Your brain expects each face to move its own way, and notices when a smile breaks that rule

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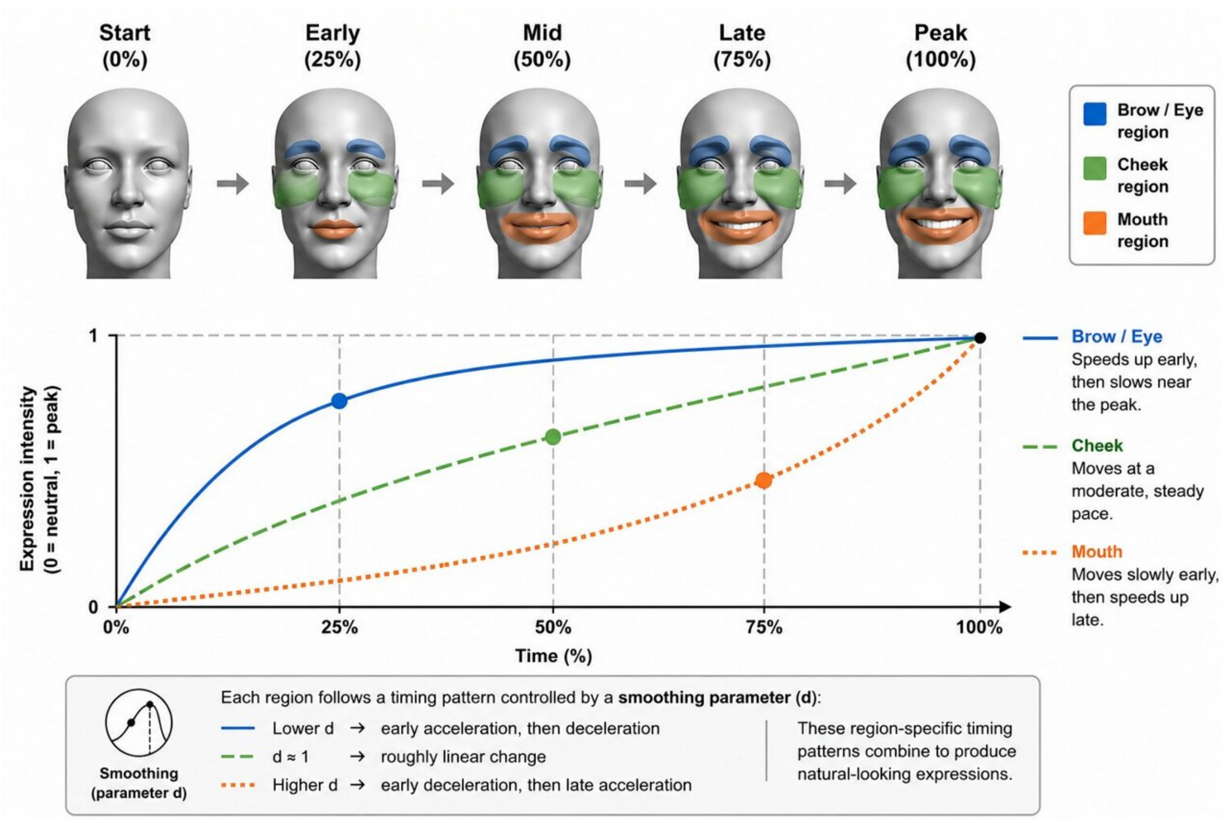


Different parts of the face do not move at the same pace during an expression. Instead, regions such as the brows, cheeks and mouth can accelerate or decelerate at different times as an expression unfolds, creating the natural movement patterns that people expect to see. The study found that these timing patterns also depend on the underlying facial structure, meaning the same expression can look more or less natural depending on the face displaying it.

