ChimpFACS
The Chimpanzee Facial Action Coding System

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In March 2005, with the support of the Centre for the Study of Emotion, and Vasudevi Reddy, Head of Department of Psychology, we held an international conference and workshop to display our accomplishments. Special thanks to Anne Pusey and The Jane Goodall Institute for use of videoarchives of the Gombe Stream chimpanzees.

In April 2006, with the invaluable assistance of Paul Marshman and the Department of Psychology at Portsmouth, we disseminate the ChimpFACS via www.chimpfacs.com.
Section 1: Introduction to the Chimpanzee Facial Action Coding System (ChimpFACS)

For over 30 years, the Facial Action Coding System (FACS; Ekman & Friesen, 1978; Ekman Hager & Friesen, 2002) has been a useful tool across a wide range of research areas, including developmental, neuropsychological and social psychology: it allows researchers to communicate about facial expressions using a common terminology. It is a suitable method for modification for use with chimpanzees as it is anatomically based and describes changes in appearance which allow for individual variations in facial structure. It is hoped that the availability of a chimpanzee version will provide a new tool in the study of chimpanzee social cognition and facilitate greater understanding of the evolution of facial communication. There is a successful precedent for the adaptation of the FACS approach to a new population; Oster and Ekman (1978) have shown that the FACS can be adapted for use with human infants and that such an application can produce novel insights into the ontogeny of facial expressions.

What is the Facial Action Coding System?

The Facial Action Coding System (FACS: Ekman, Friesen & Hager, 2002) is an anatomically based system for recording visible facial movements. The system is based upon the detailed description of minimal individual facial movements which are classified in terms of Action Units (AUs). Rather than categorising facial expressions as gestalt signals such as ‘a smile’, the FACS identifies the individual movements which make up the configuration of a particular smile, for example, lip corners retracted and cheeks raised. AUs are based upon the underlying facial anatomy. Many AUs are the result of one muscle movement, such as the zygomatic major which underlies AU12 Lip Corner Puller, or of different strands of the same muscle (e.g. orbicularis oris underlies both AU18 Lip Pucker and AU22 Lip Funneler). However, some units reflect a combination of muscle movements which are rarely observed to move independently, for example, AU4 Brow Lowerer is due to the combined action of the corrugator supercilli, depressor supercilli and procerus. There are also Action Descriptors (AD) which are codes used to denote facial movements for which the underlying muscle actions are unclear, for example, AD29 Jaw Thrust.

Facial expressions are such a central component of human social interaction that it might be thought that we are all experts in producing, recognising and responding to these signals. So why do we need a coding system to study facial expressions? Ekman et al (2002, p1) identify why an objective measure is desirable ‘most research on facial behavior has not measured the face itself, but instead measured the information that observers were able to infer from the face.’ Thus, approaches to the study of facial expressions can be divided into those that focus upon the signal itself and those which focus on how the signal is perceived by the receiver. The former method has the advantage of being able to determine how signals differ (in terms of configuration and timing for example) rather than on whether any distinction is made by the receiver. Even studies specifically interested in expressions from the perspective of the receiver’s perception and inferences should still be clear about the expressions presented. For example, if differences between expressions are perceived, it may be difficult for subjects or researchers to accurately identify the cause of the discrimination (Ekman, 1982). This issue may be heightened by the study of other species’ facial behaviours; for example, perceptual biases due to configurational processing of facial stimuli (e.g. Calder, Young, Keane & Dean, 2000) may hinder accurate observations (Waller, Vick, Smith-Pasqualini & Bard, in
The FACS manual (Ekman, Friesen & Hager, 2002) is the result of extensive study of human facial musculature, movement and resulting appearance changes. The manual is designed to be a usable research tool which provides a systematic coding method; describing each AU in detail, offering criteria for distinguishing similar AUs and descriptions of how combinations of AUs change facial appearance. For the human face, 58 AUs have been identified, described and illustrated with photographs and video clips. These include core facial movements, miscellaneous codes, codes for head and eye directions and for recording areas of the face which are not visible. The codes are not always sequential, for example, although there are only 58 AUs, the numerically highest AU is 72; some inconsistencies are due to amendments (e.g. absence of AU3) and others are to enable ready differentiation (e.g. 50’s for head orientation, 60’s for eye direction and 70’s for visibility). All ChimpFACS codes are consistent with the original FACS labels.

In the FACS manual, each AU is presented in terms of the sections below and illustrated with photographs and video clips:

A. Underlying musculature: location and direction of action
B. Appearance changes: multiple cues for identifying AUs
C. How to do the action unit: voluntary production of AU in isolation
D. Intensity scoring for the action unit: criteria for coding decisions
E. Reference for AUs: subtle differences between AU combinations

The ChimpFACS presently focuses primarily on addressing the first two of these, namely describing muscle actions and subsequent changes in appearance, but the final two sections relating to intensity scoring and reference sections for AUs are also addressed (see Section 2: Presentation of AUs).
Adapting FACS for Chimpanzees

The expressive capacity of the primate face has long been noted (Darwin, 1872) and this is underpinned by a highly differentiated musculature (Huber, 1931). The chimpanzee FACS attempts to describe facial movements in terms of the appearance changes caused by muscle movements; the foundation of the ChimpFACS is the current knowledge regarding facial musculature (see Waller, Vick, Parr, Bard, Smith-Pasqualini, Gothard & Fuglevand, in press), in combination with an understanding of how this relates to human facial movements (Ekman, Friesen & Hager, 2002), and extensive observation of chimpanzee facial movements. In adapting the FACS for chimpanzees, it was necessary to translate each AU (e.g. Oster & Ekman, 1978), taking into account the considerable differences between the human and chimpanzee facial structure (Fridlund, 1994).

The anatomical basis of the FACS is central; the starting point for ChimpFACS was the facial anatomy of the chimpanzee and the original FACS presentation of underlying muscles and their associated movements. The facial architecture of the human and chimpanzee face differ in some respects (Huber, 1931; Pellatt, 1979). AUs are based on the movements of underlying musculature, so it is first necessary to consider whether the chimpanzee has the muscle(s) required for a given AU. A review of studies on chimpanzee facial musculature has shown that it is very similar to that of humans, both in basic plan and functionally morphology (Waller et al, in press). However, there are differences in facial morphology that result in certain AUs being absent or difficult to reliably code in the chimpanzee (see Table 1.1-1.3 for summary).

Table 1: Summary of musculature and AUs in humans and chimpanzees

<table>
<thead>
<tr>
<th>1.1 Upper face AUs</th>
<th>Human Musculature</th>
<th>Chimpanzee</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inner Brow Raise</td>
<td>Frontalis, pars Medialis</td>
<td>Muscles and actions present but AU1 &amp; AU2 do not seem to move independently</td>
</tr>
<tr>
<td>2. Outer brow raise</td>
<td>Frontalis, pars Lateralis</td>
<td></td>
</tr>
<tr>
<td>4. Brow Lowerer</td>
<td>Procerus; Depressor Supercilli, Corrugator</td>
<td>Procerus present and functions to pull down brows at glabella. DS and C unclear. Brows are seen to lower (P or DS) but not knit (C)</td>
</tr>
<tr>
<td>5. Upper Lid Raiser</td>
<td>Orbicularis Oculi</td>
<td>Present, difficult to identify action due to morphology and colouration of eye area</td>
</tr>
<tr>
<td>6. Cheek raise</td>
<td>Orbicularis Oculi, pars orbitalis</td>
<td>Muscle present and AU6 identified</td>
</tr>
<tr>
<td>7. Lower Lid Tightener</td>
<td>Orbicularis Oculi, pars palebralis</td>
<td>Difficult to identify this subtle action due to morphology and colouration of eye area and eye movements</td>
</tr>
<tr>
<td>43. Eye closure</td>
<td>Orbicularis Oculi</td>
<td>AU43 present</td>
</tr>
<tr>
<td>45. Blink</td>
<td>Orbicularis Oculi</td>
<td>AU45 present</td>
</tr>
<tr>
<td>46. Wink</td>
<td>Orbicularis Oculi</td>
<td>This unilateral action has not been seen</td>
</tr>
</tbody>
</table>

