Ontogeny and phylogeny of facial expression of pain
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1. Background
Facial expression of pain offers an important opportunity for better understanding, assessing, and managing pain. Certain facial muscle movements are sensitive and specific predictors of the presence and severity of pain. The facial display of pain has been found to be relatively consistent across human development (from infancy to adulthood), and between humans and nonhuman animals (see below).

2. Facial expression of pain in humans
Pain assessment in humans typically relies on self-report; facial expression can be used to quantify pain in individuals who are unable to express themselves verbally (eg, infants, young children, those with verbal or cognitive impairments). This approach was made possible by the Facial Action Coding System of Ekman and Friesen, which taxonomizes human facial muscle movements into “action units” (AUs). Certain constellations of these AUs reliably correspond to different human emotional states. The corresponding figure identifies the AUs most commonly associated with pain in infants (Figure A) and adults (Figure B). The study of facial expression of pain in infants, using the Neonatal Facial Coding System (NFCS), provided objective evidence at a time when many doubted the ability of infants to perceive pain. Facial expression of pain is largely a spontaneous reflexive reaction to noxious stimuli, but is, to a certain extent, subject to voluntary control; children as young as 8 years of age are capable of manipulating their facial expression of pain.

3. Facial expression of pain in nonhuman animals
A plethora of new measures of spontaneous pain have been recently developed in response to criticism that preclinical pain researchers were over-reliant on withdrawal responses. Given the similar nonverbal status of infants and nonhuman animals, facial expression of pain would seem to provide a solution, especially given Darwin’s direct prediction of phylogenetic continuity of facial expression of emotions. Langford et al. adapted the human NFCS to the mouse to create the Mouse Grimace Scale, featuring similar AUs to humans plus 2 rodent-specific changes (in whisker and ear position) (Figure C). Grimace scales have subsequently been developed for the rat, rabbit, horse, and cat. Quantifying pain through facial expression in these species has proven to have high accuracy and reliability, is useful for indicating both procedural and postoperative pain, and for assessing the efficacy of analgesics. The approach is being increasingly adopted in both veterinary research and care.

4. Conclusions
The similarity of facial expression of pain in humans and other animals provides evidence for evolutionary psychological accounts of pain communication and represents an impressive example of cross-species translation in pain research. There is a movement towards automated computerized measurement of facial expression of pain, which should eliminate some of the time burden currently associated with its use. Clinical pain continues to be undermanaged in both humans and nonhuman animals. We believe that the study and use of facial expression of pain can effectively address both problems.

References
Orbital tightening
Nose bulge
Cheek bulge
Ear position
Whisker change
Stiffly backward ears
Orbital tightening
Prominent strained chewing muscles
Mouth strained and pronounced chin
Strained nostrils and flattening of the profile

Brow bulge
Eye squeeze
Nasolabial furrow
Horizontal mouth
Taut tongue
Brow lower (AU 4)
Lid tightener (AU 7)
Eye closure (AU 43)
Nose wrinkler (AU 9)
Cheek raiser (AU 6)
Upper lip raiser (AU 10)
Horizontal mouth stretch (AU 20)

Ear position
Orbital tightening
Cheek bulge
Nose bulge
Whisker change
Stiffly backward ears
Tension above the eye area
Orbital tightening
Prominent strained chewing muscles
Mouth strained and pronounced chin
Strained nostrils and flattening of the profile