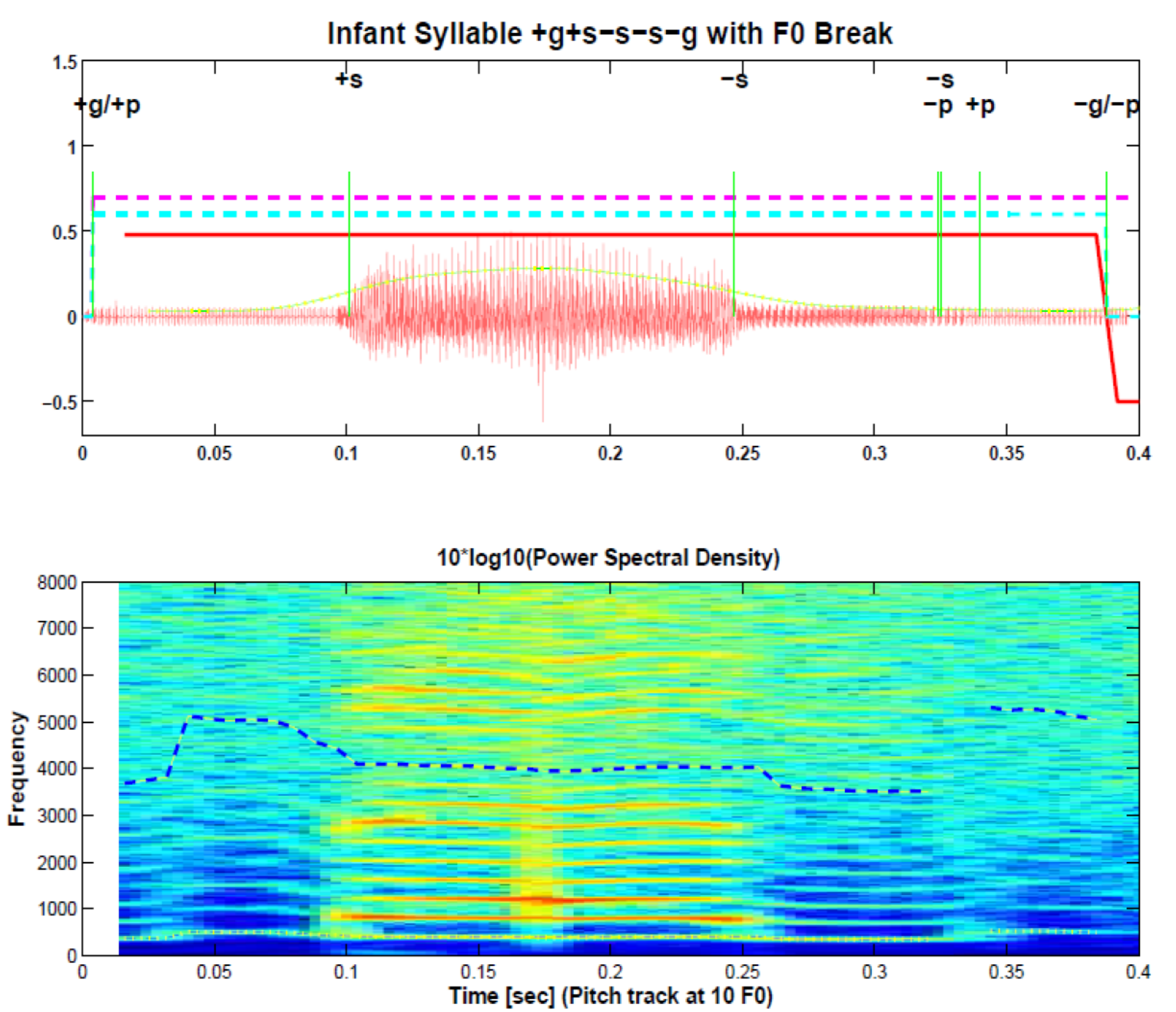


# What Are Acoustic Landmarks?

Landmarks are acoustic patterns that mark speech production events

**Table. Rules to identify each type of AC landmark (LM).** Note: The symbols and mnemonics are intended only to suggest underlying articulatory or phonetic events.