1 In humans, there is some debate regarding the function of the DS and C; they are sometimes considered part of the Orbicularis occuli and the precise action of the C is unclear (Duchenne, 1862/1990, Ekman & Friesen 1978, Isse & Elahi, 2001).
### 1.2 Lower face AUs

<table>
<thead>
<tr>
<th>Action Unit</th>
<th>Human Musculature</th>
<th>Chimpanzee</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Nose Wrinkler</td>
<td>Levator Labii Superioris alaeque nasi</td>
<td>Muscle present and AU9 clearly identifiable, action may also recruit procerus</td>
</tr>
<tr>
<td>10. Upper Lip Raiser</td>
<td>Levator Labii Superioris</td>
<td>Muscle present and AU10 clearly identifiable, capable of independent action</td>
</tr>
<tr>
<td>11. Nasiolabial Furrow Deepener</td>
<td>Zygomatic minor</td>
<td>Possible incipient muscle, absence of cheek fat would make action difficult to detect if present</td>
</tr>
<tr>
<td>12. Lip Corner Puller</td>
<td>Zygomatic major</td>
<td>Muscle present and AU12 clearly identifiable, capable of independent action</td>
</tr>
<tr>
<td>13. Sharp Lip Puller</td>
<td>Caninus</td>
<td>Muscle poorly developed, lack of cheek fat would make action difficult to detect if present</td>
</tr>
<tr>
<td>14. Dimpler</td>
<td>Buccinator</td>
<td>Muscle present but AU14 not clearly identified, perhaps due to lack of cheek fat</td>
</tr>
<tr>
<td>15. Lip Corner Depressor</td>
<td>Triangularis</td>
<td>Muscle present and capable of independent action but AU15 not yet seen independently</td>
</tr>
<tr>
<td>16. Lower Lip Depress</td>
<td>Depressor labii</td>
<td>Muscle present and AU16 clearly identifiable as independent action</td>
</tr>
<tr>
<td>17. Chin Raiser</td>
<td>Mentalis</td>
<td>Muscle small but distinct and independent action seen. Absence of chin boss means cues to AU17 differ in the chimpanzee.</td>
</tr>
<tr>
<td>18. Lip Pucker</td>
<td>Incisivii labii superioris; Incisivii labii Inferioris</td>
<td>Muscles not clearly identified. Puckering of lips not clearly identified in chimpanzees</td>
</tr>
<tr>
<td>20. Lip Stretch</td>
<td>Risorius</td>
<td>Risorius not present. Similar action in chimpanzees likely to be due to Platysma action (AU 21)</td>
</tr>
<tr>
<td>22. Lip Funneler</td>
<td>Orbicularis oris</td>
<td>Muscle present and AU22 clearly identifiable, chimpanzees may have more independent movement in upper and lower lips than humans</td>
</tr>
<tr>
<td>23. Lip tightener</td>
<td>Orbicularis oris</td>
<td>Not readily identifiable due to less eversion and contrast of lip margins</td>
</tr>
<tr>
<td>24. Lip Pressor</td>
<td>Orbicularis oris</td>
<td>Muscle present and AU24 identifiable</td>
</tr>
<tr>
<td>28. Lips suck</td>
<td>Orbicularis oris</td>
<td>Muscle present and AU28 identifiable</td>
</tr>
<tr>
<td>8. Lips Towards Each Other</td>
<td>Orbicularis oris</td>
<td>Not readily identifiable due to less eversion and contrast of lip margins</td>
</tr>
</tbody>
</table>
1.3 Miscellaneous AUs and Action Descriptors (AD)

<table>
<thead>
<tr>
<th>Action Unit</th>
<th>Human Musculature</th>
<th>Chimpanzee</th>
</tr>
</thead>
<tbody>
<tr>
<td>19. Tongue show</td>
<td>Action Descriptor</td>
<td>AD19 Tongue protrusion is seen in both infants and mature chimpanzees</td>
</tr>
<tr>
<td>21. Neck Tightener</td>
<td>Platysma</td>
<td>Muscle present but AU21 may be more difficult to identify due to hair covering neck and jaw</td>
</tr>
<tr>
<td>29. Jaw Thrust</td>
<td>Action Descriptor</td>
<td>AD29 present</td>
</tr>
<tr>
<td>30. Jaw Sideways</td>
<td>Action Descriptor</td>
<td>AD30 present</td>
</tr>
<tr>
<td>31. Jaw Clencher</td>
<td>Action Descriptor</td>
<td>AD31 not yet identified</td>
</tr>
<tr>
<td>32. Bite</td>
<td>Action Descriptor</td>
<td>AD32 present</td>
</tr>
<tr>
<td>33. Blow</td>
<td>Action Descriptor</td>
<td>AD33 present</td>
</tr>
<tr>
<td>34. Puff</td>
<td>Action Descriptor</td>
<td>AD34 not yet identified</td>
</tr>
<tr>
<td>35. Cheek Suck</td>
<td>Action Descriptor</td>
<td>AD35 present</td>
</tr>
<tr>
<td>36. Tongue Bulge</td>
<td>Action Descriptor</td>
<td>AD36 not yet identified</td>
</tr>
<tr>
<td>37. Lip Wipe</td>
<td>Action Descriptor</td>
<td>AD37 present</td>
</tr>
<tr>
<td>38. Nostril Dilate</td>
<td>Nasalis, pars alaris</td>
<td>Nasal architecture differs considerably form humans. AU38 and AU39 not seen in chimpanzees</td>
</tr>
<tr>
<td>39. Nostril Compress</td>
<td>Nasalis, pars transversa; Depressor Septi Nasi</td>
<td></td>
</tr>
</tbody>
</table>

NB Action Descriptors represent movements for which the underlying musculature has not been defined.

In terms of underlying chimpanzee bone structure in comparison to humans, the forehead is lower with more substantial brows, the nasal area is flatter and lacks a bridge, there is much less cheek fat and no bony chin boss, the face shows more prognathism and the mouth is elongated. These differences mean that similar movements across species may be identified using different cues. For example, in contrast to humans, chimpanzee eyes do not usually have much of the white sclera visible (Kobayashi & Kohshima, 1997, 2001; although again there does seem to be some degree of variation in this feature, Goodall, 1986; Boesch & Boesch-Ackerman, 2000). The visibility of sclera is a cue for a few AUs (e.g. AU5 Upper Lid Raise) so the difference is morphology impacts upon the cues available when coding. However, in some respects the texture of the chimpanzee face (often with many visible lines even in neutral) means that there are other reliable cues for recognising facial movements.

