

Voicing and Aerodynamics

Gestures and their consequences

- Gestures are actions that result in certain articulatory, aerodynamic and acoustic consequences.
- The consequences of a given action may vary as a function of conditions in the vocal tract which the particular gesture does not itself control.
 - For example: "miss you"
- In such circumstances, what **counts**, in terms of contrast, actions or their consequences?
- Variability of consequences is particularly significant for laryngeal gestures.

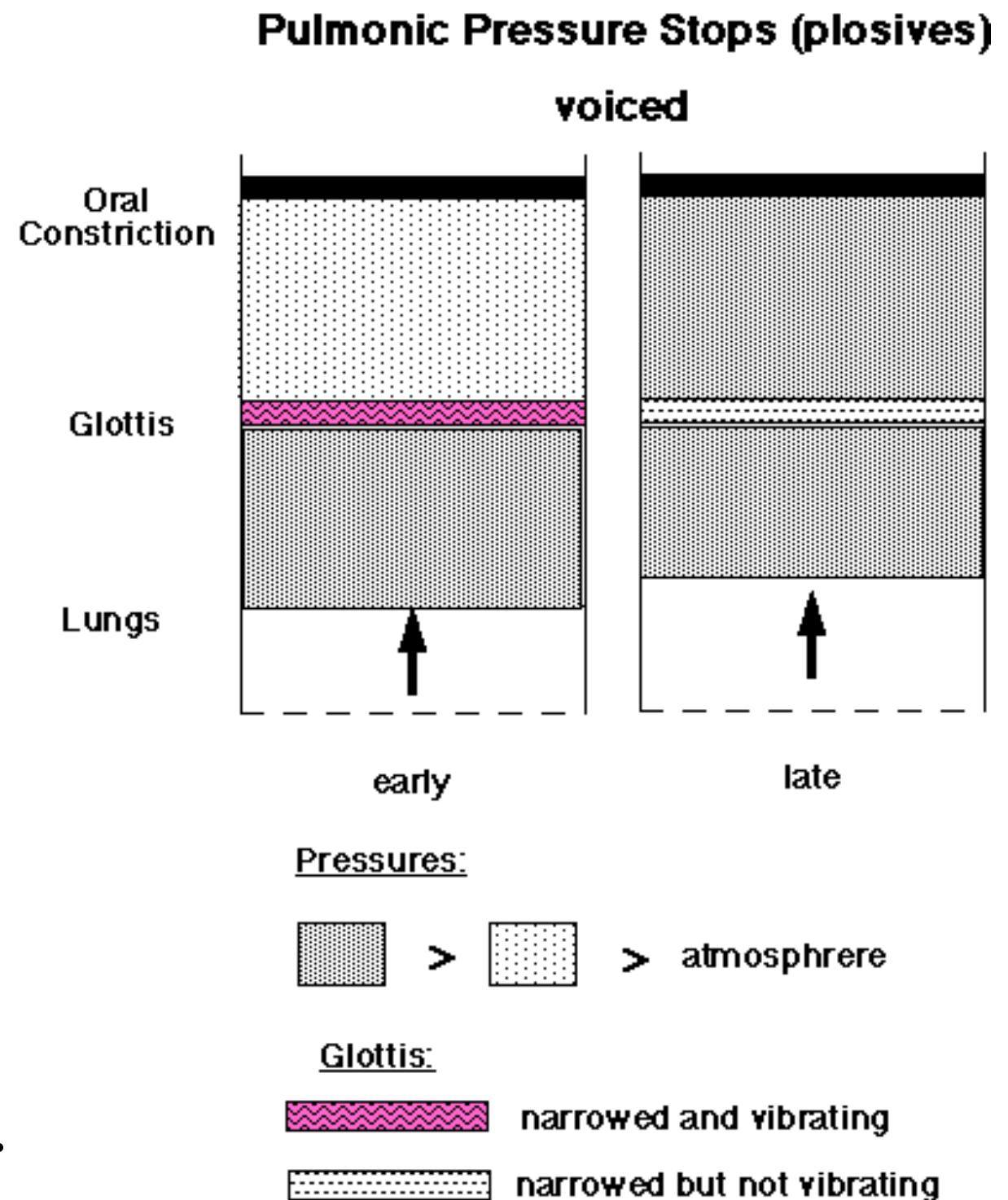
Vocal Fold Vibration

- Requires two sets of conditions to be met:
 - **aerodynamic conditions**
pressure below the glottis must be greater than pressure above the glottis.
 - **laryngeal conditions**
Vocal folds must be narrowed,
Vocal folds cannot be too stiff.
- Laryngeal gestures will not always have expected consequences if their aerodynamic conditions are not met.