Symbol	Mnemonic	Rule
+g	Glottal onset	Beginning of sustained laryngeal motion, i.e., of periodicity or of power and spectral slope similar to that of a nearby segment of sustained periodicity
-g	Glottal offset	End of sustained laryngeal motion
+p	Periodicity onset	Beginning of sustained periodicity of appropriate period
-p	Periodicity offset	End of sustained periodicity of appropriate period
+b	Burst onset	At least 3 of 5 frequency bands show simultaneous power increases of at least 6 dB in both the finely smoothed and the coarsely smoothed contours, in an unvoiced segment (not between +g and the next g)
-b	Burst offset	At least 3 of 5 frequency bands show simultaneous power decreases of at least 6 dB in both the finely smoothed and the coarsely smoothed contours, in an unvoiced segment
+s	Syllabic onset	At least 3 of 5 frequency bands show simultaneous power increases of at least 6 dB in both the finely smoothed and the coarsely smoothed contours, in a voiced segment (between +g and the next g)
-s	Syllabic offset	At least 3 of 5 frequency bands show simultaneous power decreases of at least 6 dB in both the finely smoothed and the coarsely smoothed contours, in a voiced segment
+f	Frication onset	At least 3 of 5 frequency bands show simultaneous power increases at high frequencies and decreases at low frequencies (unvoiced segment)
-f	Frication offset	At least 3 of 5 frequency bands show simultaneous power decreases at high frequencies and increases at low frequencies (unvoiced segment)
+v	Voiced frication onset	At least 3 of 5 frequency bands show simultaneous power increases at high frequencies and decreases at low frequencies (voiced segment)
-v	Voiced frication offset	At least 3 of 5 frequency bands show simultaneous power decreases at high frequencies and increases at low frequencies (voiced segment)