Like humans, chimpanzees show considerable variability in facial appearance in terms of face shape, amount of facial hair and skin colouration and texture (as can be seen from the illustrations throughout the ChimpFACS manual). There are differences which may be primarily due to age and sex, but these do not account for all the variation in facial appearance. The skin of the adult chimpanzee is slightly leathery in appearance with many wrinkles and furrows permanently visible on the face. The skin may range from a pink or light brown tone to very dark, with some individuals showing distinct markings such as mottled patches of colour. There is usually some hair on the chin and varying amounts of hair on the forehead and
down the sides of the face. These differences in facial appearance mean that there is also variation in how an AU will change the appearance of the face; understanding facial movements in chimpanzees requires an understanding of how the movements will appear given the underlying facial morphology. As with FACS, images of neutral expressions are needed as a starting point for coding facial movements as it is only by comparing appearance against this baseline that facial movements can be reliably detected.

**Figure 1.1 Variation in chimpanzee facial appearance**

![Image of chimpanzees showing facial variation](image)

**Identifying Facial Actions**

ChimpFACS AUs were identified and compared to movements observed on the human face. In order to facilitate comparative research, terms are continuous with the original FACS as much as possible. For example, the chimpanzee does not seem to be able to move the medial (AU1) and outer (AU2) sections of the frontalis muscle independently, so the chimpanzee AU is named AU1+2. While anatomically based, the FACS only codes observable changes in facial appearance. For example, the original FACS combined muscle movements that could not be reliably distinguished, even in cases where the underlying muscles differed; three muscle actions are combined into AU4 though these may be independent actions. Indeed, the most recent FACS investigator’s guide tentatively describes these as AU41, AU42 and AU44 for for procerus, depressor supercilli and corrugator actions, respectively (Ekman, Friesen and Hager, 2002).

The chimpanzee FACS shares many difficulties in common with the development of the baby FACS (Oster & Ekman, 1978; Oster, in prep). For example, for Baby FACS, AUs had to be inferred from observable movements which appear very different due to the fat present on the infant’s face. Thus, differences in the morphology of the face can make it difficult to translate AUs: the same muscle movement may not have the same appearance due to differences in the underlying architecture of the face (Fridlund, 1994; Seiler, 1973). For example, due to the lack of cheek fat in chimpanzees, deepening of the nasolabial furrow cannot be used as an indicator of AUs (as it is in AU10 AU11 and AU12 in humans). Oster (in prep) identifies these absent cues in the BabyFACS manual; in the ChimpFACS, absent cues are included in the section ‘Comparison to human AU’.
A central problem to the development of a comprehensive coding system is the issue of independence of movements. This is found at two distinct levels: the first is at the level of the facial muscles themselves, and the second at the level of observable movements. With regard to musculature, a review of the anatomy suggests that some chimpanzee facial muscles are more intermingled with each other than in humans. While it is somewhat difficult to predict the precise appearance changes for each AU on the basis of existing anatomical knowledge, this does indicate what the relevant issues for a movement might be; for example, it indicates which other muscles may be involved. Moreover, functional anatomy of the chimpanzee face has demonstrated independent action in most facial muscles (Waller et al, in press).

At the observable level, it is difficult to extract an individual AU from whatever movements may be co-occurring. While action units can be more clearly studied in adult humans by voluntary facial movements and innervation studies (Ekman describes these procedures for assessing validity, 1982), the ChimpFACS like BabyFACS must rely more on inferences drawn from knowledge of underlying musculature and observable movement. Individual AUs are sometimes seen in isolation on the chimpanzee face, but in most cases, the minimal units have been extrapolated from the various combinations observed. For example, AU12 (Lip Corner Puller) is not commonly seen to act independently in the chimpanzee, but it is commonly seen in combination with other units. The FACS description of AU12 is based upon careful study of all expressions involving the oblique upwards pull on the mouth corners and the extraction of the common features of AU12 across the AU combinations seen and from those infrequent examples of AU12 acting independently of other movements.

Errors in Omission, Commission and Mistaken Identity

Oster & Ekman (1978) identify problems with both errors of omission and commission. Omissions can occur for several reasons: if an action occurs rarely it may not be observed, or if a movement is particularly subtle or is masked by other concurrent movements it will be difficult to identify. In addition, omissions may occur because the cues to a movement are so different from those of the original FACS that the movement is not recognised, this is obviously a challenge when adapting the system to a new species. Background noise (see below) may also make it impossible to discriminate individual movements. These are all serious issues for the development of the chimpanzee FACS; as highlighted above, AUs are extracted from the observed facial activity and it is possible that some AUs are not accurately identified at this stage. As with the original FACS, it is hoped that the ChimpFACS will become more refined with use.

Errors of commission can occur when a cue used for identifying an AU is already present in the appearance of the neutral face. These are termed false indicators in the manual and identify and describe features of the chimpanzee face that resemble criteria for coding an AU in the original FACS manual. For example, the visibility of wrinkles is commonly used to identify AUs and the texture of chimpanzee facial skin means that this could be misleading. In terms of mistaken identity, subtle differences are presented to facilitate the discrimination of one AU from another that may be very similar in terms of appearance. For example, detailed descriptions to identify which AU underlies the raising of the upper lip, which is a feature of more than one AU (e.g. AU10 Upper Lip Raiser and AU9 Nose Wrinkler).
Section 2: Presentation of AUS

The Chimpanzee FACS should be both a manual to learn chimpanzee FACS and as a reference source for using chimpanzee FACS. This dual purpose means that some action units will be introduced before they are fully described. Following the original FACS, the action units will be presented in groups. Firstly, the upper face (brows, forehead and eyes) and then the lower face (up/down, orbital).

The structure is somewhat different from the FACS manual in that the sections on ‘How to do the Action Unit’ or ‘Intensity Scoring for the Action Unit’ are omitted. The former is omitted for obvious reasons, and the latter is omitted (at this stage) but partially replaced by a minimum criteria section which identifies which features need to be seen before any action unit is coded.

For each AU, a standard template is used including a brief description of the AU movement, FACS name and muscle(s) involved. This serves to identify the location and general action of an AU and also to highlight the underlying musculature to facilitate an understanding of how the muscles produce the changes in appearance. A diagram of the muscles responsible for AUs shows where the muscle emerges from and where it attaches so that the direction of muscle contraction can be clearly identified. Appearance changes are then described and illustrated and a reference section is provided for an AU wherever relevant.

A. Underlying musculature: location and direction of action

Understanding the location of each muscle and the direction of its action is central to using FACS. For each AU the underlying anatomy is identified and the direction of action is illustrated and described. Schematic illustrations indicate where each muscle emerges (origin) and where the muscle attaches into the soft tissue of the face (insertion). When a muscle contracts, the observed movement is away from the point of attachment and towards the origin. The skin is usually pulled perpendicular to the direction of contraction and these changes in appearance on the surface of the face, such as wrinkles, can therefore be used to detect the underlying muscle action and identify which AU has acted.

Like FACS, ChimpFACS is therefore also based upon an understanding of the underlying facial muscle plan. The ChimpFACS manual uses the same basic method of illustration to indicate muscle location and direction of action. For each AU the origin and insertion of the muscle is identified and the direction of action described. Figure 2.1 shows the direction of movement for facial muscles in the chimpanzee (Waller et al, in press). White circles correspond to approximate muscle origins (excepting orbital muscles) and black lines show estimated length/orbit of the muscle. Contraction results in movement toward the origin (orbital muscles reduced aperture of orbit).
Figure 2.1 Identified muscle action in chimpanzee face
Labels: fr = frontalis (medial and lateral portions), pr = procerus, ooc = orbicularis oculi, llsa = levator labii superioris alaeque nasi, ll = levator labii superioris, zy = zygomatic major, oor = orbicularis oris, t = triangularis, dl = depressor labii, m = mentalis. Adapted from Waller et al. (in press).

