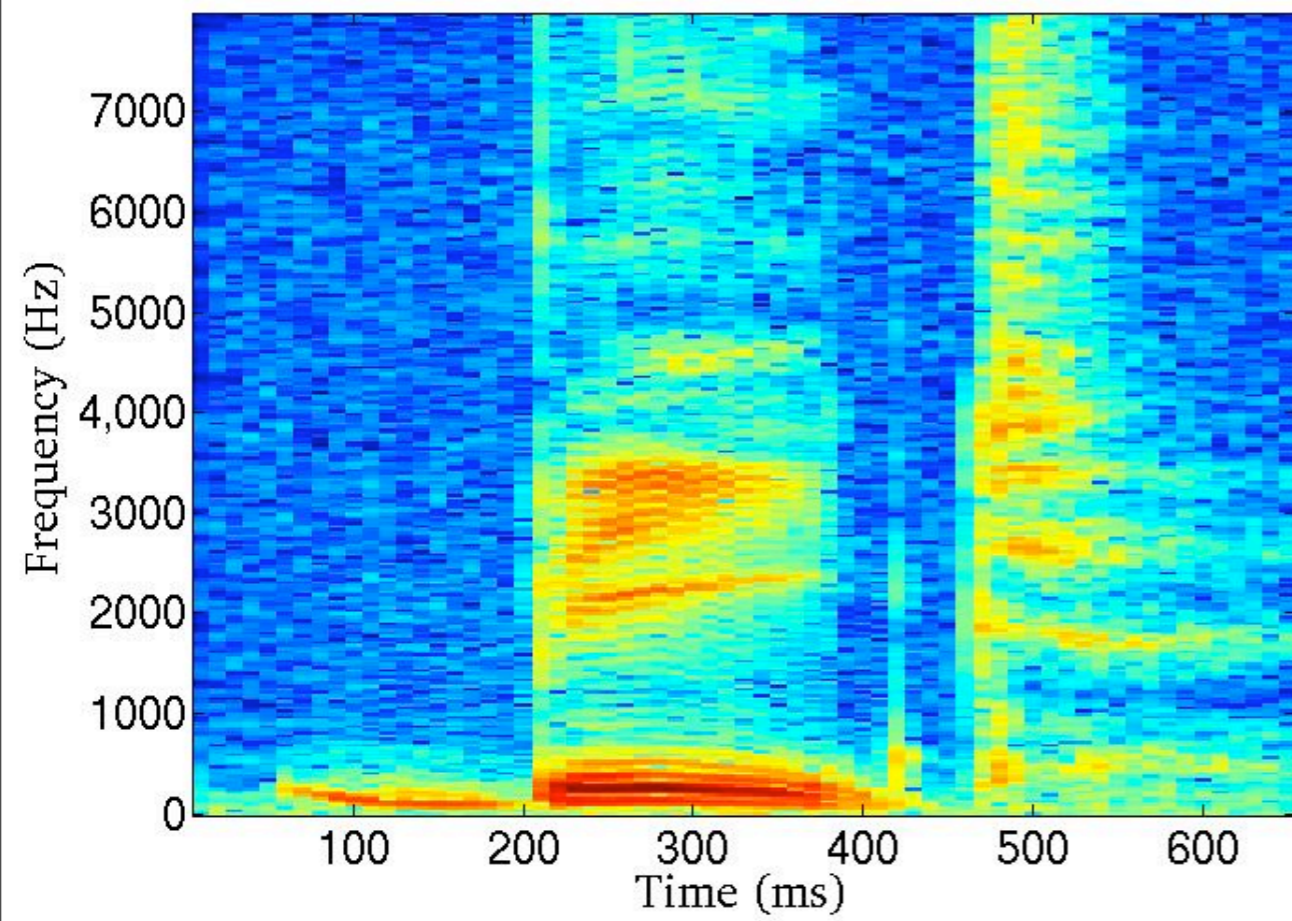


Female

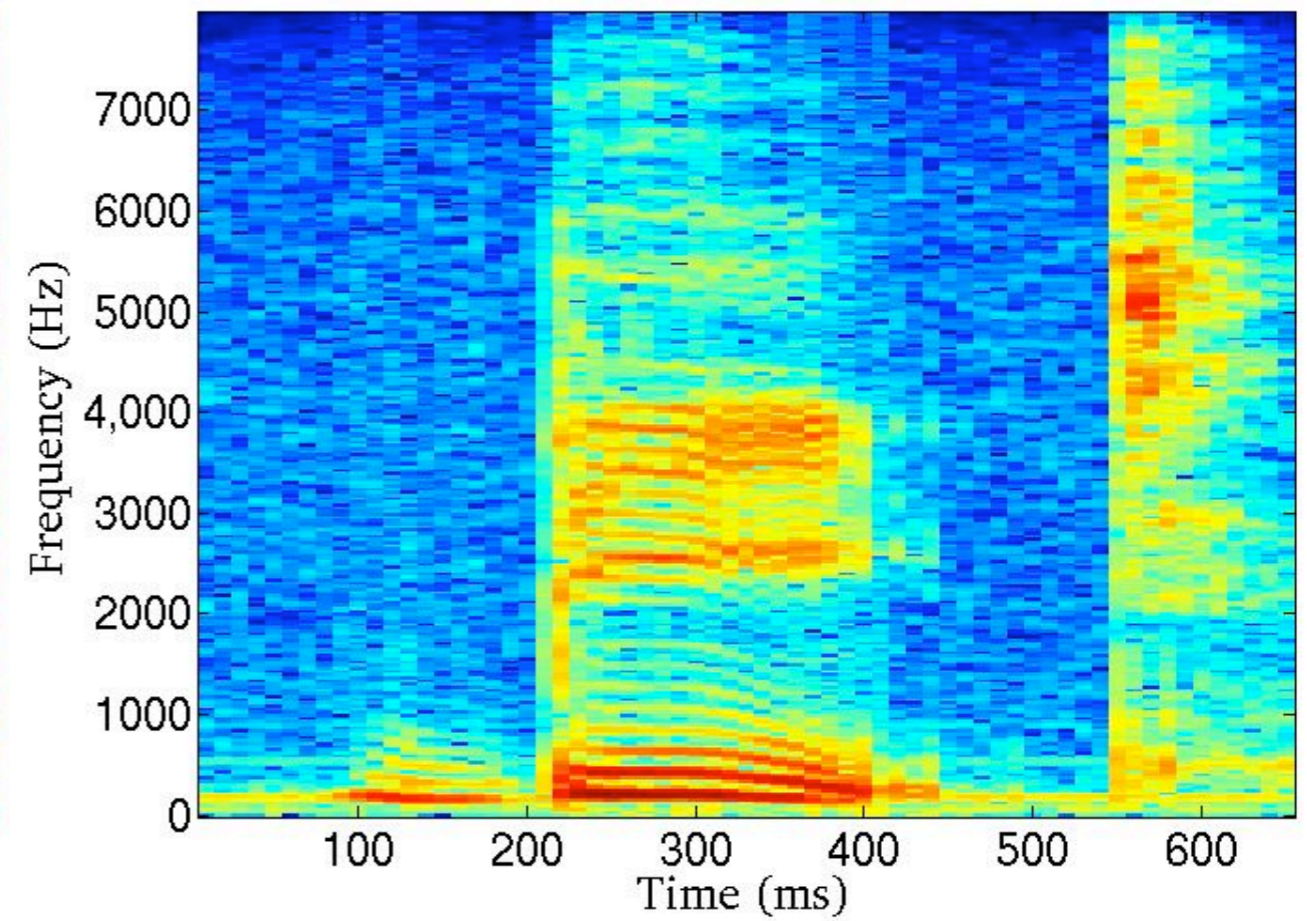


/Beat/

Male



Female



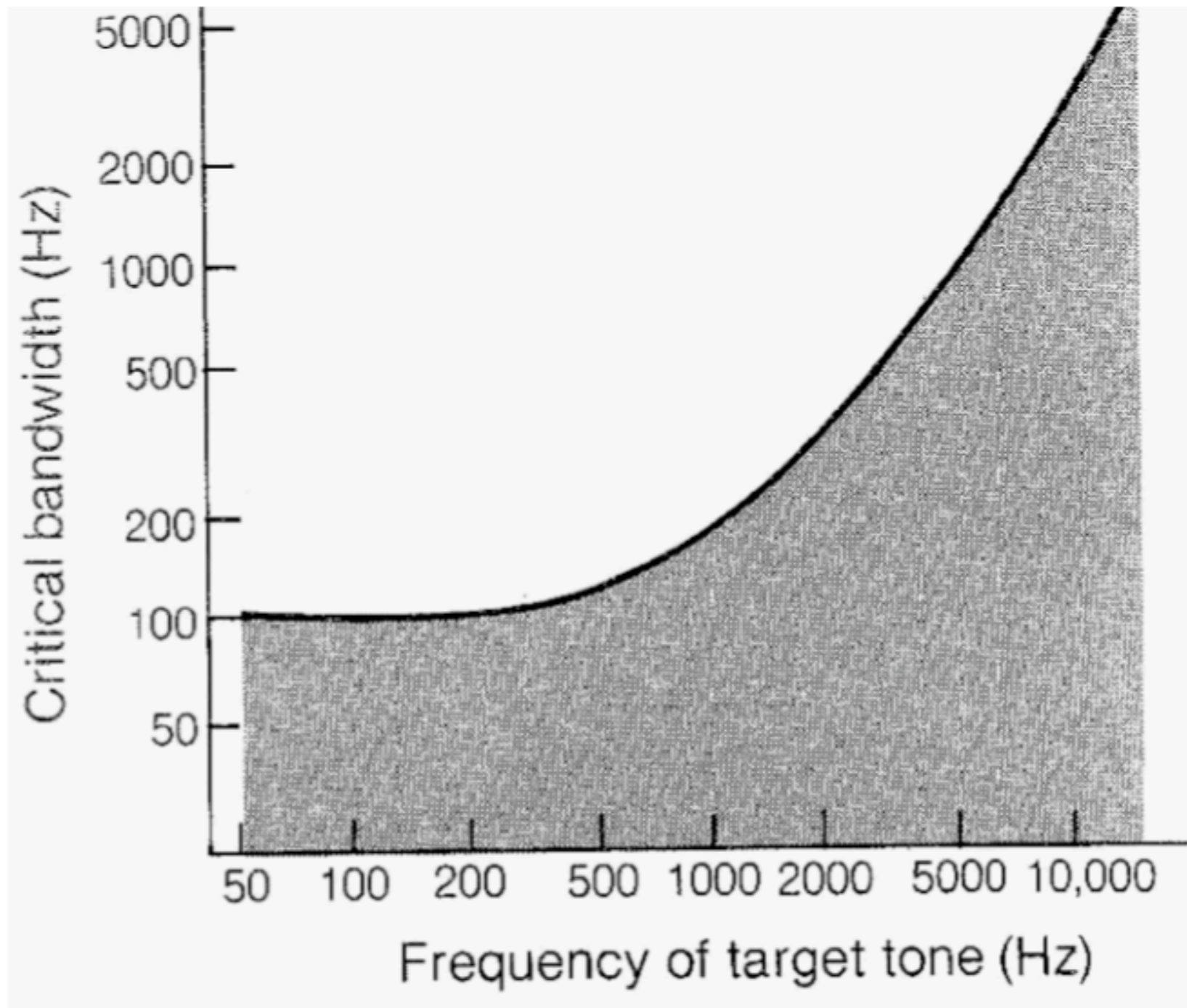
	/bat/- male	/bat/- female	/boy/ - male	/boy/ - female	/beat/ - male	/beat/ - female
/bat/- male	0	4.0	3.2	8.0	1.1	1.7
/bat/- female	4.0	0	4.0	7.5	4.0	4.0
/boy/ - male	3.2	4.0	0	6.9	3.3	3.6
/boy/ - female	8.0	7.5	6.9	0	8.2	8.2
/beat/ - male	1.1	4.0	3.3	8.2	0	1.5
/beat/ - female	1.7	4.0	3.6	8.2	1.5	0