Gesture	Expected Consequence
Vocal Fold Narrowing	Voicing
Vocal Fold Separation	Devoicing

Voicing during stop closures

- Problematic context for voicing
- Supralaryngeal cavity is closed off.
- Within 15 ms, pressure above glottis will exceed than in lungs, and vibration will cease (unless something else happens).
- Try maintaining voicing during closure, and you will see that you can only do it for a short amount of time.



Voiced Stops in English

- They often lack any voicing during the closure interval.
- Narrow transcription as voiceless unaspirated stops, e.g, [p] or [b̥].
- However, data on laryngeal gestures show that the same laryngeal gesture (vocal fold narrowing) usually occurs in English "voiced" stops, regardless of whether vibration actually occurs.
- Sometimes the laryngeal gesture has the expected consequence, sometimes it does not.
- But we hear both cases as "voiced", indicating that it is the action, not the consequences, that is important for contrast in this case.

Voicing in Thai stops

- In Thai, stops with voicing throughout their closures contrast with stops that lack voicing during their closures.
- Unlike English, these cases are produced with different gestures in Thai:
 - **Voiceless unaspirated stops**
Laryngeal gestures separate the vocal folds
 - **voiced stops**
no laryngeal separation
- But how do they manage to sustain voicing during closures for the voiced stops?