B. Appearance changes: multiple cues for identifying AUs

The appearance changes describe both the movement itself and changes in the appearance of facial landmarks resulting from the movement. Appearance changes describe the parts of the face that have moved, the direction of their movement, any changes in the shape of the facial parts, and the appearance or deepening of surface lines such as wrinkles. The FACS manual states that, ‘the exact appearance change varies from one person to another depending upon their bone structure, variations in the facial musculature, fatty deposits, permanent wrinkles, shape of features etc.’ (Ekman, Friesen & Hager, 2002, p 1). That is, not all changes in appearance will be seen in all individuals. However, the common elements seen when an AU occurs are identified and a list of appearance changes caused by the movement are given allow the same action to be recognised despite individual differences in facial appearance. Thus, individual variation is accounted for by providing multiple and redundant cues and also in some cases describing what would be seen with a given neutral appearance of the face.

ChimpFACS also presents multiple cues for identifying each AU. The terminology used to describe appearance changes are consistent with those used in the FACS, but with some additions for labelling facial landmarks on the chimpanzee face. Figure 2.2 illustrates differences in facial landmarks between human and chimpanzees. In addition to describing appearance changes in the frontal view, a description of the AU as seen in profile is also provided wherever possible. Profile descriptions are considered useful because of the increased prognathism in chimpanzees relative to the flatter face of humans, and also because of the difficulty in ensuring good, frontal views when observing mobile chimpanzees.
C. How to do the action unit: voluntary production of AU in isolation

This section guides FACS coders through performing each AU on their own face while observing the appearance changes in a mirror. For more difficult to perform AUs, there are suggestions for recruiting the muscle and performing the action in isolation. This aspect of FACS is surprisingly difficult; while we may use our faces expressively in everyday interaction, voluntary production of individual facial movements is difficult and often requires fairly extensive practice for many AUs. However, performing each AU increases understanding of the underlying movement and how this relates the surface changes.

For ChimpFACS, there is obviously no ‘how to do the action’ section, although many of the actions are readily recognisable in relation to human facial movements.

D. Intensity scoring for the action unit: criteria for coding decisions

Intensity scores are a fairly recent addition to the coding system. If intensity scores are required, AUs can be scored on a five-point ordinal scale with letters A to E indicating increasing intensity. However, the intervals between these scores are not equal and C and D cover most of the movements seen (see Figure 2.3). Intensity scores are also specific to each AU; descriptions of the appearance changes denoting a given intensity are detailed individually.

Figure 2.3 FACS intensity scores

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trace</td>
<td>Slight</td>
<td>Marked/pronounced</td>
<td>Severe/ Extreme</td>
<td>Maximum</td>
</tr>
</tbody>
</table>
We have not yet attempted to add an intensity scale for AUs in the ChimpFACS as these are optional rather than necessary for FACS coding. However, we do have a minimum criterion for each AU; the coding threshold is equivalent to FACS intensity rating of C, so excludes A ‘trace’ and B ‘slight’ evidence for a given AU. Intensity codes A and B describe appearance changes which are relatively subtle and given the more difficult viewing conditions when observing chimpanzees, these are not likely to be amenable to reliable or consistent coding. Level C describes appearance changes which clearly evident on the face as stronger actions provide more visible cues to identify an AU. The omission of intensity levels A and B means that an observer has to be confident about seeing the AU before it is coded. By setting minimum criteria for the coding of each action unit, reliability should be heightened; setting thresholds for recording appearance changes means that coders have an explicit guidelines to assist in deciding when a given AU has occurred (Ekman, 1982).

E. Reference for AUs: subtle differences between AUs

The FACS is both a training tool and a reference source for coding decisions long after training is completed. The manual provides information on combinations of AUs, some of which are simply additive in terms of resulting appearance but others are more problematic; one AU may mask another or AUs may combine to produce distinctive changes in appearance. These combinations often have implications for intensity coding decisions. The subtle differences sections provide best cues for discriminating different combinations of AUs which may be quite similar in terms of appearance changes. In addition, combinations are considered in terms of dominant AUs which may mask the presence of subordinate AUs. Alternative tables also provide information about AUs which are mutually exclusive and cannot be scored in combination either because simultaneous co-occurrence is anatomically restricted or precluded by the FACS method.

For ChimpFACS, we have presented reference sections for problematic combinations and best cues for discriminating these AUs wherever relevant. Subtle differences between similar AUs are detailed as are common combinations for co-occurring AUs. The subtle differences section highlights distinctive features of the AU compared to similar movements or AU combinations. For example, a description to assist in determining whether an AU such as AU9 Nose Wrinkler has pulled the top lip upwards or whether the lip has been raised by the addition of AU10 Lip Raiser. For each AU, a list of these common confusions is presented which identifies which features can be used to differentiate the separate AUs. A basic alternative table is also provided for AUs which cannot be scored in combination for either anatomical or scoring technique reasons.

Comparison to Human FACS

Within the reference section for each AU we have added a comparison with the equivalent human AU in order to detail how and why each AU has been modified; it is hoped this feature will assist coding and add to the ChimpFACS value as comparative tool. The difference in appearance between human and chimpanzee faces means that the criteria for coding AUs can be considerably different although the basic action may be comparable. Once the AU has been described in detail and potential coding decisions
identified, a comparison of the chimpanzee AU with the original FACS description of the AU is provided in order to clearly identify how the chimpanzee AU differs from the same AU in humans.

This section includes a discussion of false indicators and also absent cues (Oster, in prep). False indicators are features of the chimpanzee face that may give the appearance that an AU has acted. As ChimpFACS is so closely based upon the original FACS, it is important to highlight features which may resemble cues for human AU movements but which are not indicative of the same AU in chimpanzees. For example, the natural curvature of the mouth seen in some chimpanzees should not be mistaken for AU12 Lip Corner Puller, nor should wrinkles at the nasal root necessarily be seen as resulting from AU9 Nose Wrinkler. Absent cues are those which are indicative of an AU in humans but which are not seen in chimpanzees. For example, the nasolabial furrow is a key indicator of several AUs in humans but is not clear in the chimpanzee.

**Additional Codes**

**Miscellaneous Actions**

The manual includes several Action Descriptors (AD) which describe additional facial actions. While AUs are identified in terms of their muscular basis, ADs are movements for which the underlying muscle actions are unclear. For example, Tongue Showing (AD19) and Lip Biting (AD32) are both observable facial movements but these have not been identified in terms of specific muscle movements and are therefore not AUs. In addition, there are terms used to describe particular coding situations, for example, visibility of the face and head and eye orientation. These codes are consistent with those of the FACS manual and may in fact be more widely used in relation to ChimpFACS due to the mobility of study animals.

