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## **Poster presentation: Articulatory modeling of the S-shaped F2 trajectories observed in Öhman's spectrographic analysis of VCV syllables**

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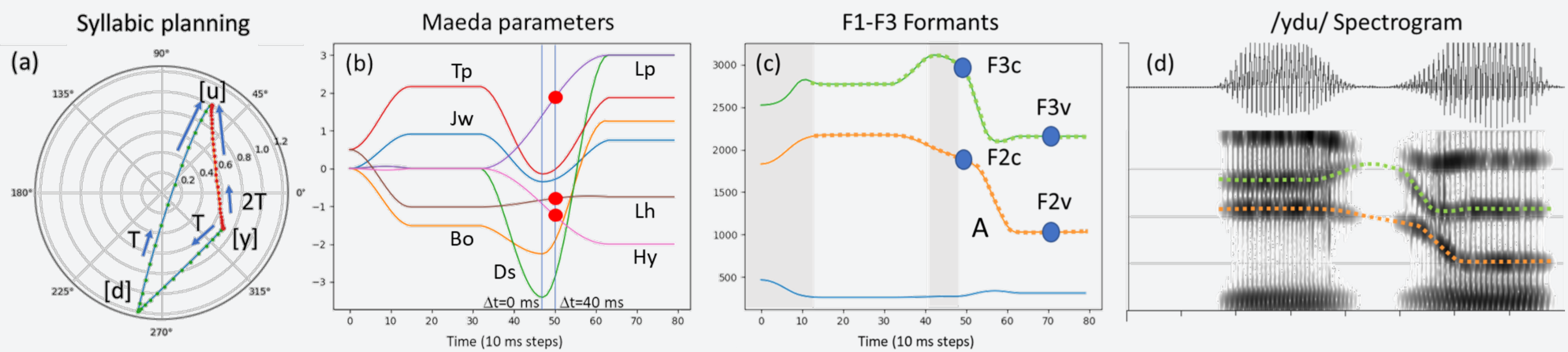
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**Abstract**

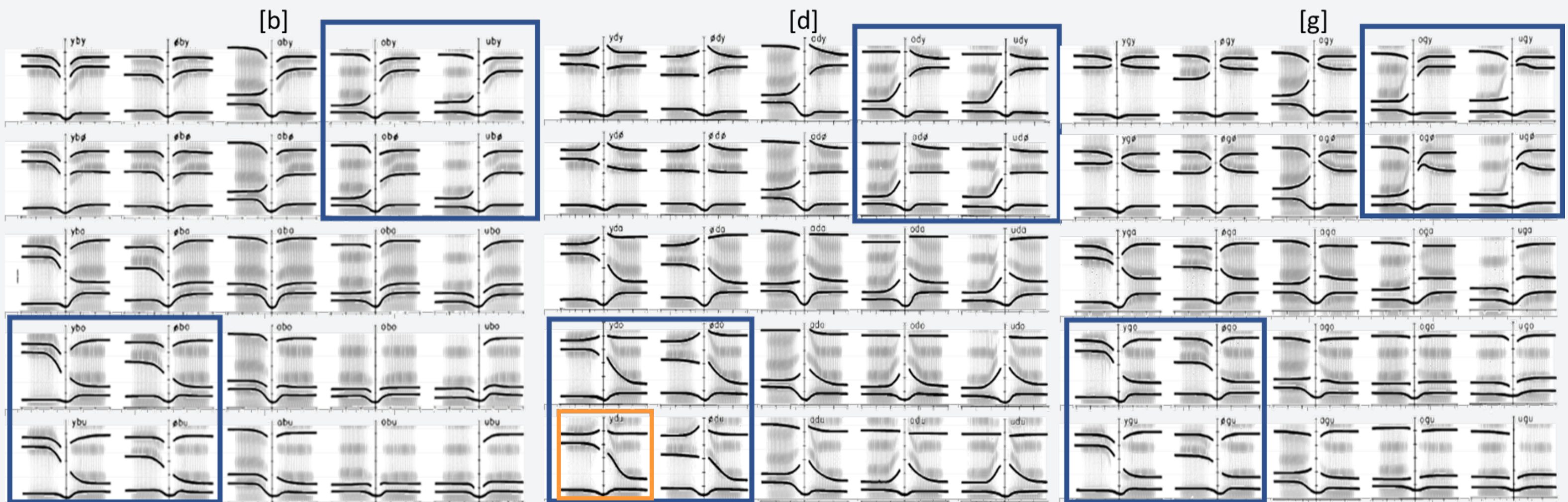
The synthesis of Öhman's 75 VCV sequences with intervocalic plosives was first achieved 30 years ago with the DRM model, yet remained purely acoustic. We re-generate the same sequences with the articulatory Maeda model using separate planning for vowel-to-vowel transitions and consonantal gestures. The vocalic anchors  $V_1$  and  $V_2$  were selected from the set /y, ø, a, o, u/.

- 1. Syllabic planning via synchronized articulatory pathways:** Geometric coordination of gestures in polar space (Fig. 1a)
- 2. S-shaped F2 emerges from articulatory synergy:** Non-linear interaction of separately controlled vocalic/consonantal parameters (Fig. 1b-c, Eq. 1)
- 3. Accurate replication of Öhman's phenomena:** Synthetic trajectories reproduce classic S-patterns without tuning (Fig. 2)

**Key Visuals**



**Figure 1** Syllable planning /ydu/ and resulting F1-F3 tracks.



**Figure 2** 75 synthetic VCV spectrograms (blue squares = S-shaped F2).

**How the S-curve emerges**

- 1. Two-tier planning** — slow vowel arc (2T) + two fast consonantal arcs (T).
- 2. Tau-governed timing** — harmonic motion:

$$X(t) = X_0 \cos\left(\frac{\pi t}{2D}\right)^{\frac{1}{\kappa}} \simeq X_0 \left(1 - \frac{t^2}{D^2}\right)^{\frac{1}{\kappa}}$$

- 3. Polar synergy rule** — transition onset precedes closure (case B) when C is polar-closer to V2.