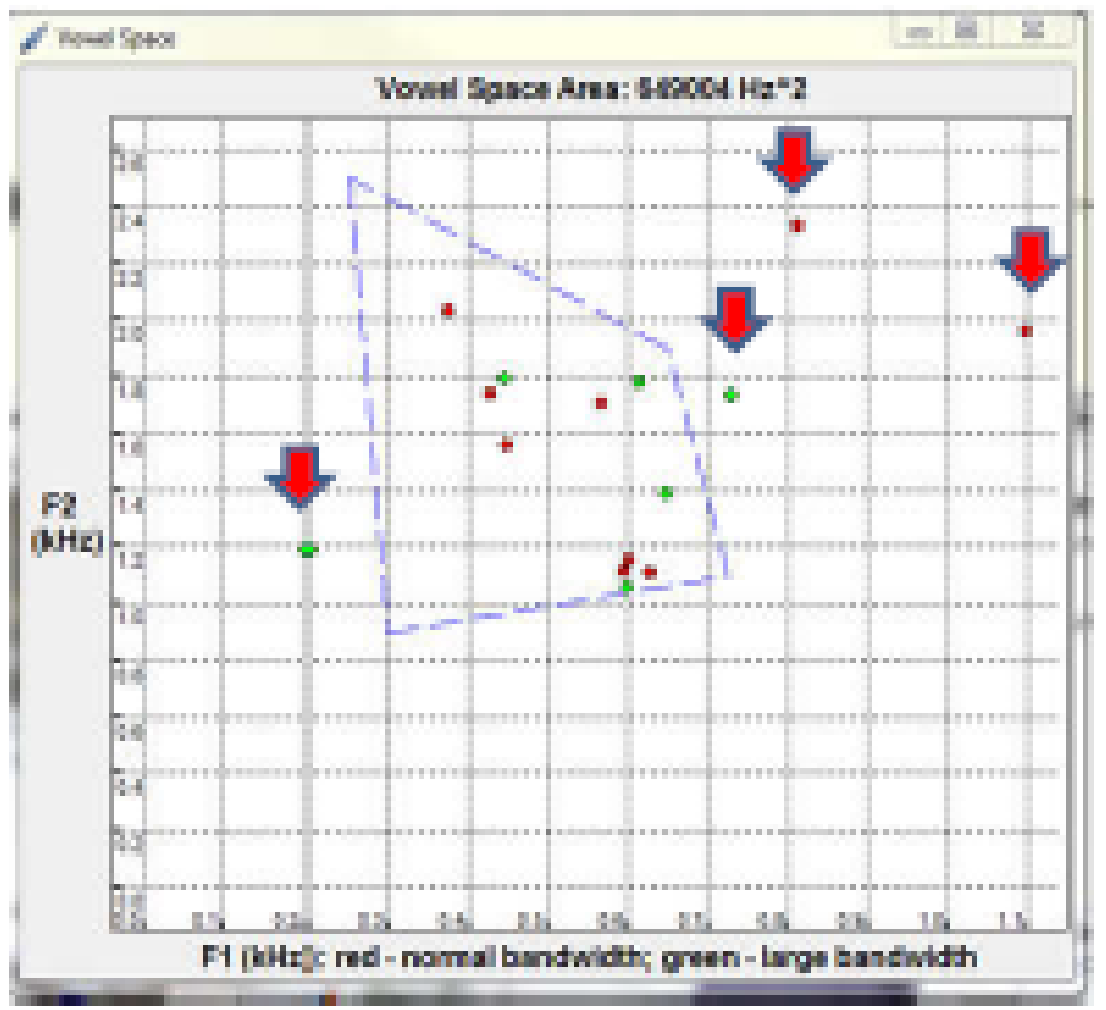



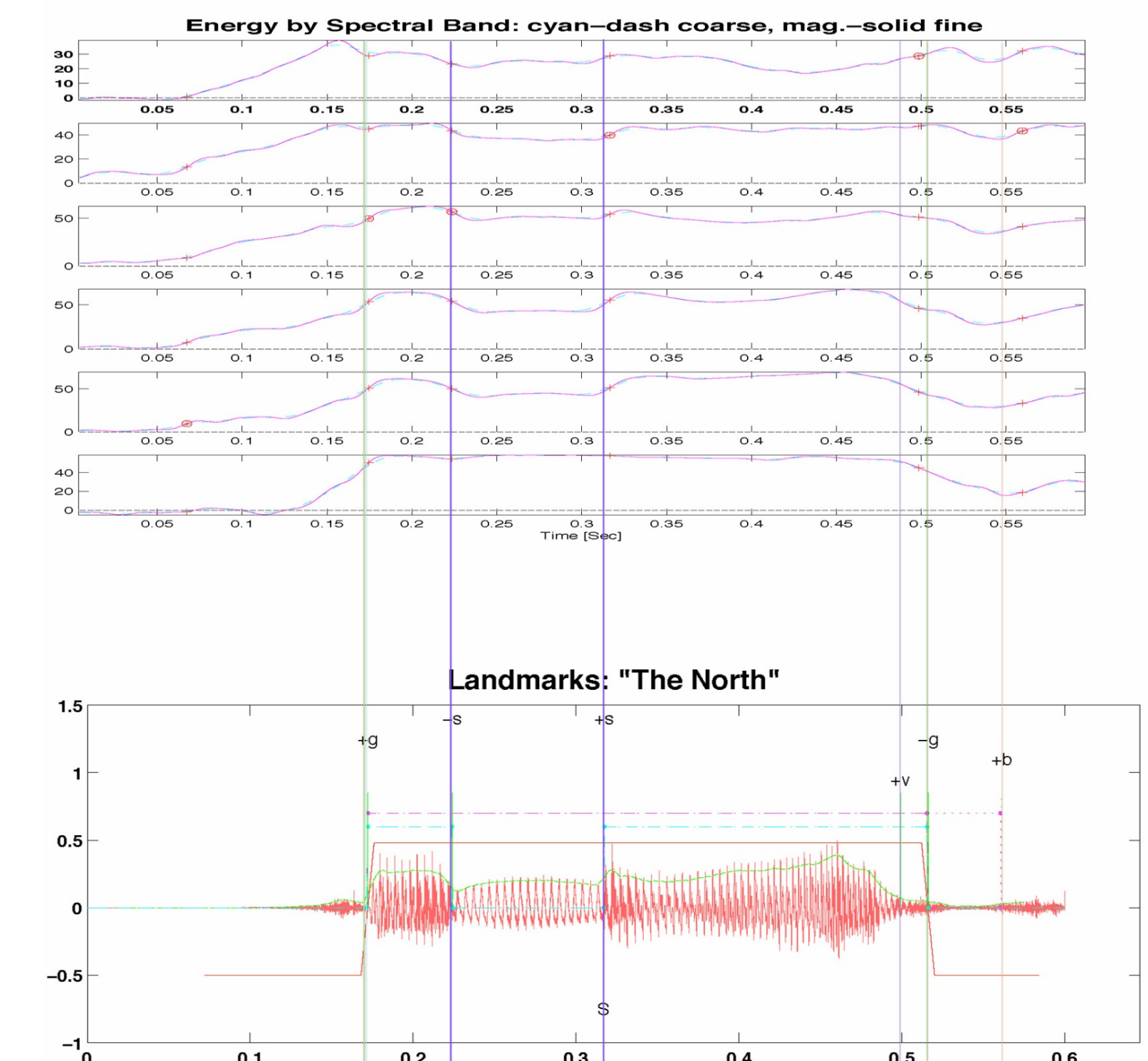
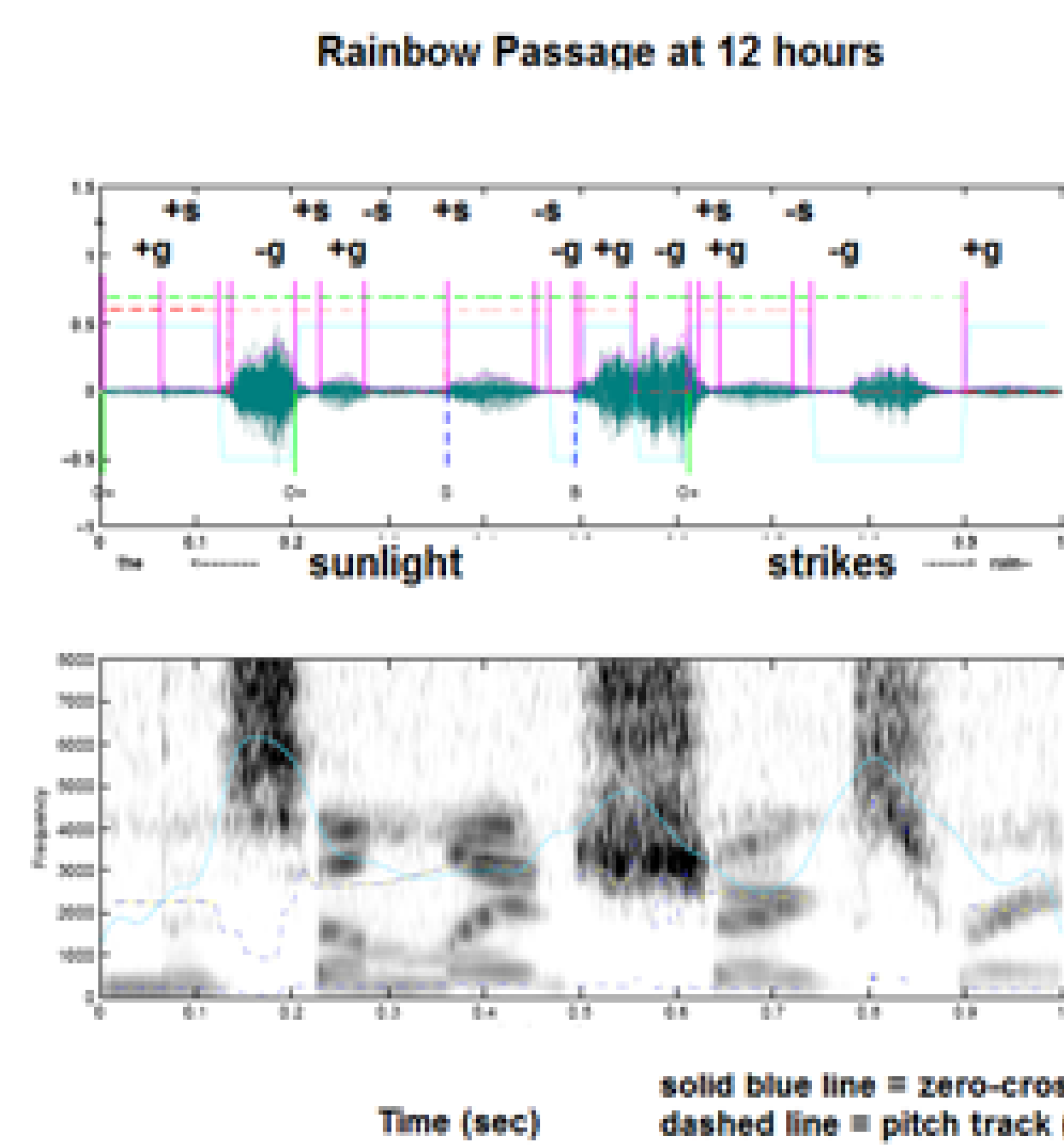
**Landmarks for one syllable of an infant babble.** The LMs are placed at instants of abrupt change of energy occurring simultaneously across multiple frequency ranges and at multiple time scales. (top) Waveform with smoothed amplitude envelope, landmarks (+g through -g), and landmark grouping. Graphics show the interval of voicing (solid red line), grouping as a syllabic cluster (dashed light blue), and grouping as part of an utterance that continues beyond the window (dashed magenta). (bottom) Narrow-band spectrogram of the segment with dotted line through F0 and dashed line through 10x F0. The spectrogram shows the harmonics (horizontal stripes) and reveals a 2-to-3 periodicity break at 0.34s. Periodicity is strong even at the start of voicing and up to the end, so g LMs are coincident with corresponding p LMs.