**Vocalisations**

As in humans, chimpanzee vocalisations alter the appearance of the mouth and face. In the original FACS, AU50 is the code used to denote speech. However, in chimpanzees, many of the main facial expressions have a vocal component which can result in dramatic changes in facial appearance, making the distinction between visual and vocal signals less distinct. For humans, mouth movements are coded in addition to AU50 if these are not explicable solely in terms of the movement required in speech. With the chimpanzee FACS, we are reluctant to discount movements made in vocalising as these often also have considerable visual impact (unlike the smaller movements of human speech). Instead, all action units are coded but a note of vocalisation is made: AU50 for continuity.
Unilateral Actions

Unilateral action units can only be recorded if there is no evidence of the action on the other side of the face. For example, even if the action is stronger on one side than another, this is not sufficient to code a unilateral action. Unilateral actions are denoted in the coding scheme by R or L before the action unit or if side is not of interest then U can be used. We do not yet know how frequent unilateral facial movements are in chimpanzees but we have seen examples of actions on only one side of the face. When there is evidence of movement on both sides of the face, but the action is stronger on one side, a prefix of A can be used to indicate asymmetry. In addition, coding of the lips can be treated independently. For example, if AU22 Lip Funneler is only seen in the top lip this is denoted by a T22 while independent action of the bottom lip would be B22. While this independent action of lips in AU22 is ‘not common’ in humans (Ekman, Friesen & Hager, 2002, p235) it seems to be much more common in the chimpanzee.
Section 3: Upper Face Action Units

This section presents movements in the upper face, that is, movements of the brows and eye region. Firstly, AU 1+2 (Inner and Outer Brow Raise) will be described. In the original FACS, these are two independent actions, but in the chimpanzee the medial and lateral sections of the brow do not seem to act independently (Waller et al, in press). Therefore, AU1 and AU2 are combined into AU1+2; the labelling is maintained so that descriptions are continuous with the equivalent action in humans. Actions relating to the eye aperture will be presented; AU6 Cheek Raise which orbits the eye and contracts the area around the eye, AU43 Eye Closure and AU45 Blink are presented together as these are discriminated from one another on the basis of timing.

AU7 (Lid Tightener) which narrows the eyes by tightening both upper and lower lids is not described for the chimpanzee due to difficulty in perceiving this action (as outlined in the following section). Similarly, AU5 (Upper Lid Raise) raises the upper lid and widens the eyes but may not be readily coded in the chimpanzee due to morphological factors. AU4 is also not described for the chimpanzee; there is some debate regarding the presence of the underlying musculature and we have no clear examples of this action in the chimpanzee. Before proceeding to describing the AUs, it is important to consider the morphology of this region of the face in chimpanzees and how this relates to presence and perception of the various AUs.

Morphology and Movement of Upper Face

The morphology of chimpanzee brows and eyes means that AUs in the upper face may differ from those in the original human FACS. Due to the considerable individual variability in brow morphology in chimpanzees, the appearance changes due to the brow raising caused by AU1+2 (Inner and Outer Brow Raise) are difficult to exemplify. As in humans, appearance changes vary across individuals and the appearance of these brow movements will depend upon the size and shape of the brow. While some chimpanzees have a barely distinguishable brow ridge, others have extremely large thick brows which may form a single, solid promontory above the eyes (see Figures 3.1 & 3.2). For example, in some individuals the texture of the skin may differ between the brow ridge and the skin beneath the ridge and this is revealed when AU1+2 act. The extent of hair covering the chimpanzee forehead will determine whether the horizontal wrinkles in the centre of the forehead are clearly visible. As the brow ridges develop as a chimpanzee matures, this appearance of this action will vary with age. However, individual variation is more noticeable than any distinct age and sex classification.

The combining of AU1 (Inner Brow Raise) and AU2 (outer Brow Raise) into AU1+2 is due to the lack of evidence that these two actions are capable of independent movement in the chimpanzee. The raising of only the inner brow is a component of the human sadness expression; however, there is some debate regarding whether the corrugator muscle (a component of AU4 Brow Lowerer) is also required for this action (Duchenne, 1862/1990; but see Ekman, Hager & Friesen, 2002). It may be that the chimpanzee does not have independent movement of medial and lateral brows, or it may be that this is a rare action and therefore an error of omission.
Figure 3.1 Variation in chimpanzee brows

![Image of chimpanzee brows](image1.png)

The chimpanzee brow may also overshadow the eyes and makes discerning subtle movements around the eye challenging (see Figure 3.2).

Figure 3.2 Overshadowing by brows

![Image of overshadowing by brows](image2.png)

In addition, the unique morphology of the human eye (Kobayashi & Kohshima, 1997; 2001) makes distinguishing eye area movements much clearer; the high contrast between iris and white sclera offers good landmarks which can be used in identifying subtle actions. For example, AU5 (Upper Lid Raise) opens the eye widely and often reveals sclera above the iris, while AU7 (Lid Tightener) tightens the lids and narrows the eye aperture which can be identified by the amount of iris visible. In coding eye movements, 63 (Eyes Down) and 64 (Eyes Up) are also described in terms of visibility of the sclera, iris and pupil. In chimpanzees, the absence of white sclera means that such landmarks are not readily available. Kobayashi & Kohshima (2001) report that while chimpanzees have relatively elongated eyes and exposed sclera in the eye outline, the colouration of the eyes and surrounding area (iris, sclera and facial skin are all brown) means that the entire eye is relatively camouflaged. Again, individual variation in brow size and eye and skin colouration means that some individuals are likely to be easier to code than others.

Subtle changes in the eye region can be coded; chimpanzee eye movements are reliably perceived by human observers in relatively close proximity (less than 10m; Bethell, Vick & Bard, submitted). However, chimpanzee gaze behaviour seems to be more intermingled with head movement and brow movement than in humans. Kobayashi & Kohshima (2001) have demonstrated that chimpanzees scan using eye gaze without accompanying head movements about 20-35% of the time, compared to a mean of 61% in humans. That is, it is difficult to discern a subtle change in appearance (such as those caused by AU7 Lid Tightener) when actions around the eye are accompanied by more general movements (brows and head) which may alter lightening and angle of view.
These factors suggest that coding small movements around the eyes is difficult and in many cases the quality of footage, movement or viewing angle will mean that it is not always possible to confidently record AU7 Lid Tightener or AU5 Upper Lid Raise in particular. For AU7 there is a further difficulty; movements of the eye itself can be seen in the lower eye lid so that any action of AU7 may not be reliably distinguished. Furthermore, this AU can be difficult to detect as changes in appearance may be confounded by the action of a number of other AUs upon the eye aperture (e.g. AU6 Cheek Raise and AU9 Nose Wrinkle).

In summary, there are three main problems for coding some AUs in the eye region:

- The whole area may be overshadowed by the brows
- Even if eyes are visible, the lack of contrast may camouflage the eye outline and reduce cues for detecting AUs (such as AU5 Upper Lid Raiser, AU6 Cheek Raise and AU7 Lid Tightener)
- Movements and changes in viewing angle can make subtle appearances difficult to discern

It is debatable whether AU5 can be reliably coded in chimpanzees for many of the same reasons identified for AU7. We do not have any good video examples of this AU, but we know that chimpanzees have the musculature required (as it is the same muscle that opens the eye). It remains to be tested whether this action could be reliably coded. However, as descriptions of ‘staring’ and ‘glaring’ are common in the literature, we include a brief summary of this AU and its subtle differences.

While both AU4 (Brow Lowerer) and AU7 (Lid Tightener) are omitted from the ChimpFACS at this stage, it should be noted that the underlying reasons differ. AU4 (Brow Lowerer) is omitted due to uncertainty regarding the presence of the corrugator and depressor supercili in chimpanzees (Waller et al, in press). We have also been unable to find an clear example of AU Brow Lowerer in the chimpanzees. Nonetheless, chimpanzees do have the procerus muscle which is recruited during AU4 actions and they may also have depressor supercili action (as this is part of the Orbicularis oculi muscle). In terms of the tentative distinction between these various muscle actions offered in the most recent version of the FACS (Ekman, Friesen & Hager, 2002), chimpanzees may have AU41 (procerus action) AU42 (depressor supercilli action) but not AU44 (corrugator action). There are certainly actions that lower the chimpanzee brow, for example during AU9 Nose Wrinkle and AU6 Cheek Raise. However it is presently unclear how independent these movements are and whether it is useful to try and differentiate brow lowering as independent action.

