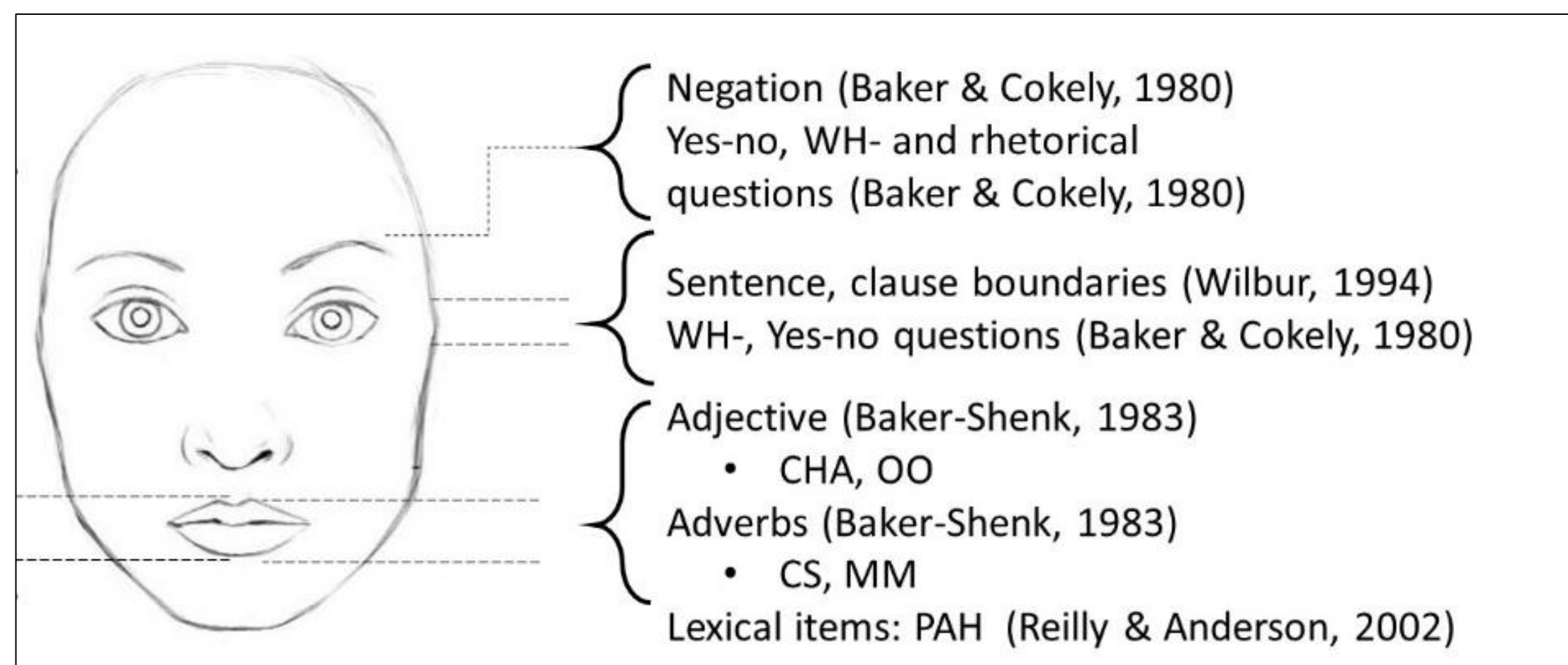# A Novel Approach to Managing Lower Face Complexity in Signing Avatars

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Critical Complex Component

Lack of adequate facial motion is a primary criticism of deaf community (Verlinden, Tijsseling, & Frowein, 2001), (Kipp, Nguyen, Heloir, & Matthes, 2011), (Ebling, et al., 2015)


Negation (Baker & Cokely, 1980)
Yes-no, WH- and rhetorical questions (Baker & Cokely, 1980)

Sentence, clause boundaries (Wilbur, 1994)
WH-, Yes-no questions (Baker & Cokely, 1980)

Adjective (Baker-Shenk, 1983)
• CHA, OO
Adverbs (Baker-Shenk, 1983)
• CS, MM
Lexical items: PAH (Reilly & Anderson, 2002)

Challenges:

• Many linguistic processes are carried by facial movement
• no process has exclusive franchise over a facial feature!
• Control and coordination are difficult

Control is Key!