### Example of speech early in Sleep-Deprivation Experiment

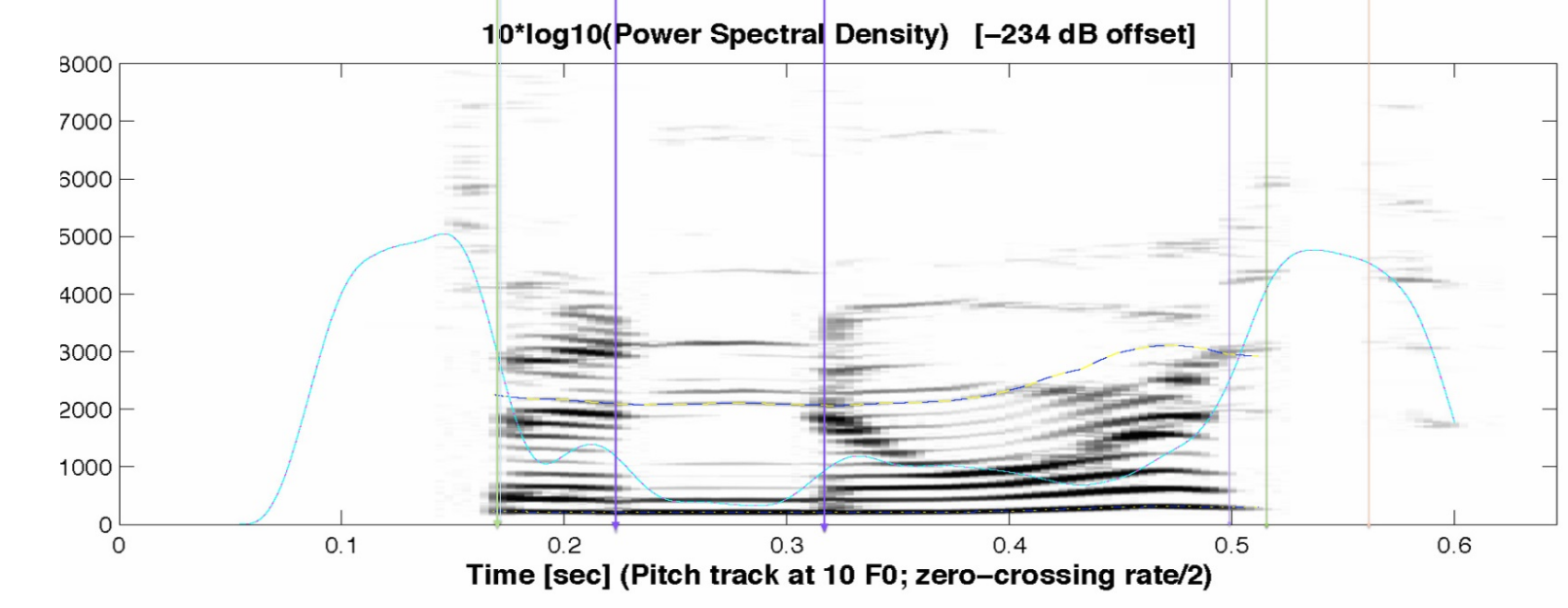
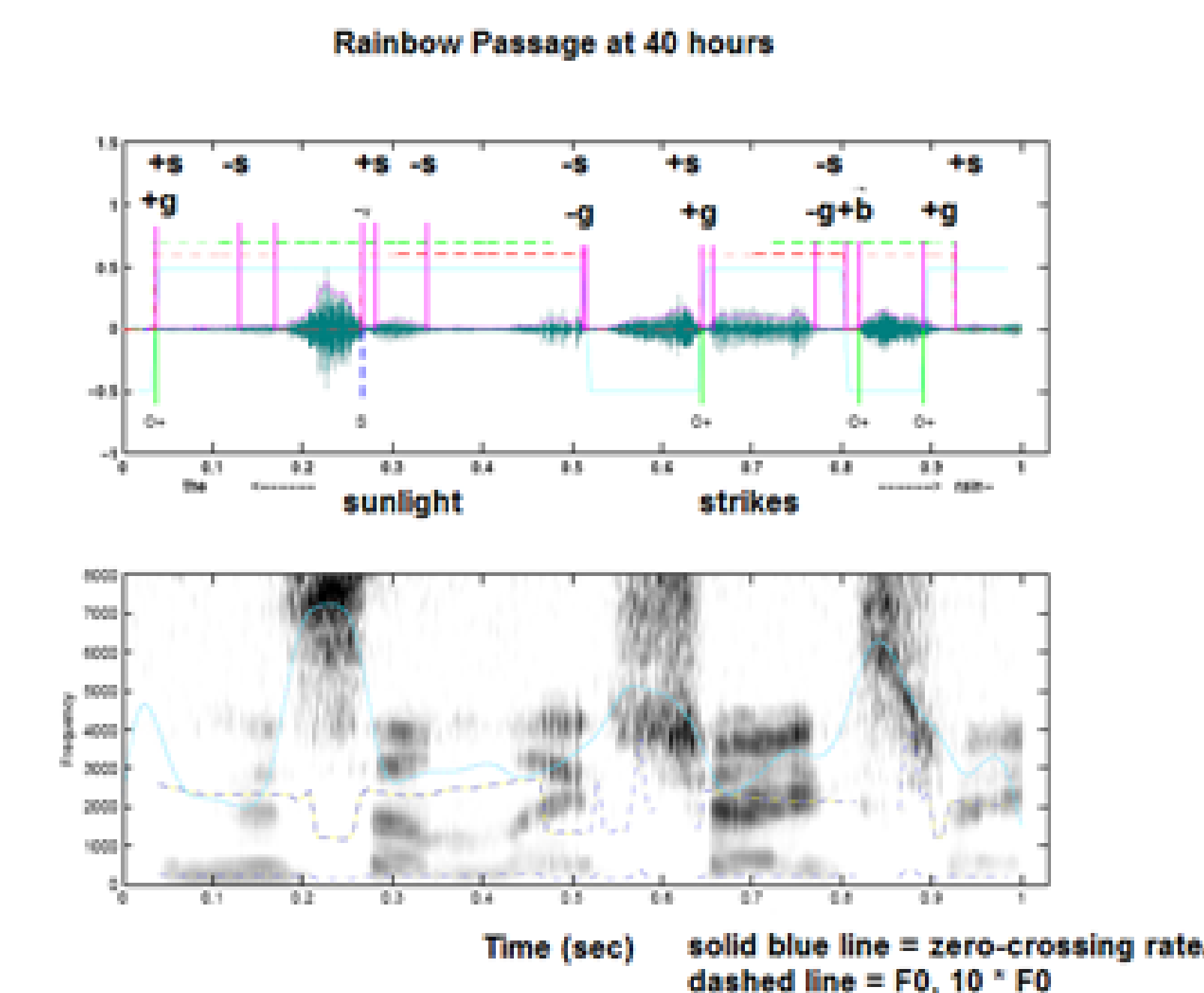
### Discussion