The omission of AU7 is quite different as it seems probable that chimpanzees have the requisite musculature and action, but these cannot be reliably determined from visible changes in appearance due to a number of factors including the subtle nature of this action (even in humans), chimpanzee eye morphology and colouration, and also the confound of eye movements visible in lower lid.
Chimpanzee Action Unit 1+2: Brow Raiser

AU1+2 raises the brows and causes changes in the appearance of the forehead and brow. These two AUs do not seem to display the independent action of medial and lateral sections of the brow which is seen in humans. Therefore, brow raising is only presented as a combined AU1+2.

Proposed Muscular Basis

The frontalis originates on the upper cranium (galea aponearutica) and has no bony attachments with terminal fibres blending with the procerus and orbicularis oculi. Contraction pulls the brow upwards.

Appearance Changes

1. Pulls the entire brows upwards; this movement can be seen as skin moving over the brow ridge or the brow itself may be pulled upwards.
2. The movement may cause the texture of the visible brow to change, as the skin under the brow ridge is pulled upwards and revealed.
3. The wrinkles on the forehead or on the upper part of the brow itself may deepen.
4. Action may cause appearance of eye cover fold to change as brow movement pulls skin upwards.
5. The upwards movement of the brows can often be clearly seen in profile views.

Figure 3.3 Texture of the visible brow changing as AU1+2 pulls the brow upwards

Video 3.1. Example AU1+2 (front view)
Video 3.2. Example AU1+2 (profile view)
Figure 3.4 Neutral and AU1+2 showing brow raise and change to eye cover fold

Minimum Criterion

Upwards movement of the brow from neutral position must be seen.

Reference AU1+2

Subtle Differences

Changes in eye gaze and head direction need to be considered when coding AU1+2 as these may influence perception of brows. There may be movement on the lateral areas of forehead during mastication; the chewing action should readily identify the cause of the movement and should not be mistaken for AU1+2.

Figure 3.5 Interaction between gaze and brows

In some individuals:

- Closing (AU43) or blinking (AU45) the eyes may result in the brows being pulled slightly downwards; it is important that the subsequent return to the neutral position is not coded as a brow raise.

- The brows may be so prominent that it is necessary to raise the brows in order to increase the visual field; this should still be coded as AU1+2 if the brow position is raised compared to neutral.
Viewing Angle

In addition, due to the prominence of the brows, slight changes in the angle of the head can lead to quite dramatic changes in the appearance of the brows, for example, visibility of wrinkles. It is therefore important to determine whether changes in the appearance of the brows are due to action of AU1+2 or a change in perspective alone. For example, movement of the brow often accompanies changes in gaze direction so that the head and eyes may be oriented upwards and the brows raised at the same time. It is therefore important that the brow raise be seen beyond the appearance change due to perspective change.

Figure 3.6 Changes in head angle may alter the appearance of the brows

Figure 3.7 Lifting brows to increase visual field
Comparison to Human FACS AU1 + AU2

Unlike in humans, the medial (central) frontalis does not appear to act independently from the lateral portion of the muscle in chimpanzees. Therefore AU1 and AU2 are expected to be seen in combination. However, one video clip shows a lateral AU2 in the chimpanzee; at this stage it is unclear whether this is indicative of a truly independent AU2 action.

The horizontal brow wrinkles which are a key indicator of AU1+2 in humans, are less obvious in the chimpanzee. There are permanent wrinkles on the chimpanzee forehead that may deepen with this action, but this AU is more readily detected by movement along the brow itself. Moreover, while the frontalis muscle is longer in chimpanzees, in some chimpanzees the forehead is almost entirely covered in hair; any wrinkling will in most cases only be visible close to the brows.

The chimpanzee brow and forehead often have visible wrinkles which may be false indicators of brow raising (a cue to AU1 and AU2 in humans) in neutral, so in order to code AU1+2 it is important that some deepening or movement of facial these landmarks is observed.
Chimpanzee Action Unit 6: Cheek Raiser and Lid Compressor

AU6 Cheek Raiser is an orbital action which pulls skin around the eyes inwards toward the eye.

Proposed Muscular Basis

Orbicularis oculi, pars orbitalis circles the eyes and contraction draws the surrounding area inwards towards the eyes.

Appearance Changes

1. Pulls skin from infra orbital triangle and temples in towards the eyes
2. Pulls skin towards the eye causing increased wrinkles and bagging beneath the eye
3. Causes horizontal wrinkles laterally at lateral edge of eyes
4. Stronger actions causes both medial and lateral sections brow to lower
5. Narrows eye aperture

Figure 3.11 Action of AU6 Cheek Raiser

Video 3.3. Example AU6
**Minimum Criterion**

Movement causing increased wrinkling in eye area must be seen to pull medially in from cheeks and temple, not only to be pushed upwards as this can be result of other AUs (e.g. AU9 Nose Wrinkler which also pushes upwards on medial eye region).

**Reference AU6**

**Subtle Differences**

AU6 may be confused with AU9 which also pulls skin up towards eyes and may increase bagging and wrinkling around the eye. Strong action lower in the face, such as AU12 Lip Corner Puller and AU10 Upper Lip Raise, also increase wrinkling beneath eyes. However, AU6 has a characteristic action which pulls in lateral eye area and creates distinctive wrinkles in the temple area, whereas lower face actions (AU12, 10) push up on eye area and AU9 pulls the skin around the eyes in medially.

**Comparison to Human FACS AU6**

The crows feet that are characteristic of AU6 in humans appear differently on the chimpanzee; rather than oblique lines radiating from lateral eye corner, the chimpanzee wrinkles seem to be parallel to each other and more horizontal. In addition, AU6 in chimpanzees seems to cause more change in the entire eye region, for example, lowering the brow, than is typically seen in humans. That is, the action seems to be more orbital and less localised in the chimpanzee.

Chimpanzees generally have more bagging and wrinkling around the eye area and these should not be used as a basis for coding AU6 (false indicators). There has to be movement towards the eye and an increase in bagging or pouching and a deepening of wrinkles and furrows.
Chimpanzee Action Unit 5: Upper Lid Raiser

This AU raises the upper eyelid beyond the usual open position. When the muscles underlying AU5 are relaxed, the eyelid closes (AU43) so that eye opening requires some action of the muscle underlying AU5. However, AU5 is not used simply to record that the eyes are open; it is only used for movements which involve further contraction of the muscle and open the eyes widely.

Proposed Muscular Basis

The levator palpebrae superioris which underlies this action in humans is not mentioned in the literature on chimpanzee anatomy.

Appearance Changes

1. Widens the eye aperture.
2. More of upper eye ball exposed.
3. Less of upper eye lid visible.

Minimum criterion

Eyes must be more widely opened than in neutral.