Credit: generated by AI using information from the paper

Imagine meeting someone new whose smile feels just a bit wrong. You might think, "this smile is too fast (or slow, or crooked)," even if the movement itself is common. How could your brain sense this subtle "offness" from so little information? Anatomically, it makes sense: The bones and muscles that give a face its unique shape also dictate how it moves. Yet for a long time, standard models of face perception have treated static identity (like eyes, nose and jaw) and dynamic expression (smiles, frowns) as entirely separate processes.

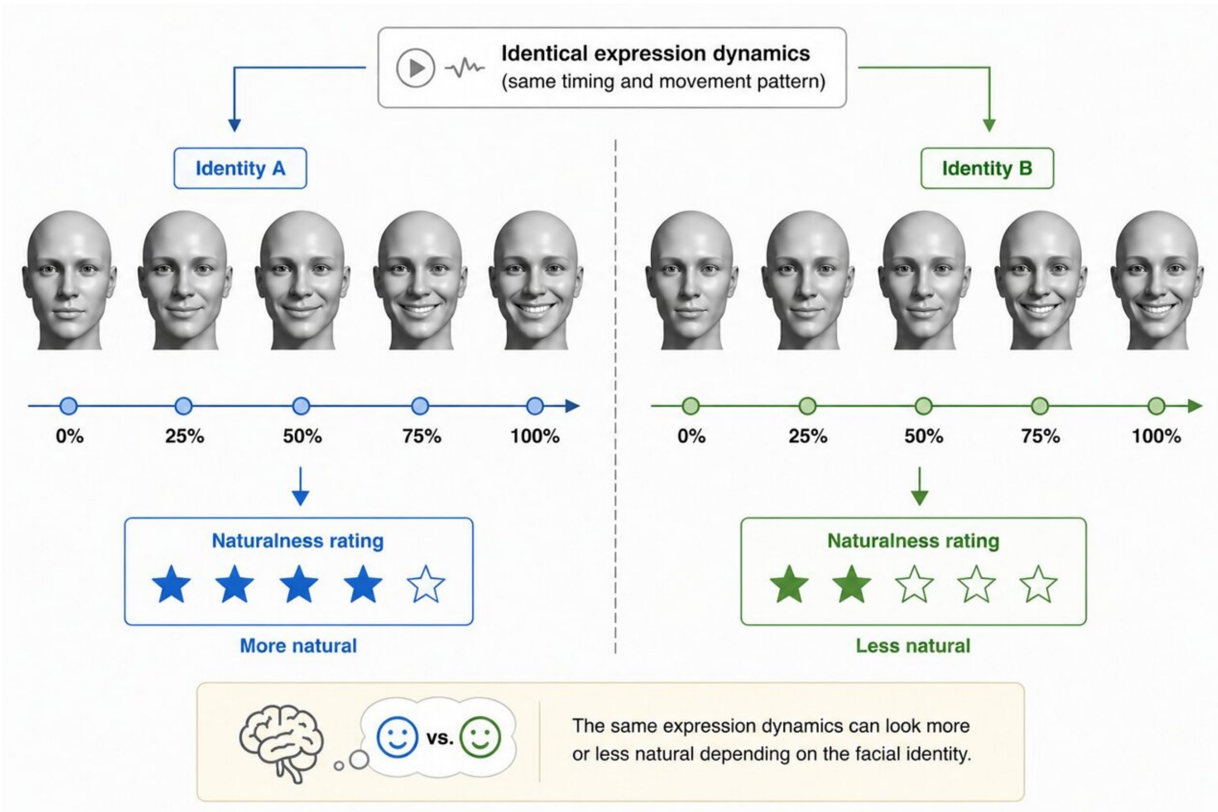
This intriguing puzzle—whether our brains expect different faces to move in distinct ways, or if there's a universal "natural" template for facial motion—is precisely what a new study 2026, published in Proceedings of the Royal Society B, set out to test.

The researchers aimed to discover whether our visual system uses facial structure to predict movement, or whether classic neuroscience models, which suggest separate brain pathways for shape and motion, are entirely correct.

