

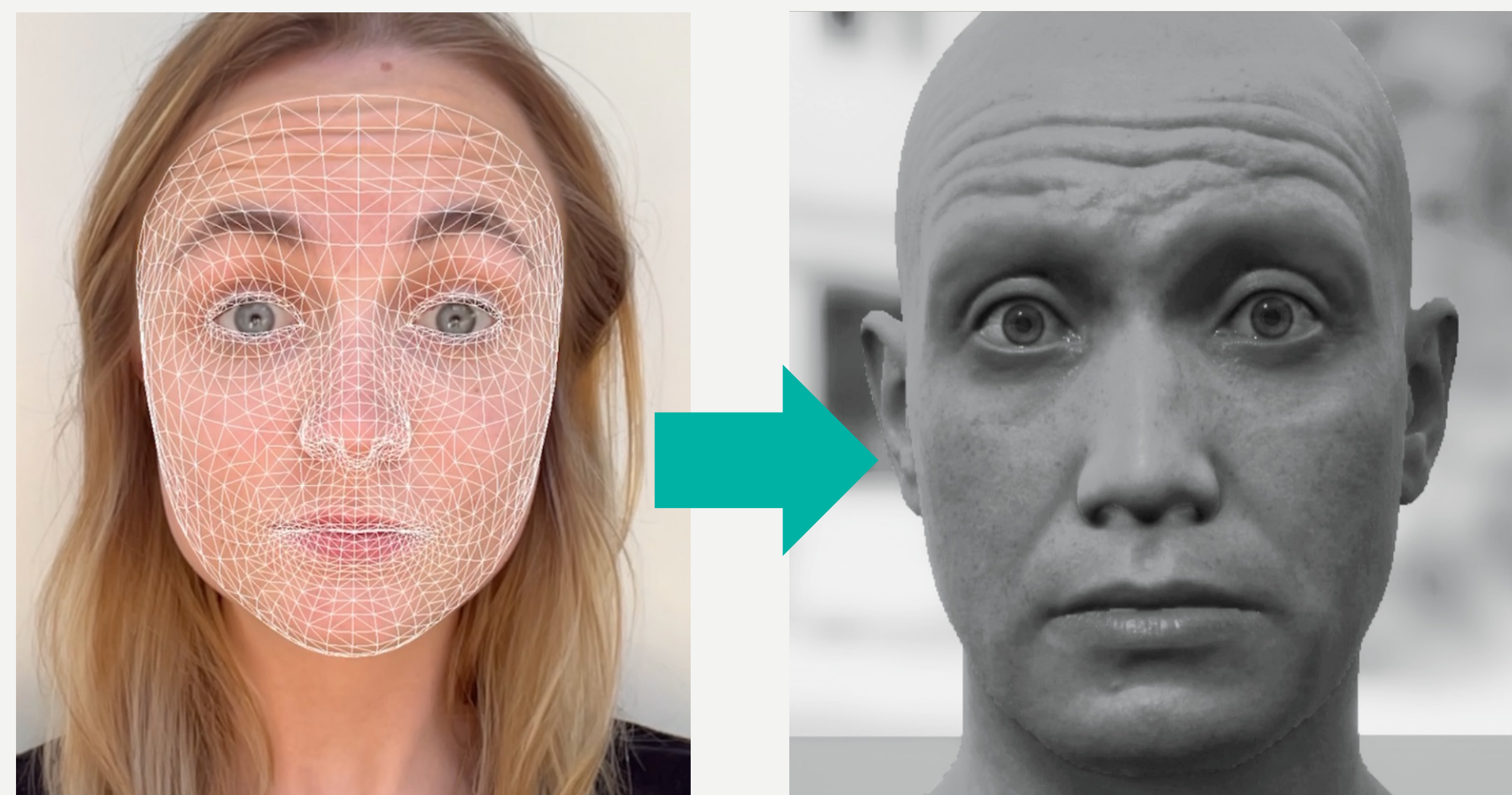
TrueDepth measurements of facial expressions: Sensitivity to the angle between camera and face

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RESEARCH QUESTION

TrueDepth measurements can be used to measure facial expressions and control avatars

Are these measurements reliable?