Reference AU5

Subtle Differences

Head movement and viewing angle affects coding of AU5. For example, AU 5 seems to be seen in cases where the chimpanzee is looking up (AU63). In the original FACS it is noted that scoring AU5 when the eyes are directed upwards is difficult; if the upper lid is not raised more than due to eye direction alone then AU5 cannot be scored. Brow movements may also alter the appearance of the eyes and this can appear as if the eyes have indeed been widened by AU5. For example, while Figure 3.10 may appear to be a good example of AU5, analysis of the video sequence reveals that the appearance of ‘staring’ is the result of brow raising rather than upper lid raise (AU5). AU1+2 may also change the appearance of the eye fold cover and again this should not be taken as evidence of AU5 (Figure 3.9)

Comparison to human FACS AU5

The morphology of the chimpanzee eye and brows mean that this is not as readily recognised as in humans. Visibility of the upper eyelid may be misleading, in many humans the disappearance of the upper lid from view often indicates action of AU5. In chimpanzees, the upper eyelid may not usually be visible in neutral.
Figure 3.8 Neutral and looking up (AU63) rather than Upper Lid Raise (AU5)

Figure 3.9 Eyes aperture widening and changed appearance of eye fold cover due to AU1+2 Brow Raise

Figure 3.10 Brow raises can alter appearance of eyes
Chimpanzee Action Unit 43 & 45: Eyes Closure & Blink

When the muscle that opens the eye aperture relaxes it cause the eye lid to droop or close. AUs 43 & 45 describe eye closure: they are differentiated only by timing. AU43 is used to identify that the eyes are closed for more than ½ second.. AU45 is the code for blinks – that is eye closure lasting less than ½ second. AU45 cannot be coded from still images because the rapid action is the defining criterion.

Proposed Muscular Basis

Relaxation of the levator palpebrae superioris

Appearance Changes

1. The eye lid relaxes and reduces the eye aperture.
2. The surface of the eye lid is exposed.
3. There should be no evidence of tension in the eye lid (tension implies that AU6 or AU7 is also acting to close the eyes).
4. For AU43 the eyes must remain fully or partially closed for more than ½ second, for AU45 it must be for less than ½ second.
5. In some individuals closing the eyes (AU43 & AU45) may also pull and lower the brows slightly

Figure 3.11 Action of AU43

Minimum Criterion

For AU43 the eyelid must be lowered for more than ½ second but for AU45 the action must take less than ½ second.
Reference AU43 & 45

Subtle Differences

AU43 should not be confused with extreme looking down.

Comparison to Human FACS for AU43 and AU45

In contrast to humans, in chimpanzees these actions may cause the brows to lower.
Section 4: Lower Face Action Units

This section will describe actions in the lower face: AU9 Nose Wrinkler, AU10 Upper Lip Raiser, AU12 Lip Corner Puller, AU16 Lower Lip Depressor and AU17 Chin Raiser.

AU9 Nose Wrinkler causes wrinkling at the root of the nose as it pulls the nose slightly upwards and inner brows downwards. AU10 Upper Lip Raiser pulls the top lip upwards towards the nose. AU12 Lip Corner Puller draws the mouth corners obliquely toward the ears. AU16 Lower Lip Depressor pulls the bottom lip downwards towards the chin. In addition, within the AU16 Lower Lip Depressor section an Action Descriptor AD160 Lower Lip Relax is described. AD160 Lower Lip Relax is an action which also moves the lower lip downwards but which we have tentatively discriminated from AU16 Lower Lip Depressor as it seems to be caused by a different underlying action. AU15 Lip Corner Puller is not described as we have no evidence to present this as an independent action.
Chimpanzee Action Unit 9: Nose Wrinkler

AU9 acts to wrinkle the nose; it pulls the nostril wing area medially upwards toward the root of the nose and draws the inner corners of the brow downwards.

Proposed Muscular Basis

Levatator labii superioris, alaeque nasi and procerus. Levatator labii superioris, alaeque nasi pulls the nasal area upwards towards the brow while contraction of the procerus pulls the inner brows downwards.

Appearance Changes

1. Nose is pulled slightly upwards.
2. Causes wrinkles to deepen at the root of the nose.
3. Pulls nostril wings upwards and medially towards the root of the nose which causes the nasal channel (central vertical groove down the nose) to deepen.
4. Deepens the lateral portion of the subnasal furrow.
5. In the medial eye area particularly, the skin beneath the eyes shows increased bagging and wrinkling.
6. The inner brow is pulled down towards the root of the nose.
7. Stronger actions of AU9 may raise the upper lip.

Figure 4.1 Neutral and action of AU9 Nose Wrinkler

Video 4.1. Example AU9
Minimum Criterion

The best cue for identifying AU9 is the distinctive wrinkling at the nasal root. Individual variation in the visibility of wrinkles at nasal root in neutral means that nose wrinkling should be compared against a neutral in order to determine whether movement has occurred (i.e. wrinkles have deepened). When analysing video, AU9 is seen as a distinct movement towards the nasal root.

Figure 4.2 AU9 Nose Wrinkle in profile

Reference AU9

Subtle Differences

Pressing the lips together (e.g. when spluttering or chewing) may cause movement in the nasal area (nose appears to move upwards slightly) but it does not lead to the characteristic wrinkling at the root of the nose.

A strong action of AU9 may pull the lip lip upwards so that the top teeth may become visible. However, the lip raise will not be as extreme as that seen in AU10 Upper Lip Raiser. While both AU9 and AU10 can lead to the lip being raised, only AU9 shows the distinctive wrinkling at the root of the nose and associated lowering of the inner brows. Compared to AU9, AU10 appears to thicken the upper lip as it rises, although in combination with other AUs (e.g. AU12 Lip Corner Puller) this thickening may not be a good differentiating feature as the top lip will be flatter across the upper gum and teeth.

Comparison to Human FACS AU9

As in humans, the most distinctive indicator for identifying AU9 in the chimpanzee is the increase in furrows and wrinkles at the root of the nose. In more extreme actions, the top lip is raised in both species. The muscle underlying AU9 (labii superioris alaeque nasi) is more intermingled with the procerus (involved in AU4 Brow Lowerer) in chimpanzees than in humans, but does not have same secondary associations with levator labii superioris (AU10 Upper Lip Raise). As in humans, the inner corners of the brows are lowered when AU9 acts. Permanent wrinkles at the nasal root may act as false indicators of AU9 in chimpanzees.
Chimpanzee Action Unit 10: Upper Lip Raiser

AU 10 pulls the top lip upwards; it causes changes in the shape of the upper lip and can reveal both the upper teeth and gums.

Proposed Muscular Basis

Levator labii superioris originates in the maxilla and zygomatic bone above the infraorbital foramen and inserts into muscles of the upper lip. Muscle action raises the upper lip.

Appearance Changes

1) Raises the upper lip up in a relatively smooth elliptical curve.
2) The distance from the nose to the upper lip is shortened compared to neutral.
3) The lip appears to thicken at the edge as it is retracted.
4) The inside of the lip may become visible and the upper teeth are revealed.
5) In stronger actions of AU10, the subnasal furrow deepens as the lip is pulled upwards.
6) In extreme actions, the lip is fully retracted revealing both the upper teeth and gums.
7) In profile, the top lip is seen to be pulled up towards the nose and in stronger actions the lip may appear to be slightly bulging.

Figure 4.3 Action of AU10 Upper Lip Raiser

Figure 4.4 Neutral upper lip and a more extreme action of AU10 (both teeth and gums exposed, note thickening and shortening of lip)

Video 4.2 Example AU10

AU10 is shown in combination with mouth opening (AU25) and lower lip relax (AD160)
Minimum Criterion

The clearest indication that AU10 has occurred is if the independent (asynchronous with the onset of other AUs) upwards movement of the lip is seen. The best cue is the shortening of the distance between nose and upper lip.

Reference AU10

Subtle Differences

The shape of the lip may depend upon the presence of other AUs. For example, a strong AU12 Lip Corner Puller will result in the top lip being pulled so as to flatten against the teeth and gums. Compare Figures 4.4 and 4.5 and note how the appearance changes caused by raising the lip differ.