Supralaryngeal Expansion

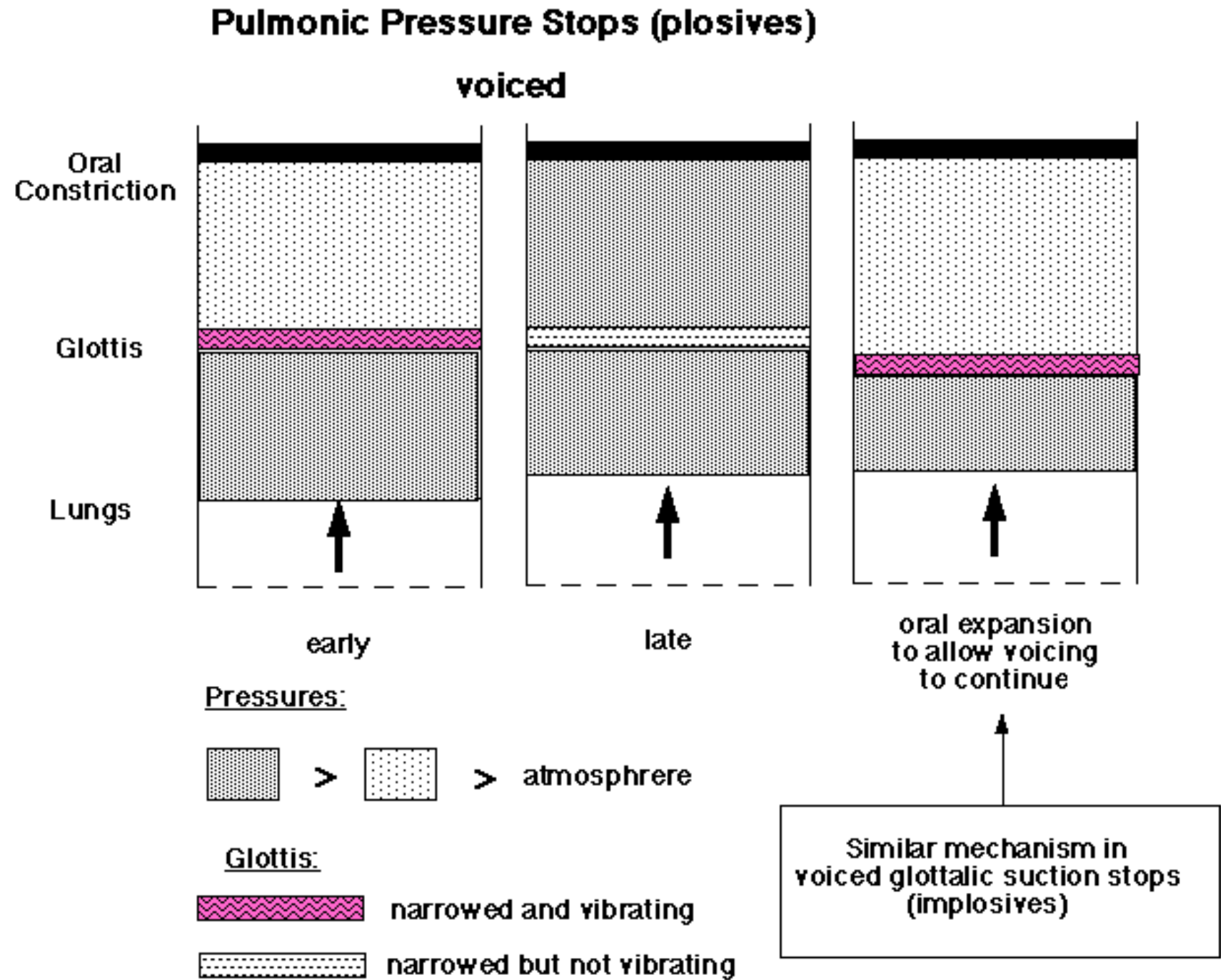
- One way to sustain voicing during a closure is to expand the supralaryngeal cavity, so as to lower the pressure that builds up.
- How can the cavity be expanded, while maintaining closure?
- Passive Expansion
 - Soft tissues of supralaryngeal cavity will compress passively as pressure builds up, thus expanding the cavity size
 - Effectiveness of compression:
labial stops > coronal stops > dorsal stops
 - This accounts for differences in stop inventories in languages, and "gaps" in the systems.
e.g., Thai lacks a voiced dorsal stop

Supralaryngeal Expansion

- Active Expansion

- Probably required in a language that contrasts voiced and voiceless unaspirated stops.

- Larynx lowering is also the basic gesture employed for expansion.