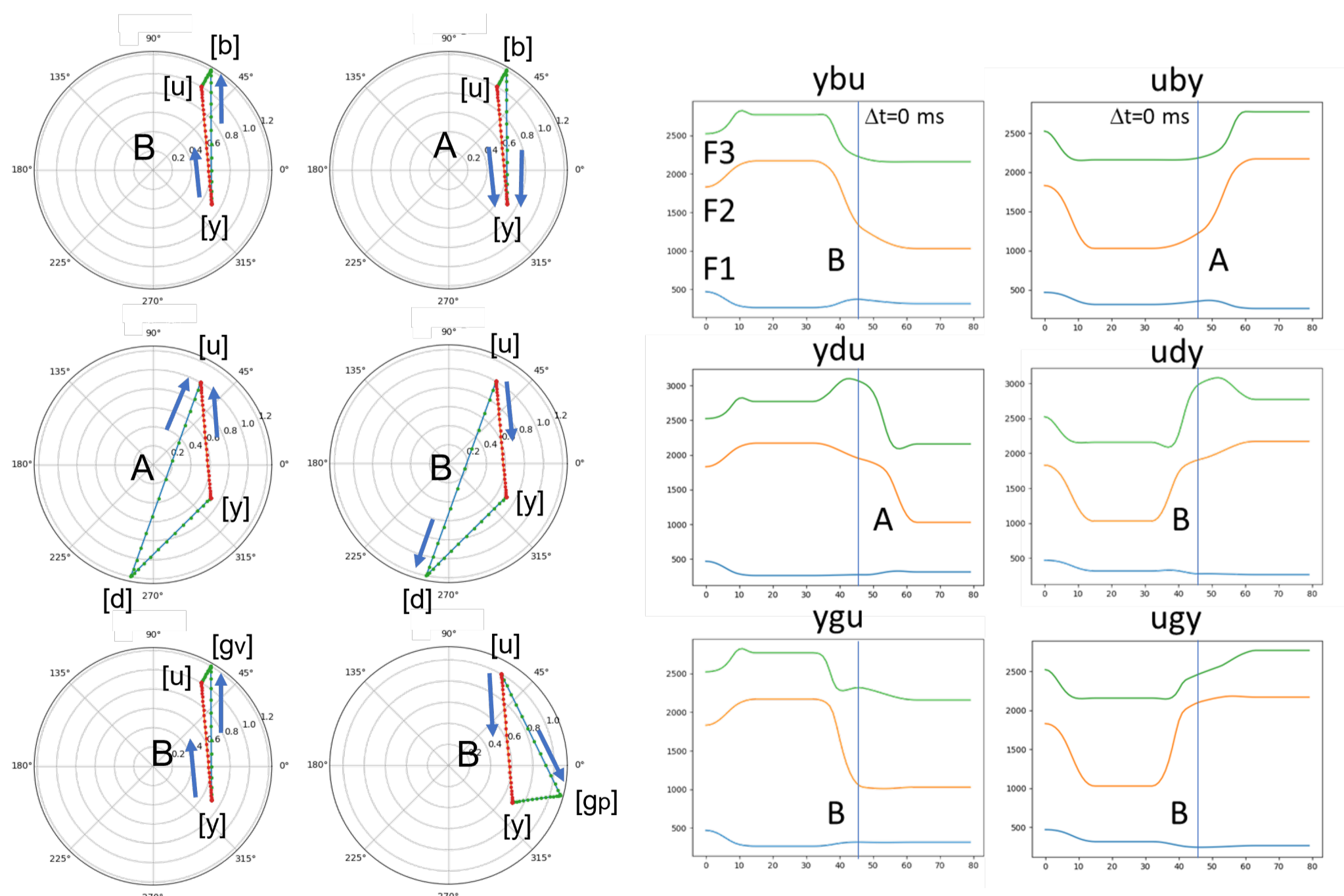
$$P(t) = \Omega + \text{Re}[S_v \odot \Psi \bar{z}_v(t) + S_c \odot \Psi \bar{z}_c(t)] \quad (1)$$

| Parameter | $\Omega$ | $\Psi_1$ | $\Psi_2$         |
|-----------|----------|----------|------------------|
| 1-Jaw     | 0        | -1.5     | $\pi$            |
| 2-Body    | 0        | -2.5     | $\frac{5\pi}{3}$ |
| 3-Dorsum  | 0        | 3        | $\frac{\pi}{3}$  |
| 4-Tip     | 0.5      | -2.75    | $\pi$            |
| 5-LipP    | 0        | 3        | $\frac{\pi}{3}$  |
| 6-LipH    | 0.5      | 2.5      | $\pi$            |
| 7-Hy      | 0        | -2       | $\frac{\pi}{3}$  |

**Table S1:** Complex parameters used in Eq. 1



Scan for code & data



**Suppl. S3** Polar arcs for /uCy/ and /yCu/ with Pre/Post-closure transitions.

**Conclusion**

Using an articulatory model, we recover Öhman's classic observations deterministically: S-shaped F2 transitions are a **co-product of vowel and consonant synergy**. The work extends tube-model insights to a fully interpretable articulatory framework.