Good 3

Bad 11

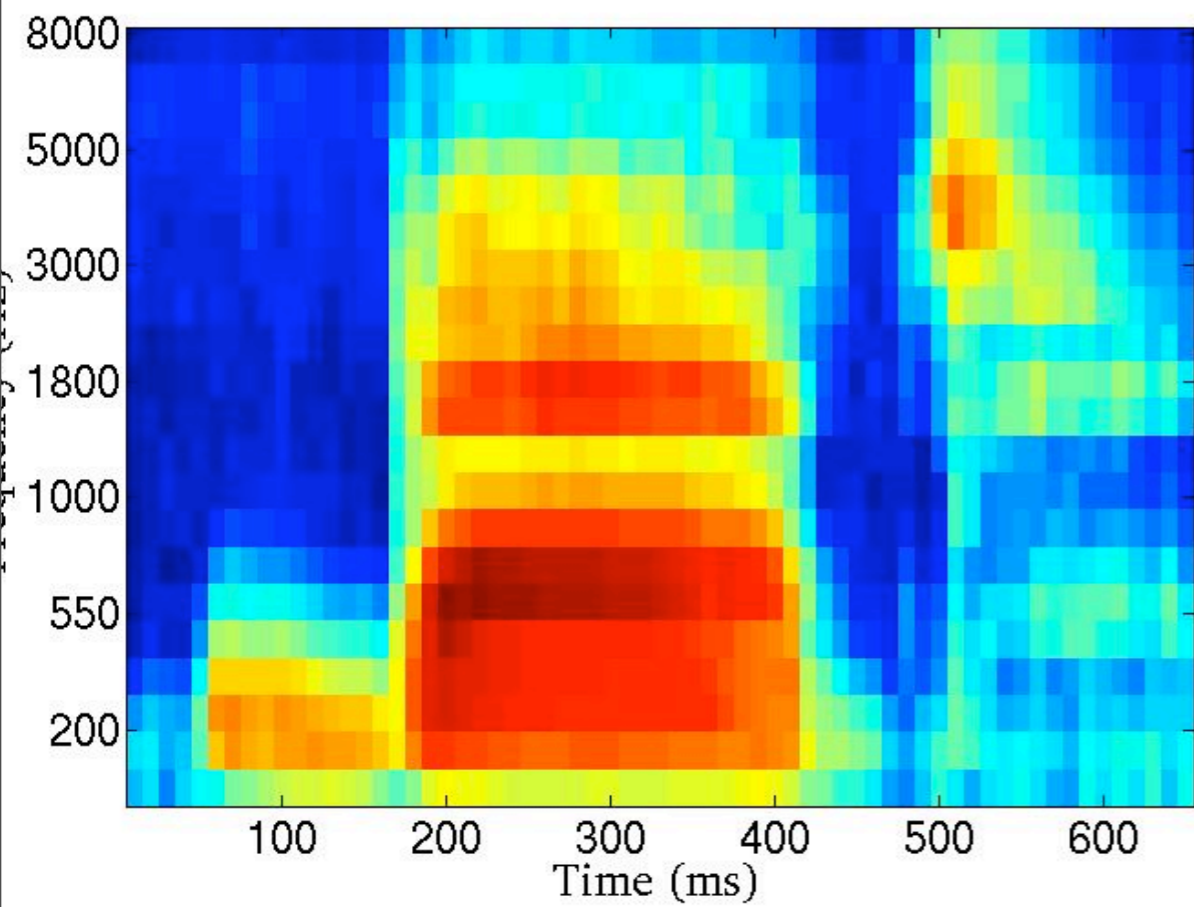
Can we still improve ?

“Close” in frequency = within “critical bandwidth”