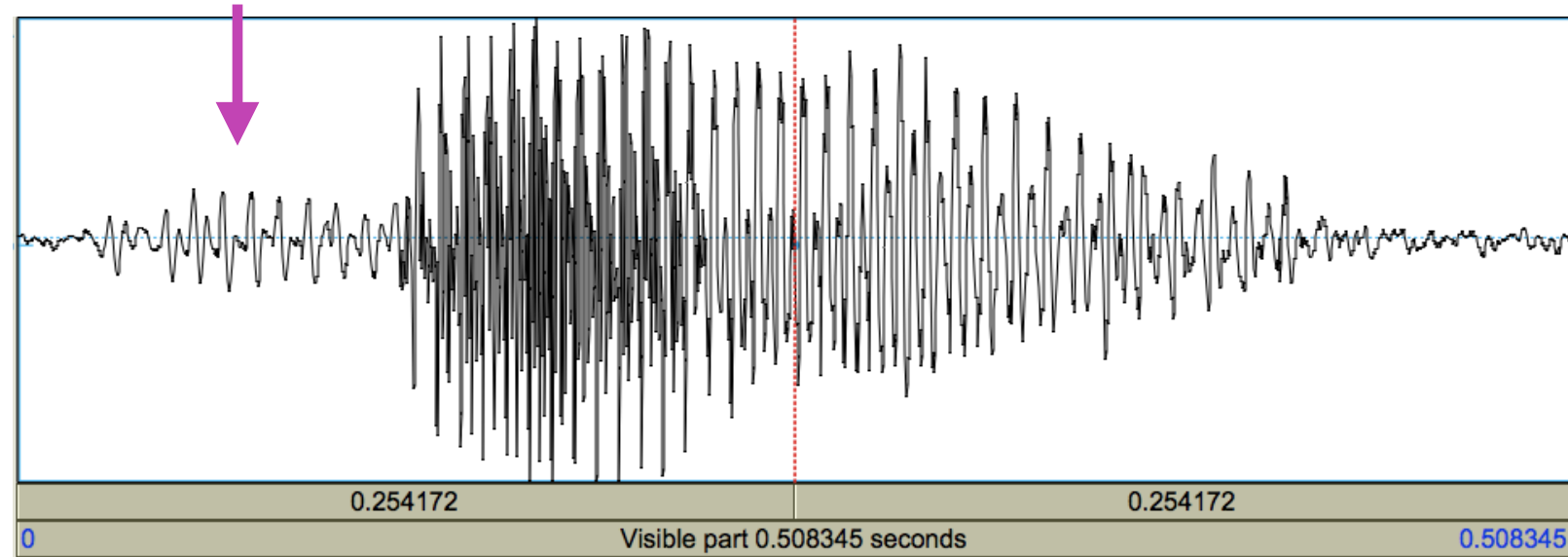


Voiced Implosives

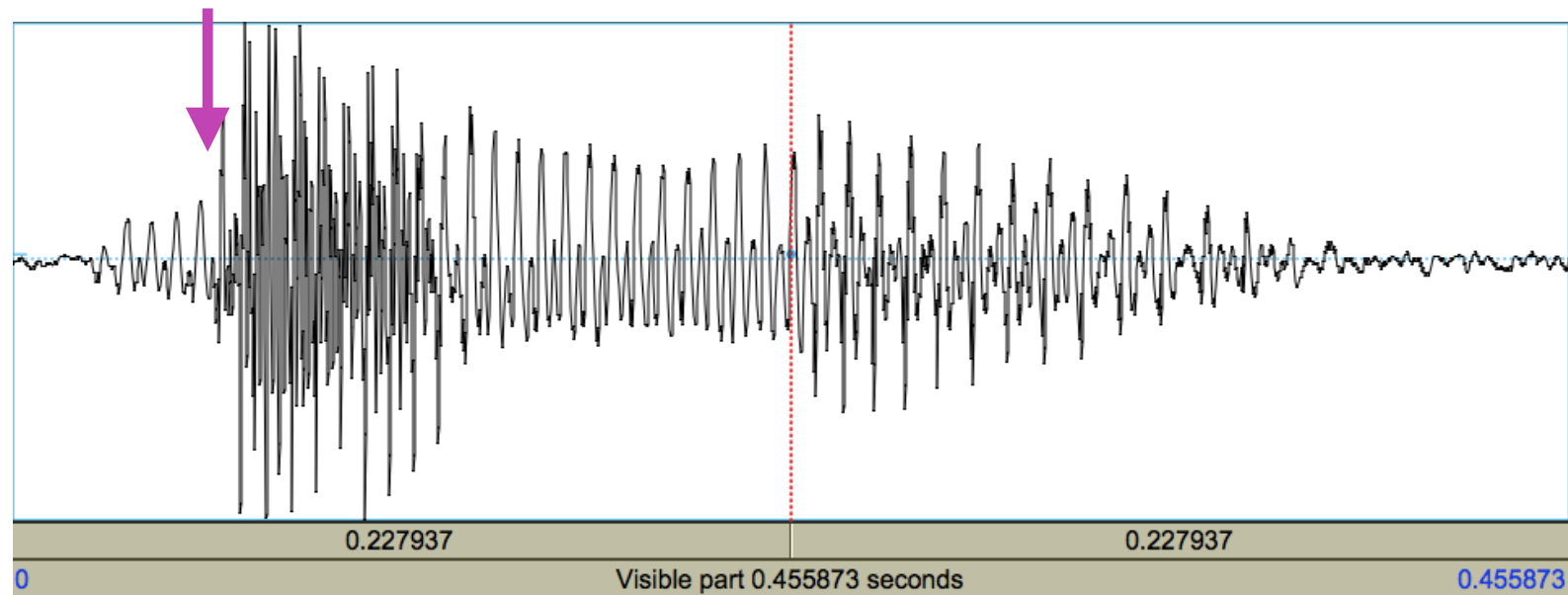
- Voiced implosives use larynx lowering to rapidly expand the size of the supralaryngeal cavity, and to create strong vocal fold vibration.
- Larynx Lowering in voiced plosives vs implosives:
 - **Timing of larynx lowering**
Implosive: larynx lowering begins at closure release
Plosive: lowering is synchronous with closure
- Voiced implosives [ɓ ɗ ɠ] contrast with voiced plosives in several languages
 - e.g. Sindhi