One face, many motions

Researchers ran a clever online experiment with 436 volunteers. They showed 3D animated faces (angry, happy, surprised) whose shape or movement was subtly altered by random "noise." Some people judged how natural the expression's timing felt, while others judged how similar the face shape looked to a familiar target.

Using reverse-correlation techniques, they could pull out which motion features made a smile feel right, and which shape features determined identity. The key twist was that the same expression timing was tested on different face shapes (and vice versa) to see if context mattered.



A side-by-side comparison showing two different facial identities displaying the same expression dynamics. Although the timing and movement pattern are identical, observers rated one version as more natural than the other, illustrating that expectations for facial motion are shaped by facial structure rather than a single universal template. generated by AI using information from the paper

The result? People did expect different patterns of motion for different faces. For example, a smile that looked perfectly timed on one face could seem oddly fast or slow on another. As the authors summarize, "observers did not rely on a single, generic template of natural motion, but instead expected different patterns of movement for different faces."

There isn't one universal "normal" smile—each face carries its own ideal timing. This finding echoes a broader idea called motion-from-structure: Our brains seem to compute facial motion partly based on facial structure. It's like each face has a hidden motion signature built into its anatomy.

Interestingly, people tracked timing changes in all parts of the face. Even subtle accelerations of eyebrows, cheeks or lips—faster or slower than a steady pace—made expressions feel more or less natural, depending on who was smiling. These weren't conscious calculations, but the reverse-correlation analysis revealed consistent "natural motion" profiles across viewers.

The surprising part is that the pattern of these profiles flipped when the identity changed, even if the underlying motion noise was identical. The brain's internal expectations for motion were face-specific.

Stable identity, even if the face jitters

What about recognizing who it is? You might worry that if motion and shape interact, then bizarre motions could scramble identity cues. But the study found the opposite: Identity perception stayed rock-solid across motion contexts. No matter how the expressions were timed, people zeroed in on the same structural features (nose shape, eye spacing, etc.) to judge identity.

In the experiment, participants relied on an unchanged "shape template" to recognize the person, regardless of oddball motion. Even deliberately asynchronous movements didn't throw off the identity signal.

In the authors' words, the shape features for recognition "remain stable across motion contexts." So shape-to-motion influences go one way. Identity constrains expected movement, but movement quirks don't easily alter who you recognize.

These findings neatly fit a modern view of face processing: mostly separate channels for form and motion, with a little cross-talk. The brain's motion pathway gets a head start from facial structure—a bit like knowing a car's model tells you roughly how its engine sounds—but the identity pathway is robust to different driving styles.

This suggests that while face shape and motion are largely processed independently, there are minor early interactions. Here, that early interaction seems to give each face its unique dynamic fingerprint: a built-in rulebook for how it should move.

Why it matters

This research answers a subtle everyday puzzle: why your brain might expect a different kind of smile than mine. It suggests that the uncanny or insincere feeling of an expression isn't just in our heads, but in how our brains learned each face's own motion style.

In practical terms, it means animators and game designers shouldn't use one-size-fits-all motion timing. A character with a wide jaw needs a different smile tempo than one with a narrow face, or it might look "off." Similarly, virtual assistants and social robots could tune their expressions to their facial geometry for more natural interaction.

In the clinic, knowing that expression perception is partly tailored by face structure could inform therapies for conditions like prosopagnosia (face blindness) or autism, where motion cues are processed differently. And for all of us, it's a reminder that each face is a tiny natural machine: Its shape sets up an expectation for how it moves.

The next time a friend's grin seems oddly stiff or oversmiled, remember—it might just be your brain drawing on that person's unique "motion-from-structure" signature.

More information: Raphael Tordjman et al, Motion-from-structure in face perception: expectations of natural face motion depend on face shape, *Proceedings of the Royal Society B: Biological Sciences* (2026). DOI: 10.1098/rspb.2026.0515