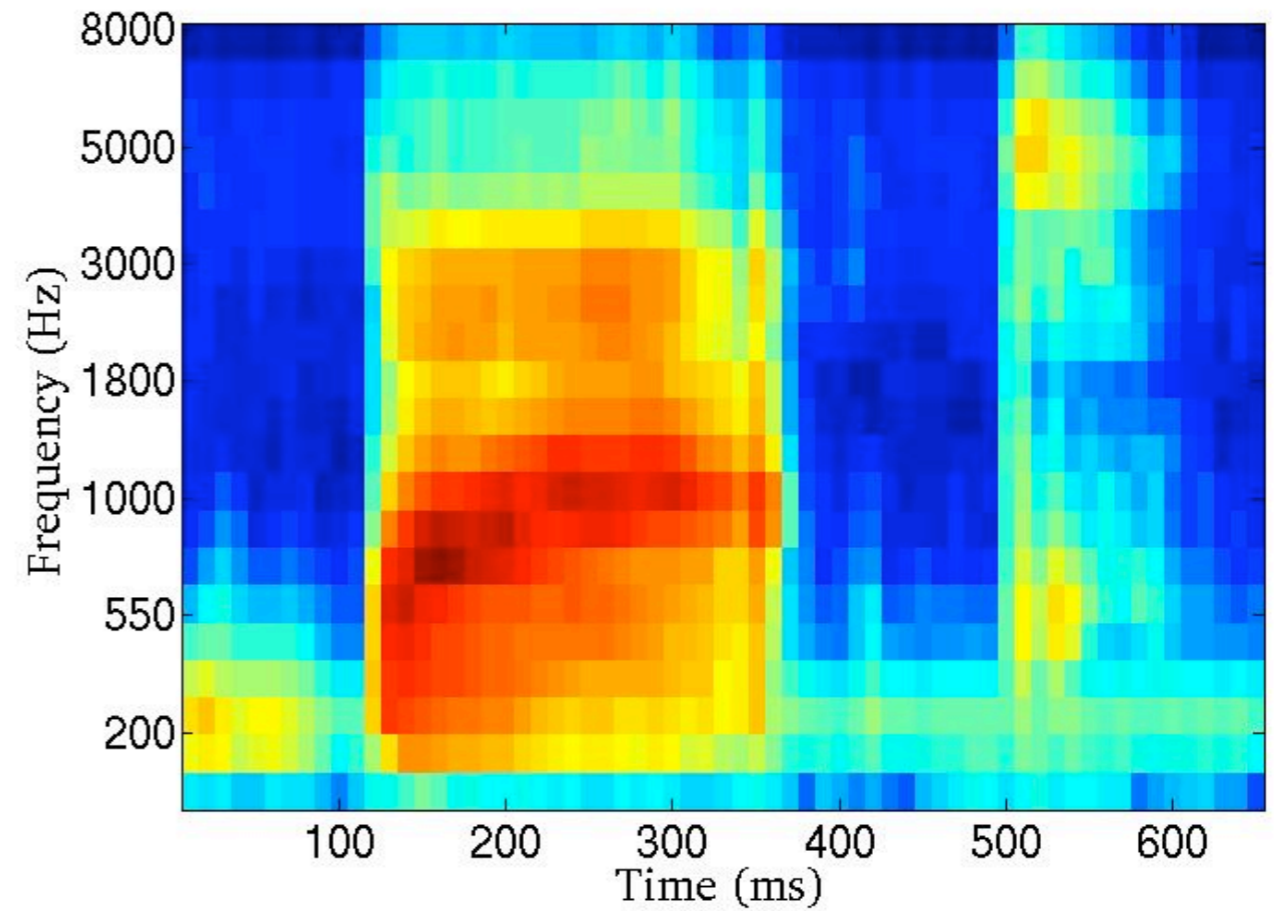


/Bat/

Male

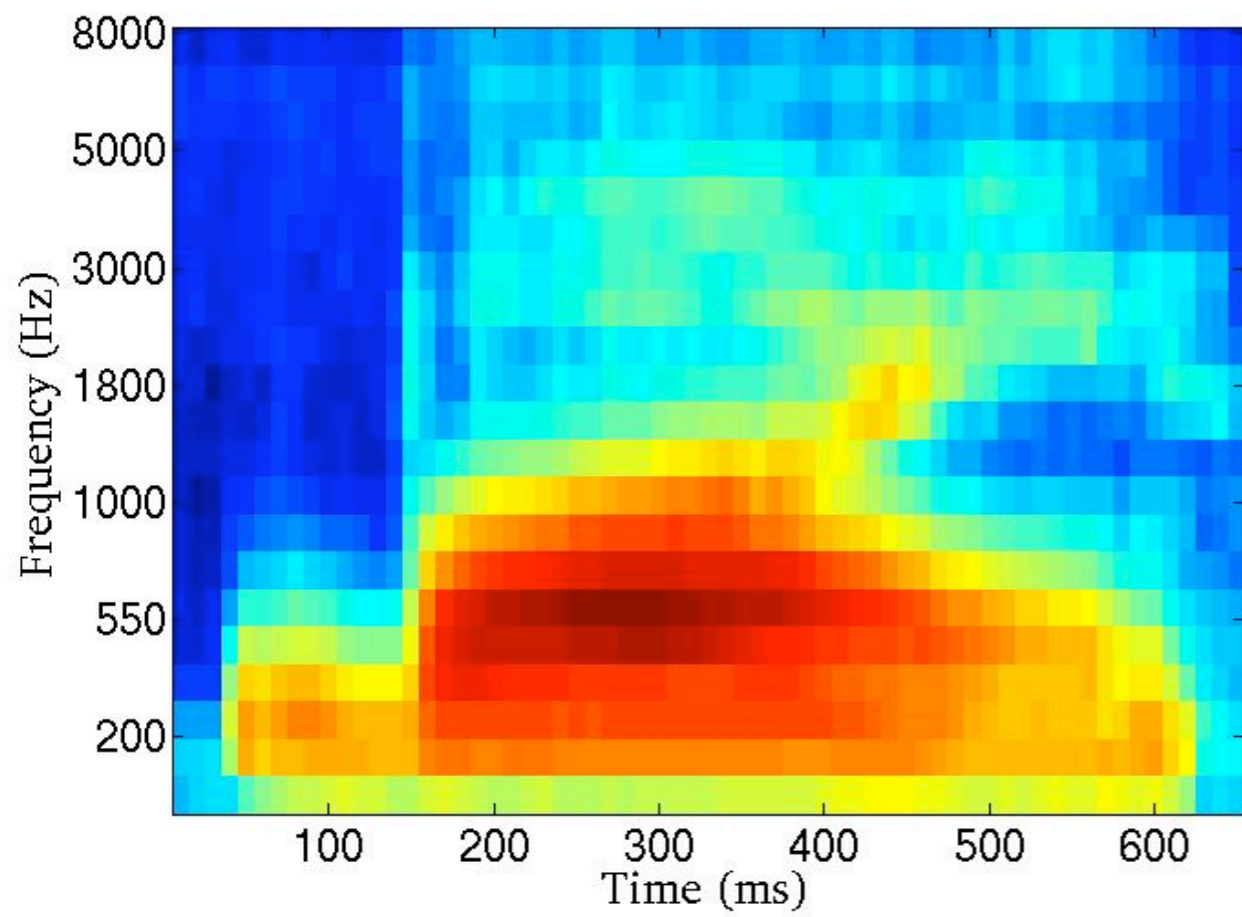


Female

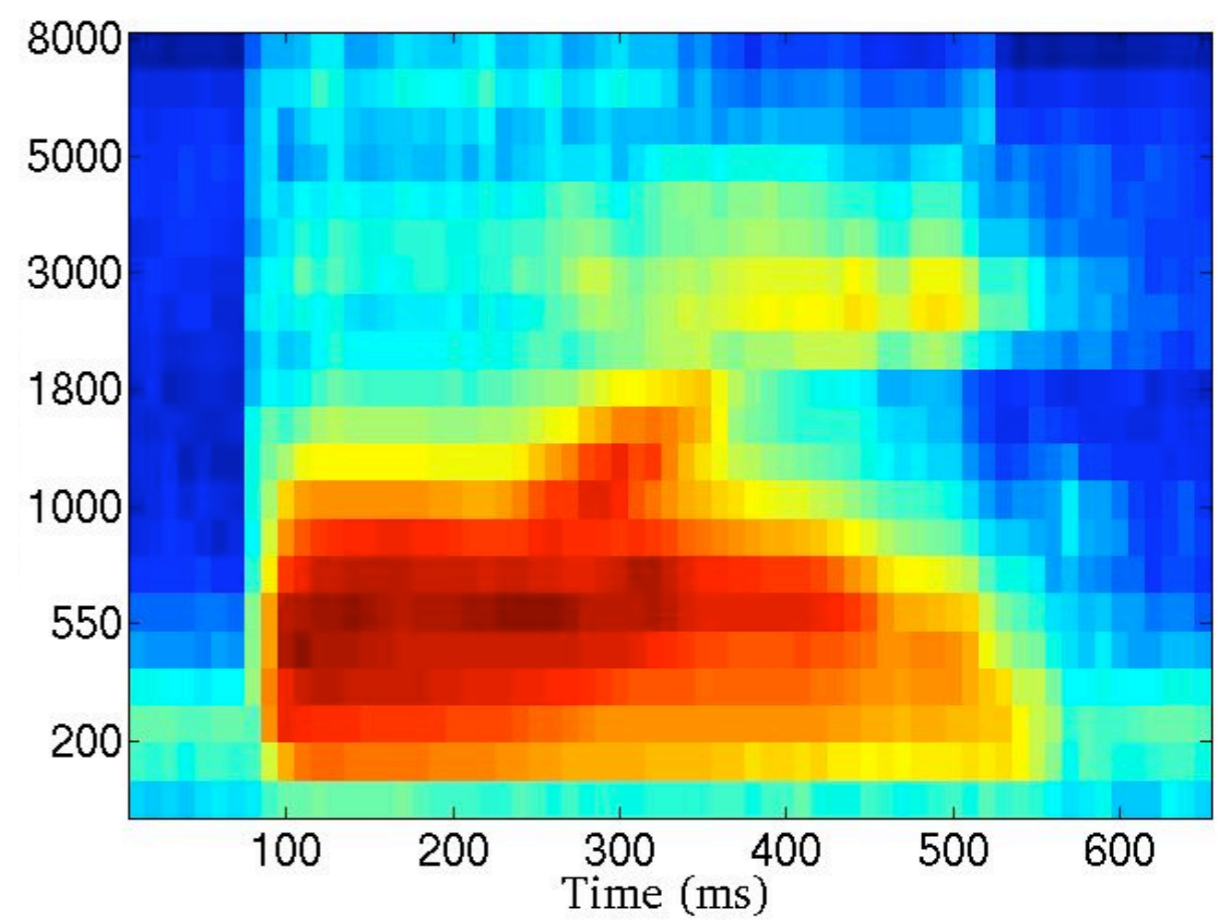