Timing of Larynx Lowering

Sindhi [banu]



Sindhi [bani]

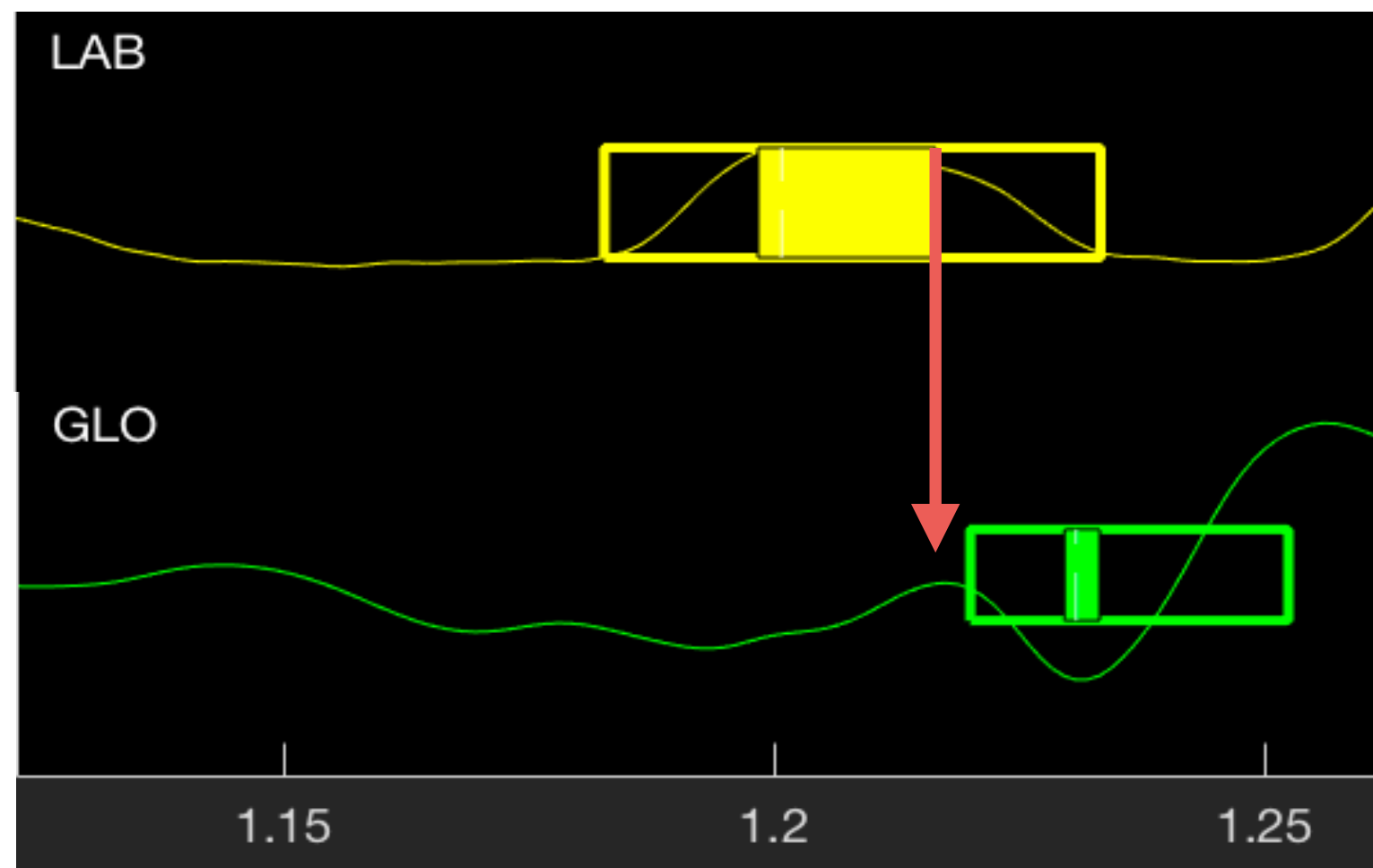


- Difference in timing suggests earlier timing of larynx lowering in plosive than in implosive.