Muscular action and coordination is complex on the lower face (Chen, et al., 2012)

A. levator labii superioris
B. zygomaticus minor
C. zygomaticus major
E. orbicularis oris

F. risorius
G. depressor labii inferioris
H. and depressor anguli oris
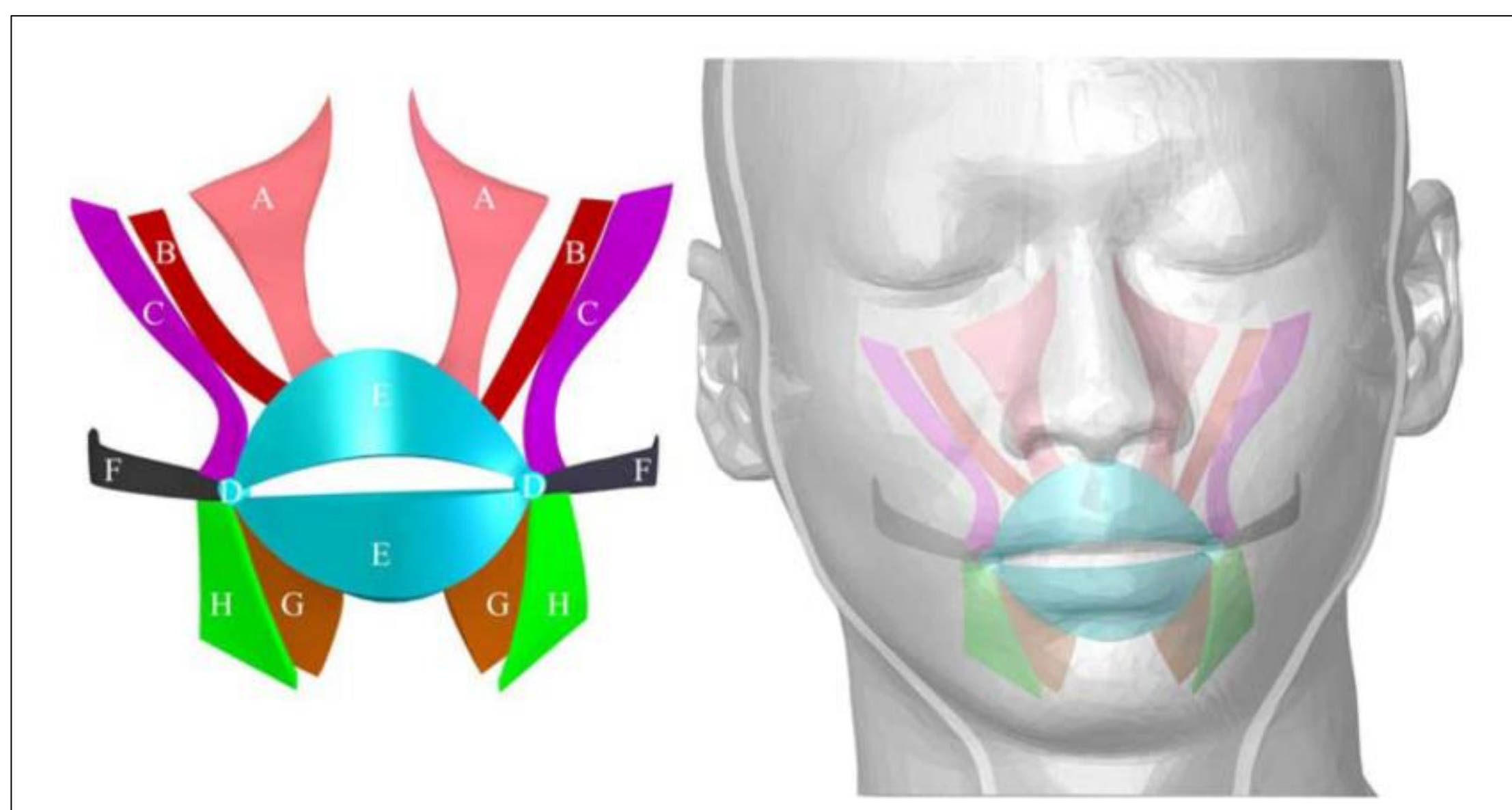
Two main technologies

• Morph targets → simple and straightforward to implement but inflexible when many expressions must be combined as in SL
• Muscle & skin based → mor natural results but comes with an increased burden on the artist using the system

Most approaches focused on the MPEG4 H-Anim standard driven by one of these two approach

• Morph-based: JA-Signing (Jennings, Elliott, & Kennaway, 2010)
• Morph-based: EMBR (Kipp, Heloir, & Nguyen, 2011)
• Muscle Based: Paula (Wolfe, et al., 2018), (Johnson, 2018)

Feedback from the deaf community has consistently highlighted the inadequacies of mouth postures generated by these systems.

A Novel Control Approach

Muscles act in concert to achieve "effect"

• Start with the 44 controls of (Johnson, 2018) in a muscular based system
• Leverage muscle coordination to give muscle systems morph-like control
• Controls are linked to "effect" sliders

Problem: Hiding the complexity!