/Boy/

Male



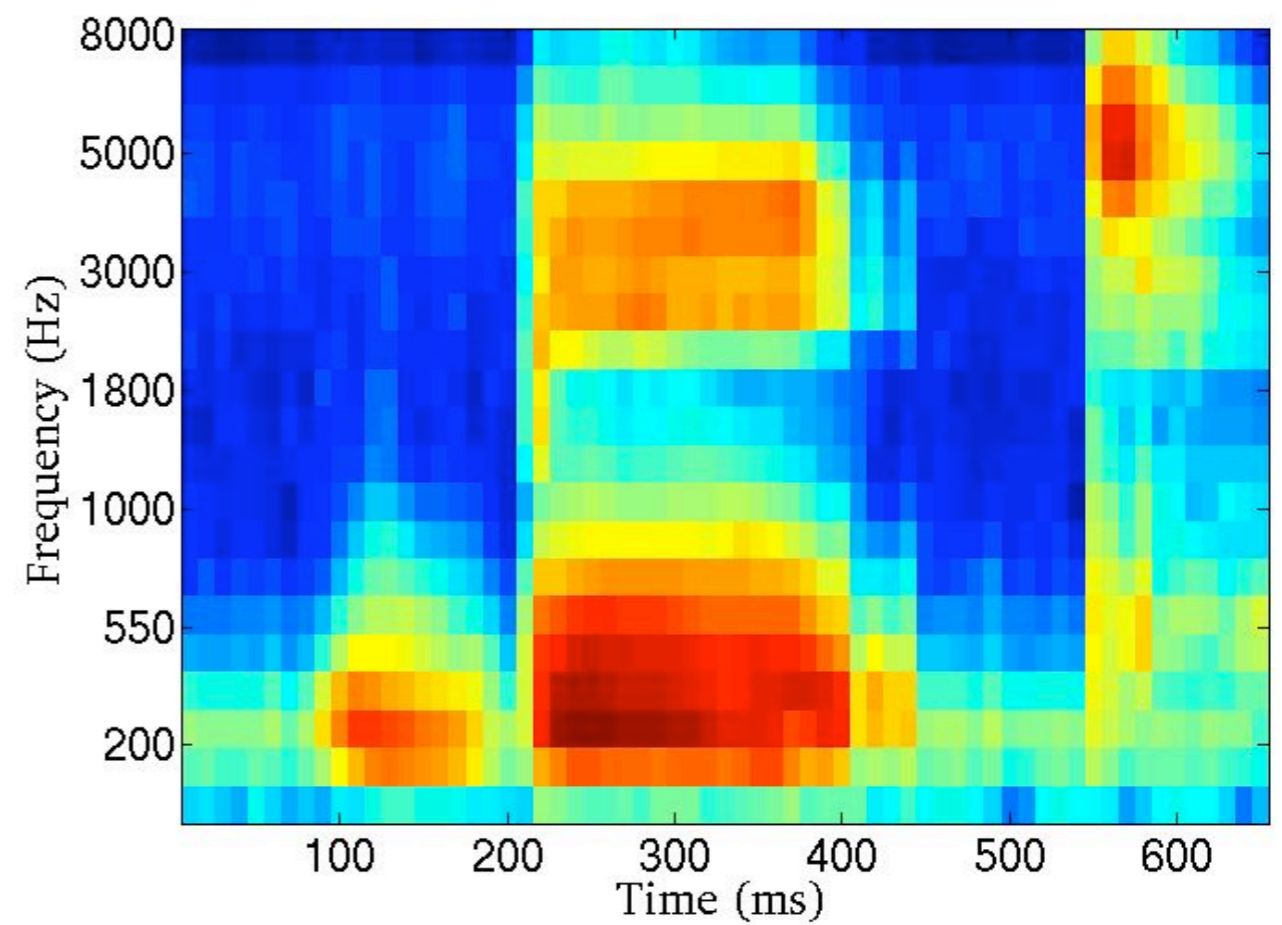
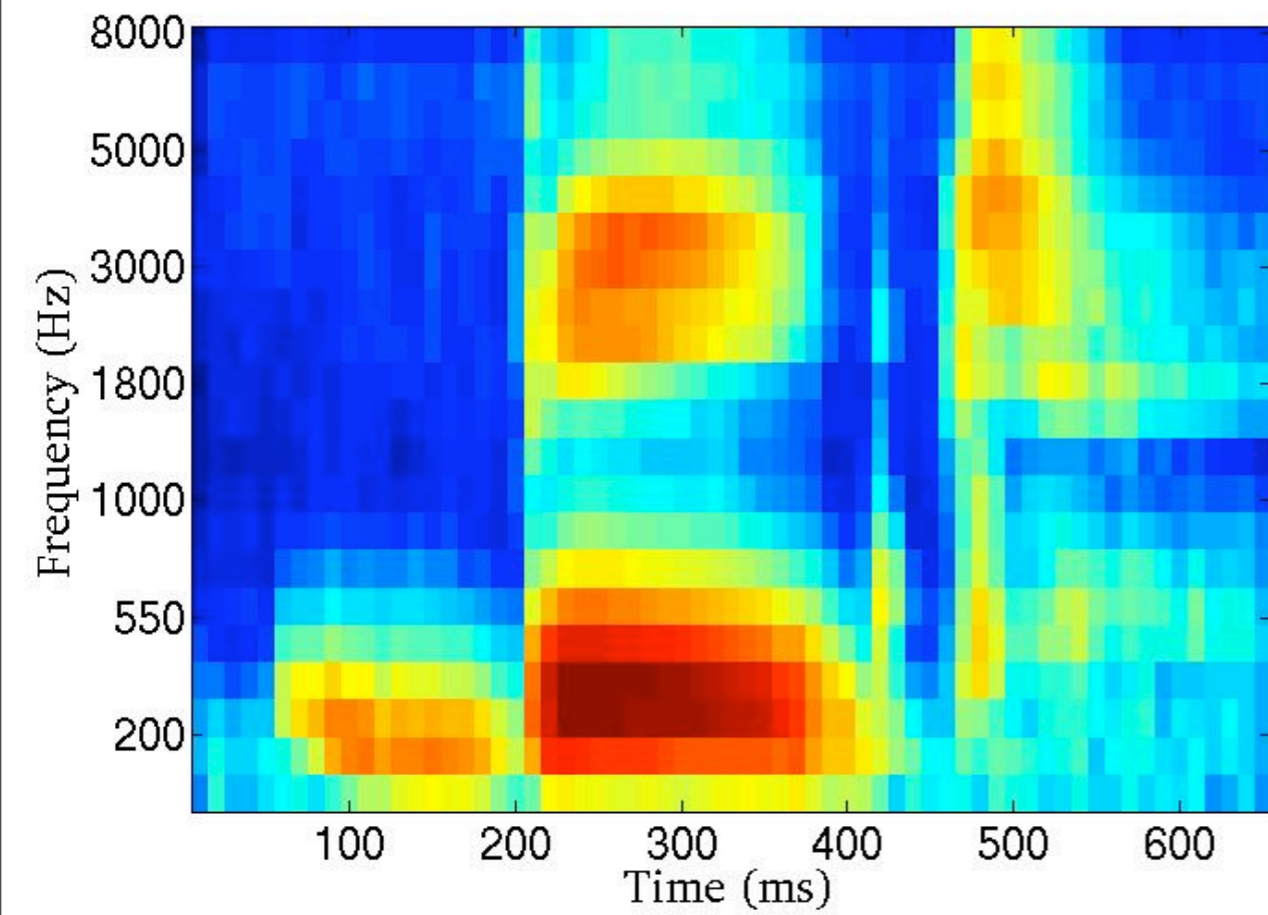
Female