Hausa Bilabial implosive /ɓ/

Labial Constriction

Larynx Height

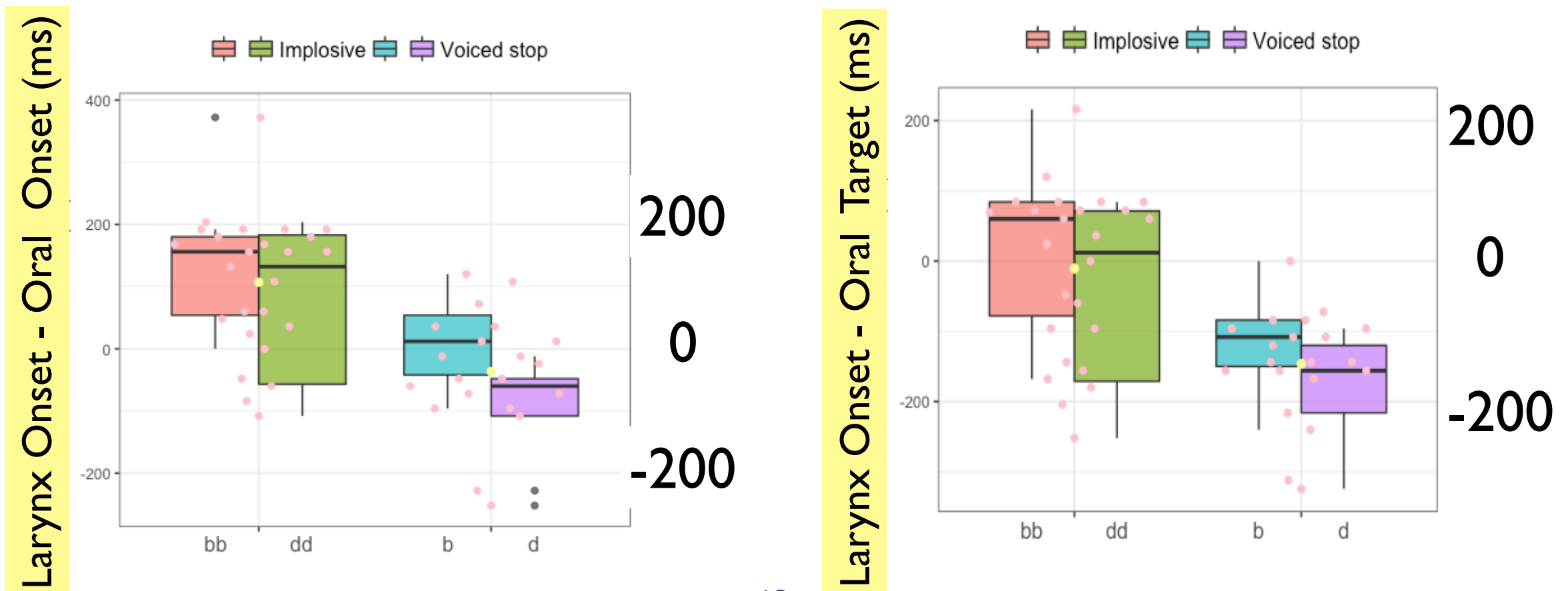


Time (ms)

Data from MRI
Oh (in prep)