• Each slider will affect multiple controls in different amounts
• Multiple sliders may affect a control
• Combined effect on each control computed by control scripts (MaxScript)

	Effect	Cooperating muscle group	Layer
1	Lip Spread	left/right risorius, left/right buccinator, obicularis oris	1
2	Jaw Drop	left/right depressor, labii inferioris, mentalis, orbicularis oris	2
3	Upper Lip Roll	obicularis oris	4
4	Lower Lip Roll	left/right mentalis, left/right depressor, labii inferioris, obicularis oris	4
5	Left Lip Corner	left zygomaticus major, left depressor anguli oris, obicularis oris	3
6	Right Lip Corner	right zygomaticus major, right depressor, anguli oris, obicularis oris	3
...			

```
dependsOn LipSpreadSlider
t = LipSpreadSlider / 10
if t >= 0 then
  slerp identity qmaxSpread  t
else
  slerp identity qmaxPucker -t
```
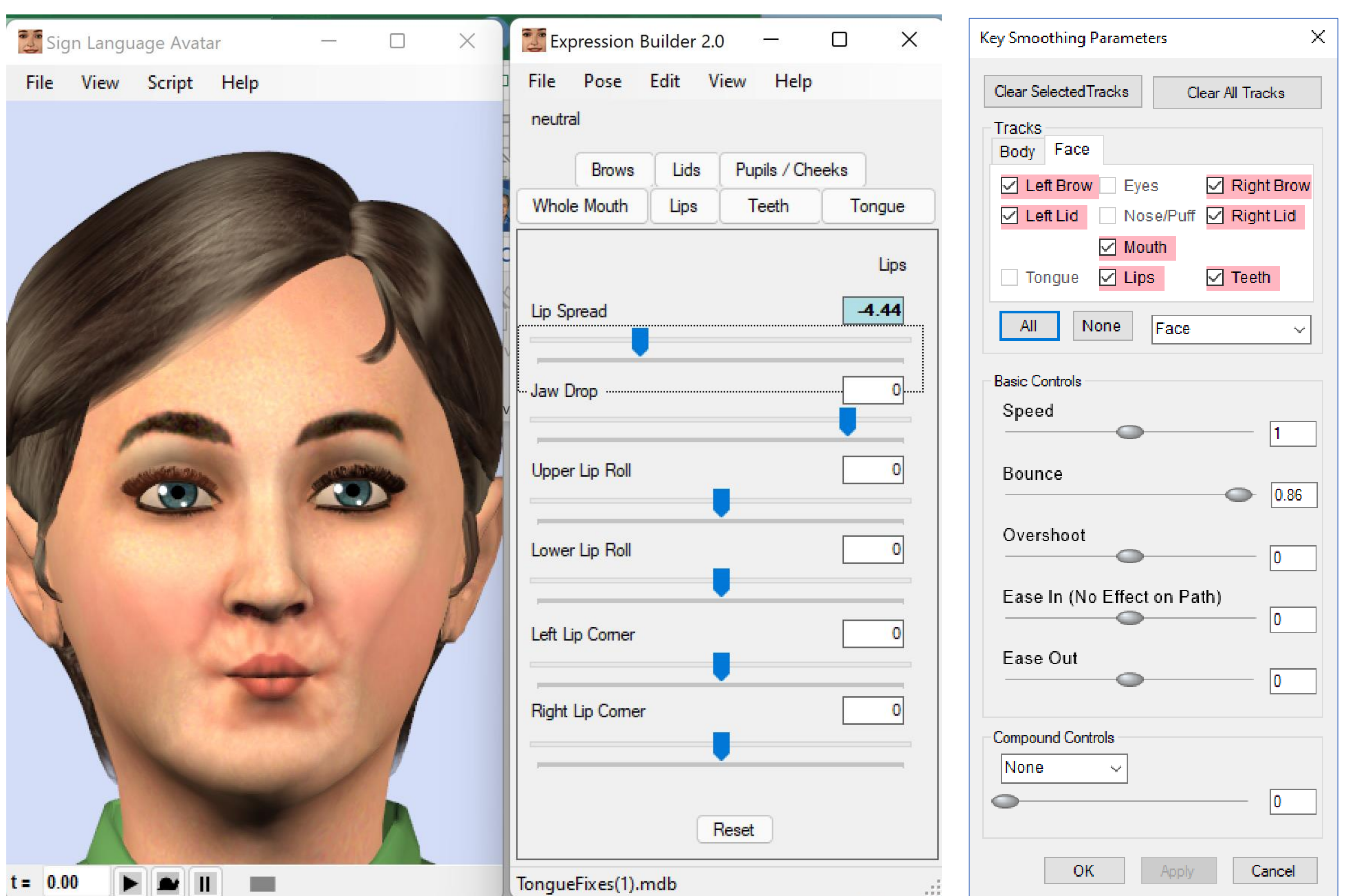
Metadata to communicate script parameters to real-time renderer

```
--:1:LipSpreadSlider:symmetric:qmaxSpread:
qmaxPucker:10:-10:100:100
```

Results

A more intuitive interface with layered panels to control various parts of the face. Motion details are controlled with intuitive sliders based on Tension-Continuity-Bias Splines

Paper with references