/Beat/

Male

Female



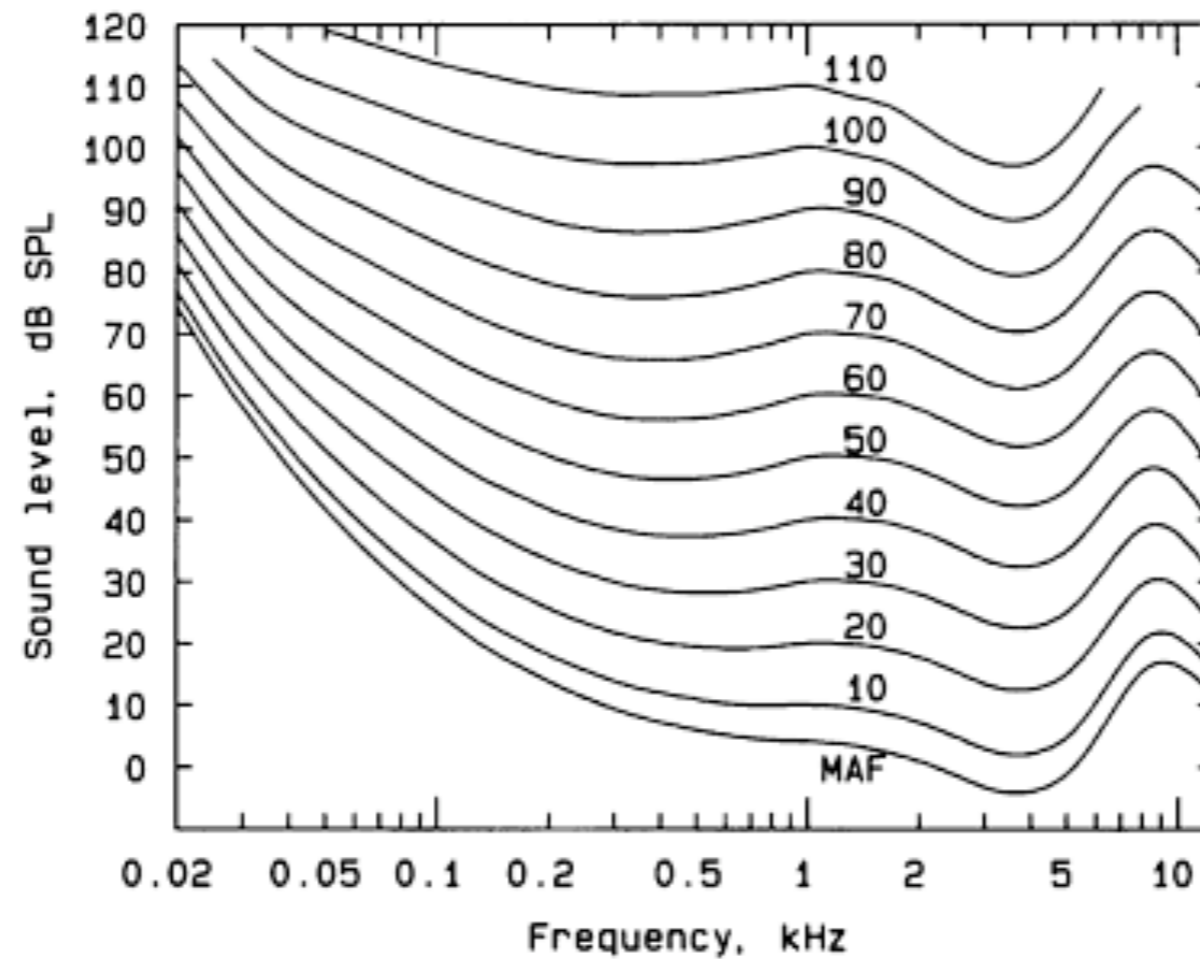
	/bat/- male	/bat/- female	/boy/ - male	/boy/ - female	/beat/ - male	/beat/ - female
/bat/- male	0	0.8	0.5	1.6	0.2	0.3
/bat/- female	0.8	0	0.8	1.5	0.8	0.8
/boy/ - male	0.5	0.8	0	1.3	0.7	0.7
/boy/ - female	1.6	1.5	1.3	0	1.7	1.6
/beat/ - male	0.2	0.8	0.7	1.7	0	0.2
/beat/ - female	0.3	0.8	0.7	1.6	0.2	0

Good 4

Bad 11

Anymore ?

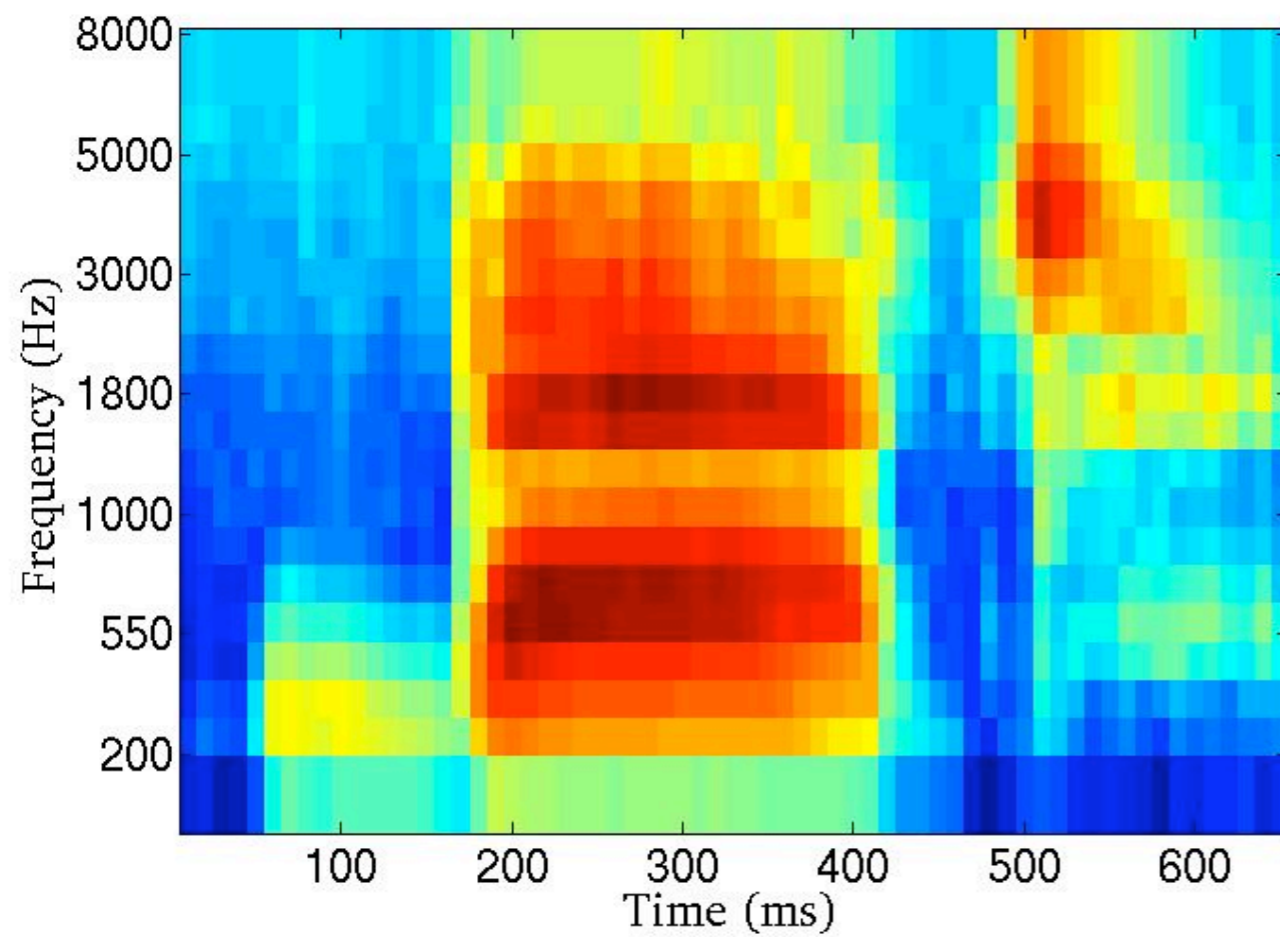
Equal Loudness and Cube-root compression