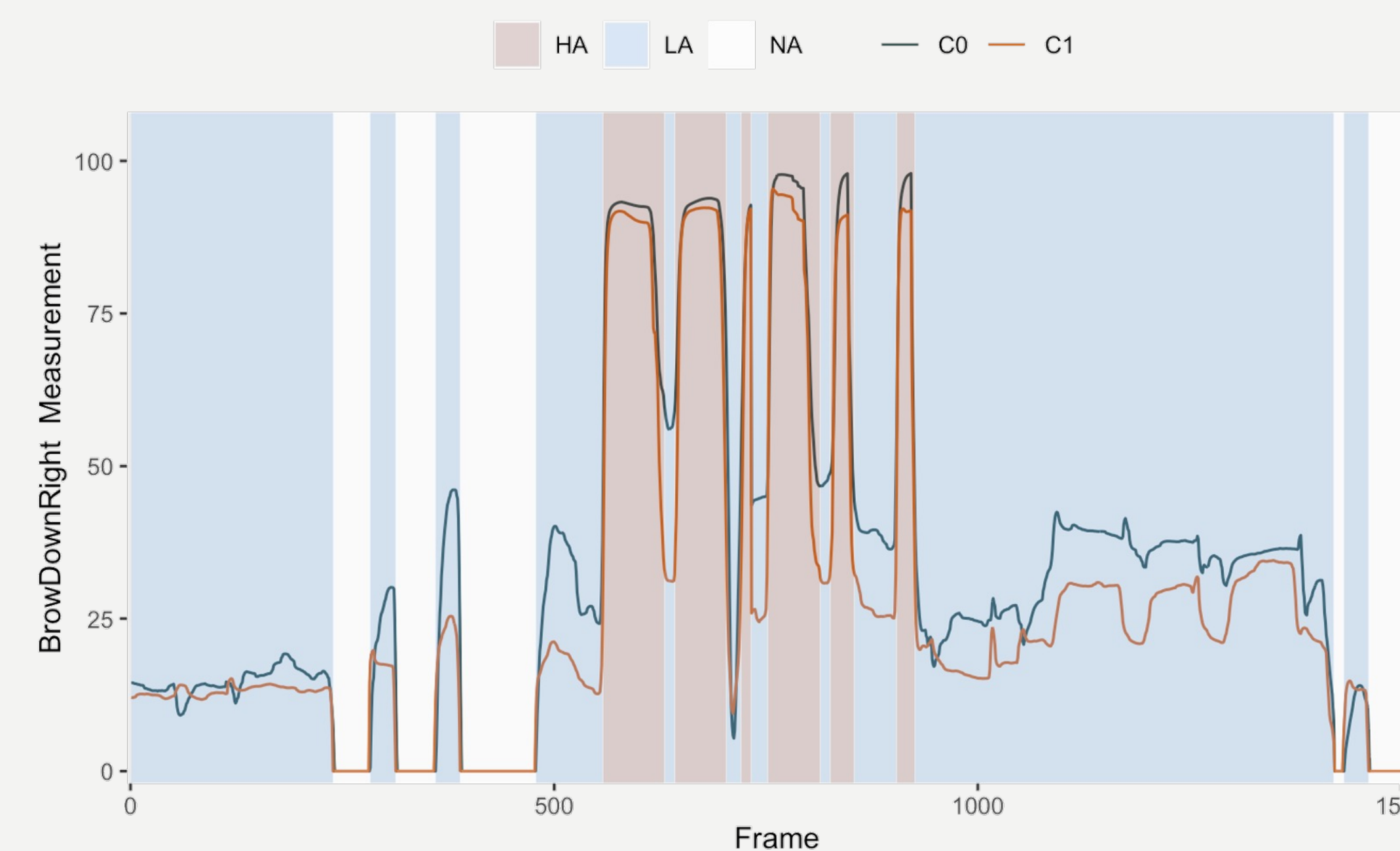
DATA COLLECTION

- **Participants:** one male, two female
- **Materials:** five TrueDepth cameras (in iPhones)
- **Task:** participants displayed an identical sequence of facial expressions for each recording



PRE-PROCESSING

- **Classified measurements in frames** as “high activation” (HA), “low activation” (LA), and “no activation” (NA)



STATISTICAL MODELLING

- A **pairwise comparison** was made between the reference camera (C0) and the other cameras (C1, C2, C3, and C4)
- **Linear mixed effects models** were built for each pair of cameras, blendshape, and activation level (HA/LA)
- **Pearson's correlation coefficients** were calculated for blendshape values measured by the two cameras

| % Effect (HA) | Lower bound | Upper bound | Mean | Standard dev. |
|---------------|-------------|-------------|------|---------------|
| C1 | 0 | 44 | 12 | 11 |
| C2 | 0 | 74 | 24 | 20 |
| C3 | 0 | 59 | 21 | 13 |
| C4 | 1 | 41 | 17 | 10 |

| % Effect (LA) | Lower bound | Upper bound | Mean | Standard dev. |
|---------------|-------------|-------------|------|---------------|
| C1 | 3 | 276 | 95 | 76 |
| C2 | 11 | 219 | 86 | 56 |
| C3 | 0 | 296 | 68 | 70 |
| C4 | 0 | 199 | 55 | 43 |

| Correlation (HA) | Lower bound | Upper bound | Mean | Standard dev. |
|------------------|-------------|-------------|------|---------------|
| C1 | 0.50 | 0.97 | 0.85 | 0.13 |
| C2 | 0.52 | 0.98 | 0.85 | 0.11 |
| C3 | 0.52 | 0.98 | 0.82 | 0.11 |
| C4 | 0.45 | 0.97 | 0.81 | 0.11 |

| Correlation (LA) | Lower bound | Upper bound | Mean | Standard dev. |
|------------------|-------------|-------------|------|---------------|
| C1 | 0.13 | 0.73 | 0.47 | 0.17 |
| C2 | 0.06 | 0.75 | 0.48 | 0.20 |
| C3 | - 0.17 | 0.75 | 0.48 | 0.18 |
| C4 | - 0.03 | 0.67 | 0.38 | 0.18 |

RESULTS

- The **angle between camera and face** generally has a **significant and often substantial effect** on measured blendshape values
- **HA frames are generally highly correlated**
- **LA frames are generally much less reliable than HA frames**, with higher percentage differences and lower correlation coefficients

FUTURE WORK

- Investigate the effect of distance and calibration method
- Expand to a larger and more diverse participant group to generalize findings