- Vowel area & dispersion**
  - VF paralysis: Abnormal F1 & F2 values due to tracheal resonance?
- Contradictory to findings from the past studies (Bond & Moore, 1994; Bradlow et al., 1996; Neel, 2008) however, this is the effect of outliers created by dysphonia

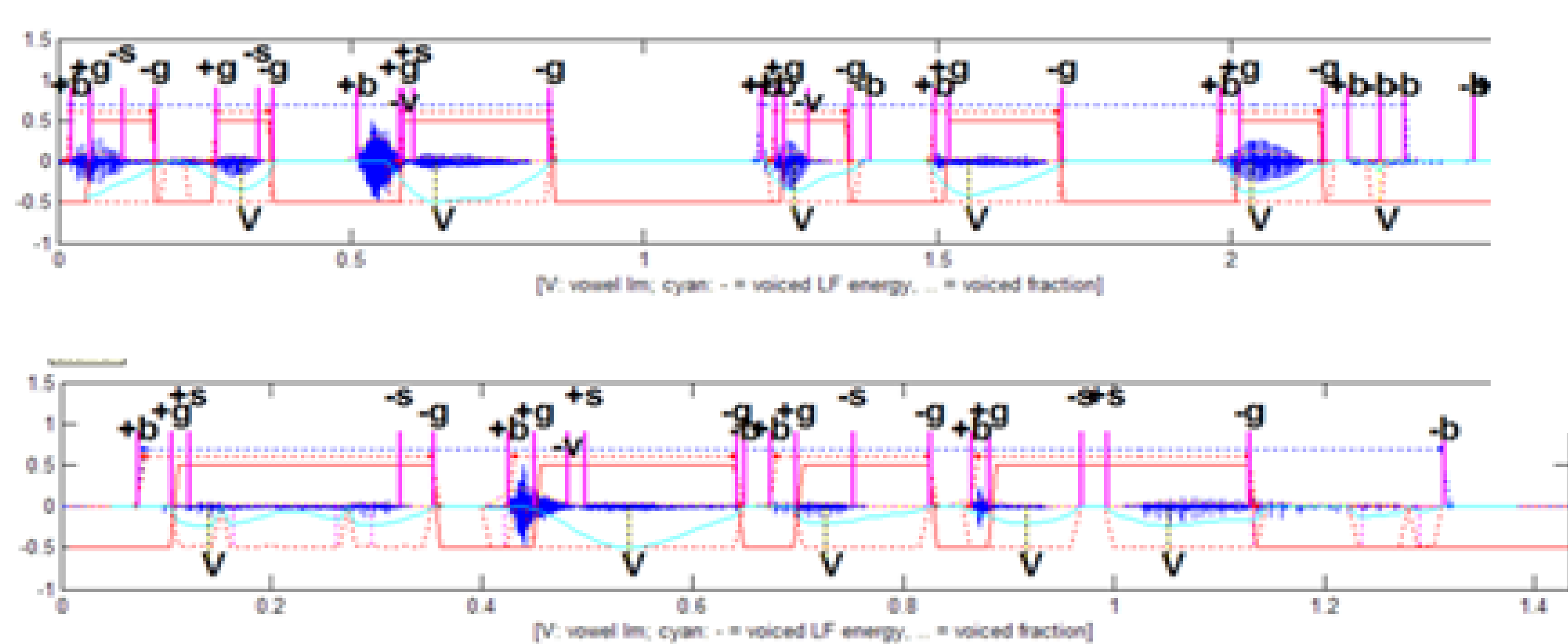





### Example of speech late in Sleep-Deprivation Experiment



### Clear (top) vs. Conversational (bottom) Utterances



They had two empty bottles.

Duration Difference