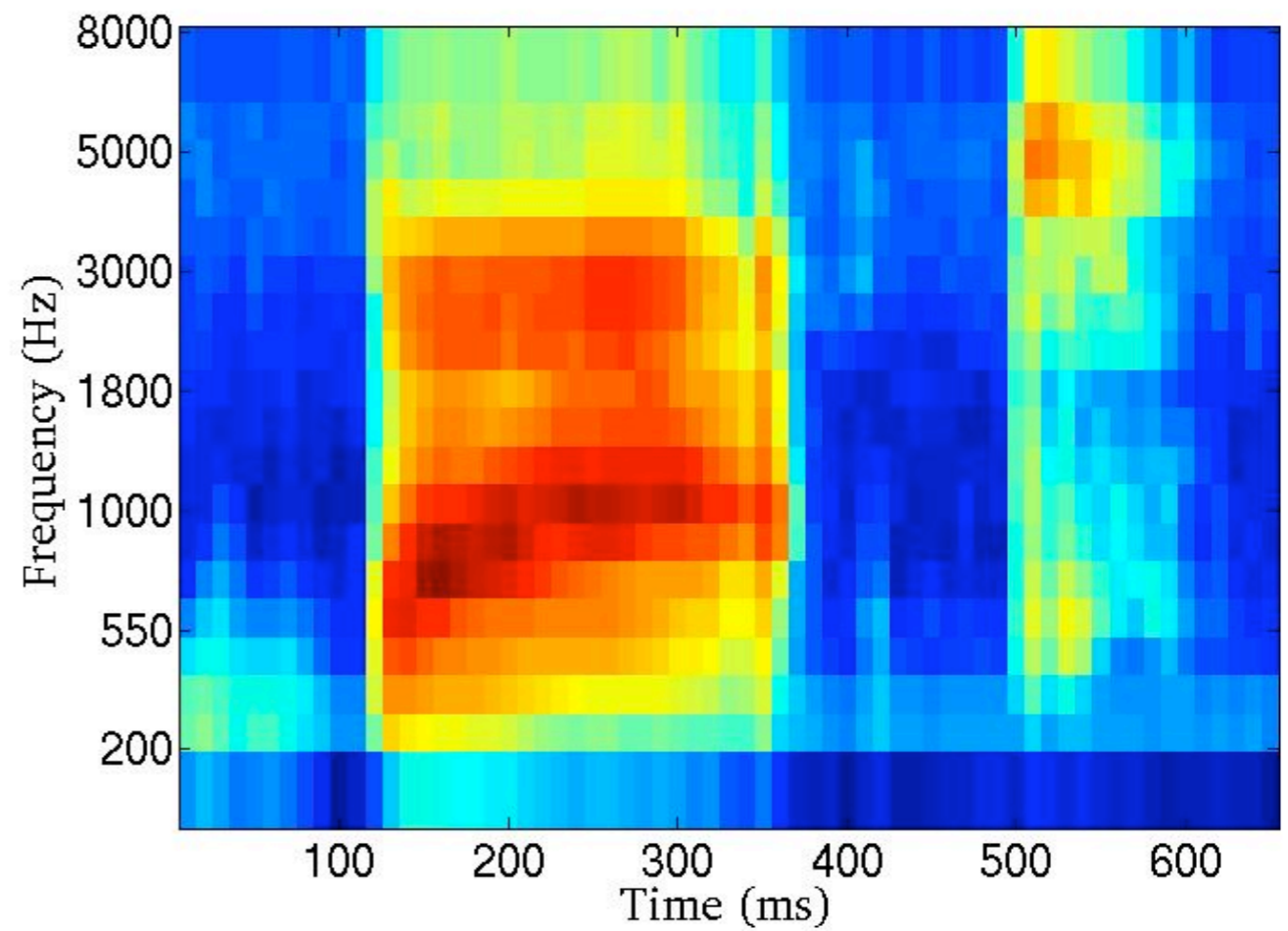
<i>Judgment</i>	<i>Power</i>
Loudness (one ear)	.3
Brightness, dark-adapted eye, target of 5°	.3
Smell of coffee odor	.55
Taste of saccharine	.8