Results

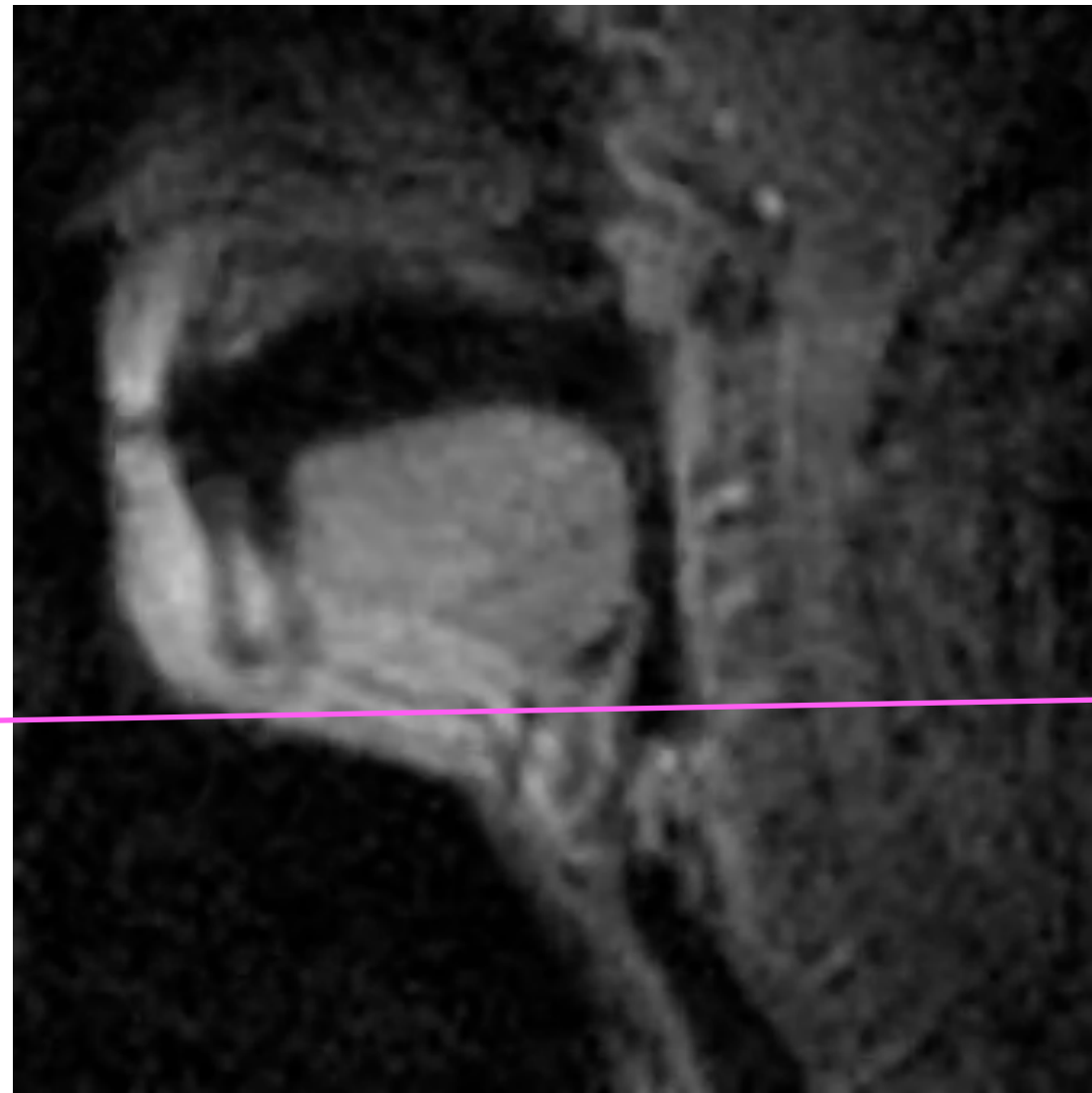
- Time from **onset of oral constriction** to **onset of laryngeal gesture** is roughly synchronous for plosives (in-phase),
- Lag is much longer for implosives, where laryngeal onset is coordinated to begin near the release of the oral constriction (anti-phase).
- Implosive lag is more variable



Plosives vs. Implosives



[aba]



[aba]