/Bat/

Male

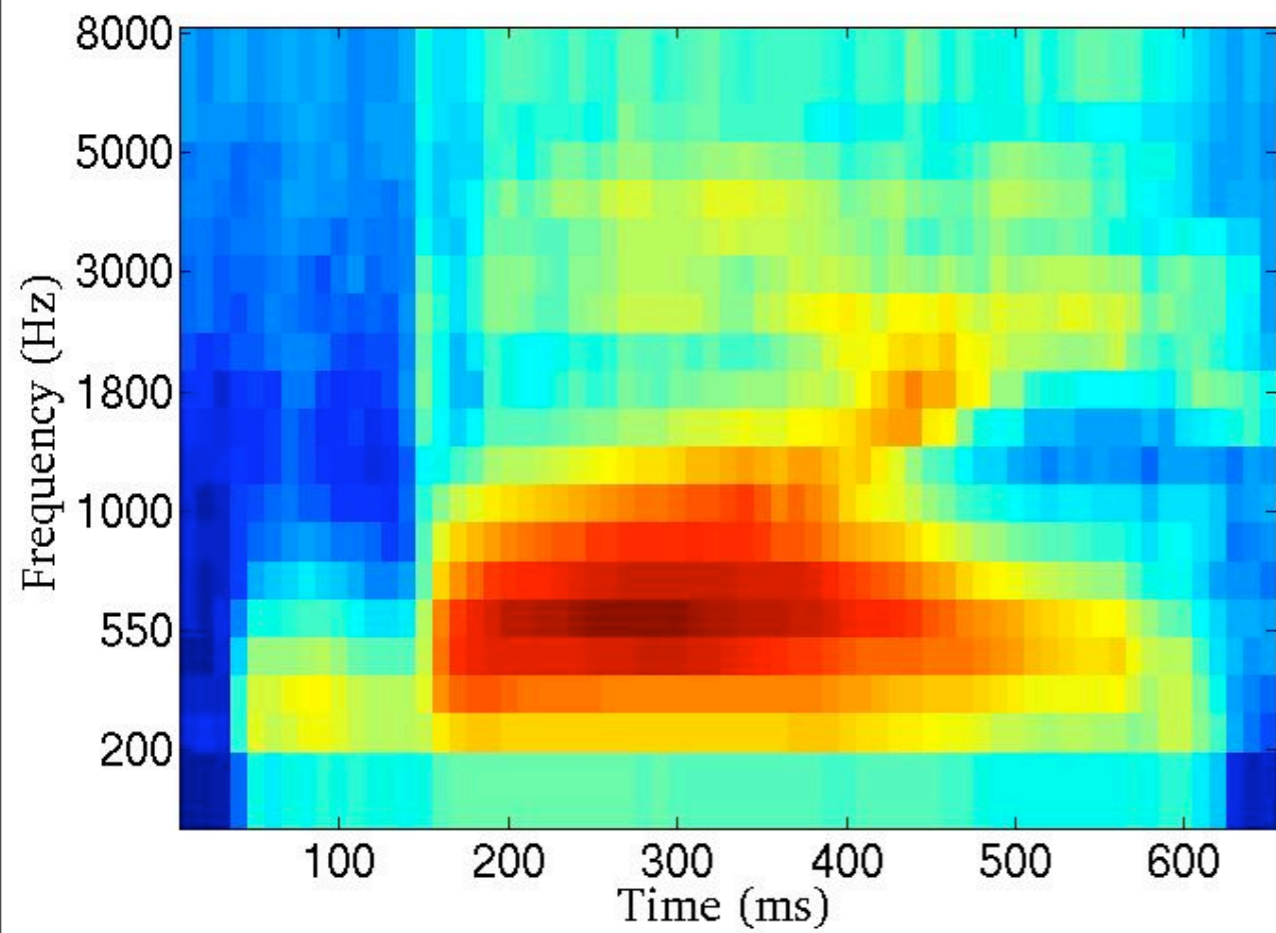


Female

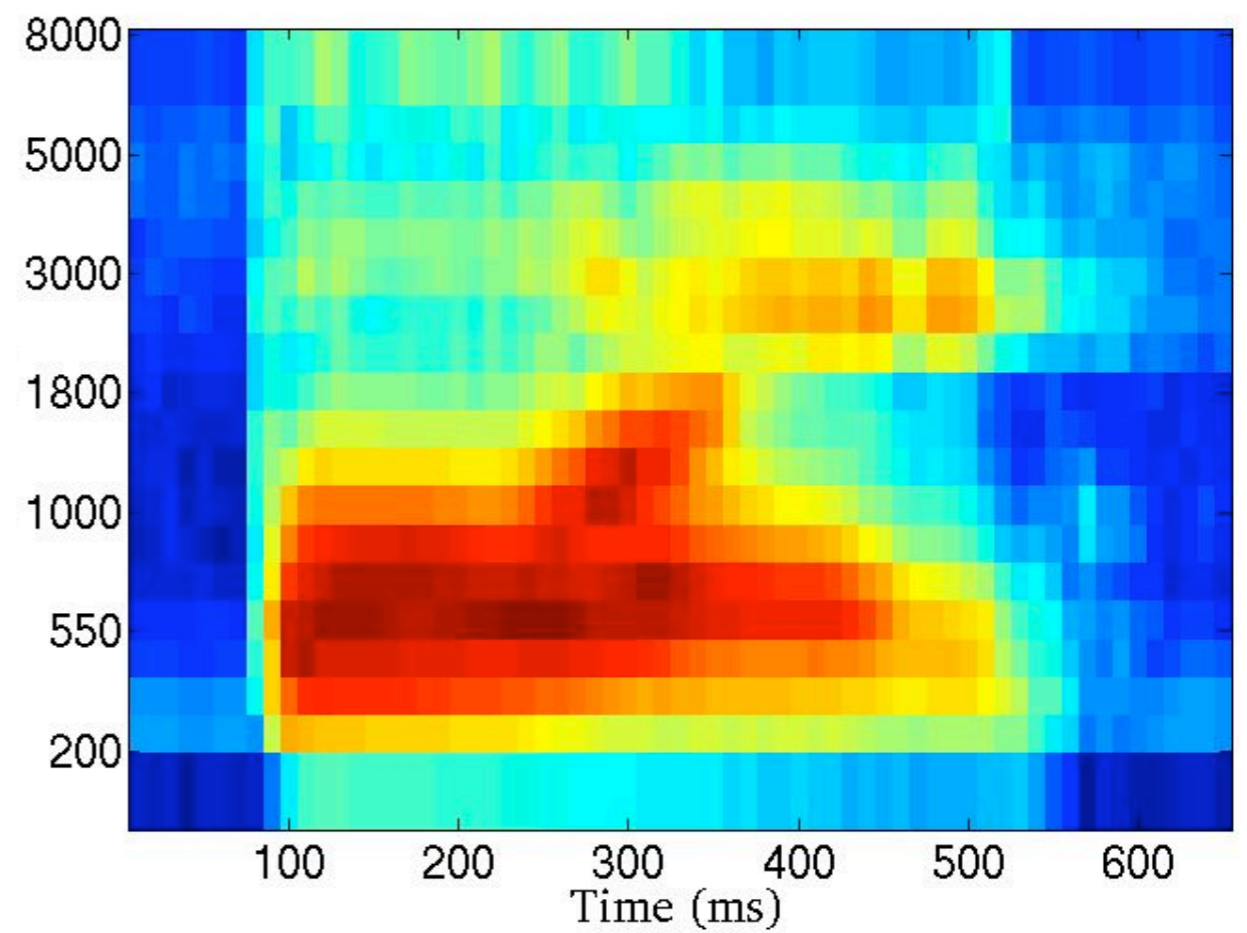


/Boy/

Male



Female



	/bat/- male	/bat/- female	/boy/ - male	/boy/ - female	/beat/ - male	/beat/ - female
/bat/- male	0	3.4	2.1	4.0	2.3	2.2
/bat/- female	3.4	0	3.8	3.4	4.5	4.1
/boy/ - male	2.1	3.8	0	3.2	3.0	2.7
/boy/ - female	4.0	3.4	3.2	0	5.2	4.6
/beat/ - male	2.3	4.5	3.0	5.2	0	2.0
/beat/ - female	2.2	4.1	2.7	4.6	2.0	0

Good 4

Bad 7