There are other actions that may lead to the lip being raised. For example, a strong AU12 may lead to the top lip being raised, so that when AU10 is recorded there should be evidence that the lip has been retracted more than can be accounted for by the strong AU12 alone. Often, the two actions can be seen to work independently, for example, in the raising and lowering of the lip while AU12 is continuous.

Figure 4.5 Addition of AU10 Upper Lip Raise to AU12 Lip Corner Puller and AU27 Jaw Drop

A strong action of AU9 Nose Wrinkler is likely to raise the upper lip. However, AU9 can be distinguished by distinctive wrinkling at nasal root, if this is absent code AU10 Upper Lip Raiser. If AU9 is present, independent action of AU10 may be confirmed by asynchrony of these movements. The fattening of the lip is a good indicator that AU10 has acted.

Comparison to Human AU10

When AU10 is seen to act in humans, there is a distinctive shape to the top lip described as ‘an angular bend in the lip’ (Ekman, Friesen & Hager, 2002). In chimpanzees, AU10 does not cause this distinctive change of appearance in the upper lip. Instead the lip appears to be raised into a smoother crescent shape. In addition, the distinctive shape of the deepened nasio-labial furrow which is a key identifier of this AU in humans, is not available as a cue in the chimpanzee.
Figure 4.6 Addition of AU10 Upper Lip Raise to appearance of AU12 Lip Corner Puller

![Images of chimpanzees showing facial expressions](image1.png)

**Video 4.3. Example AU10** Note that effect of AU10 on an existing lip corner puller (AU12)

Figure 4.7 Unilateral AU10 Upper Lip Raise (note deepening of sub nasal furrow on left side of face)

![Images of chimpanzees showing facial expressions](image2.png)
Chimpanzee Action Unit 12: Lip Corner Puller

AU12 Lip Corner Puller pulls the mouth corners backwards and upwards at an oblique angle towards the ears; it causes changes in the shape of the mouth and lower face.

Proposed Muscular Basis
Zygomatic Major, this muscle originates on the zygomatic arch and inserts at the mouth corner. Action of this muscle draws the mouth corners obliquely upwards.

Appearance Changes
1. The action of AU12 draws the lip corners upwards and backwards (towards the ears), elongating the mouth into a crescent shape.
2. Changes shape of mouth area; in neutral the jaw area is oval when seen in the frontal view, stronger actions may cause pouching in the infra orbital triangle and the oval shape of the jaw is altered.
3. Causes semicircular mouth corners furrows to deepen into wrinkles. These lines may be better seen in profile, especially in subtler actions.
4. When seen in profile, a strong action may result in a series of visible furrows running from the side of the nose and around the mouth corner.
5. Stretches the top lip causing vertical wrinkles in infra nasal area to become less visible and lips may appear slightly fuller.
6. Stronger 12 pulls lip upwards so that lips part and some of upper or lower teeth may be visible (but no as much as when in combination with AU10 Upper Lip Raiser.

Figure 4.8 Action of AU12 Lip Corner Puller

Video 4.4. Example AU12
Note that other AUs are also acting.
Figure 4.9 AU12 Lip Corner Puller causing wrinkling at mouth corner

![Figure 4.9 AU12 Lip Corner Puller causing wrinkling at mouth corner](image)

Figure 4.10 AU12 Lip Corner Puller in profile (lips retracted vertically by other AUs)

![Figure 4.10 AU12 Lip Corner Puller in profile (lips retracted vertically by other AUs)](image)

Minimum Criterion

The best indicator of this AU is the oblique upwards movement at the mouth corners and the characteristic wrinkling in this area. As these lines are often visible in the neutral face, it is important that movement or deepening of these lines is noted before AU12 Lip Corner Puller is recorded.

Reference AU12

AU12 Lip Corner Puller and other mouth actions may be part of vocalisation production: vocalisations should be coded using AU50.

Subtle Differences

Presence of AU10 Upper Lip Raiser with AU12: The action of AU12 pulls the lips upwards at an oblique angle and it is sometimes difficult to determine whether AU10 is also acting. The degree of lip raising can be judged from the amount of top teeth/gums visible and also from the deepening of the subnasal furrow and other horizontal wrinkles that appear beneath the nose area. To code AU10 in combination with AU12 there needs to be more evidence lip raising than can be accounted for by the AU12 action. When coding video clips it may be possible to distinguish the action of AU12 and AU10 due to asynchronous timing of the two actions. The best indicator that AU10 is acting with AU12 is the shortening of the upper lip.
As in humans, AU12 causes changes to both the lower and upper face. The characteristic curvature of the mouth when AU12 acts is similar in both humans and chimpanzees. Moreover, both species show bunching and wrinkling of skin at the mouth corners. However, because chimpanzees do not have the same cheek fat as in humans, the characteristic deepening of the nasolabial furrow (a key indicator of AU12 in humans) is not observed in the chimpanzee. In addition, the different morphology of the lips means that the pulling on the lips by AU12 is less clearly observable on the chimpanzee face and observers need to examine the vertical lip furrows on the top lip to assess this aspect of an AU12 action. Due to the shape of the chimpanzee mouth, it is likely that subtle actions of AU12 will be more difficult to distinguish on the chimpanzee face, unless a profile or 3/4 view is available. However, in stronger actions AU12 is readily identifiable in the chimpanzee.

The chimpanzee mouth may show some arching at the corners even in neutral state. This could be a false indicator that AU12 has acted. In order to code AU12 it is necessary to see movement of the mouth corners, evidence that the mouth corners have been drawn back towards ears or the deepening of mouth corner wrinkles. This curvature is less apparent in neutral frontal images due to the degree of prognathism in the chimpanzee.
Figure 4.13 Curvature of chimpanzee mouth in neutral
Chimpanzee Action Unit 16: Lower Lip Depressor

AU16 Lower Lip Depressor pulls the lower lip downwards towards the chin.

**Proposed Muscular Basis**
Depressor labii inferioris; some strands may arise from the bone of the lower jaw but others are not differentiated from the platysma and attach in the skin of the lower lip. Action of this muscle pulls the lower lip down towards the jaw.

**Appearance Changes**
1. Pulls the lower lip down and may reveal inner lip area.
2. Opens mouth and parts lips.
3. Causes lower lip to protrude.
4. In most cases exposes lower teeth and in more extreme actions the lower gums.
5. Skin moves downwards over chin.

**Figure 4.14** Action of AU16 Lower Lip Depressor in profile view

**Figure 4.15** Action of AU16 Lower Lip Depressor

<table>
<thead>
<tr>
<th><img src="image1" alt="Profile View" /></th>
<th><img src="image2" alt="Profile View" /></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Profile View" /></td>
<td><img src="image4" alt="Profile View" /></td>
</tr>
<tr>
<td><img src="image5" alt="Profile View" /></td>
<td><img src="image6" alt="Profile View" /></td>
</tr>
</tbody>
</table>
**Minimum Criteria**

In order to code AU16, the lower lip must be pulled downwards. Relaxation of the lower lip so that it hangs loosely should not be coded as AU16. In addition, the lower lip must be lowered to a greater extent than would be expected by the position of the jaw and the camera angle alone.

**Reference AU16**

It is unclear whether all cases of lower lip depression are the result of depressor labii contraction. In some cases, it appears as if the weight of the lower lip is sufficient to cause it to depress and protrude. This would imply that *contraction* of musculature is required to keep the lips *closed*. Further investigation into the anatomy of the chimpanzee face is needed to confirm this. At this stage, however, given the frequency and consistency of movement, if the appearance changes match the minimum criteria, AU16 can be coded. When the lip is simply relaxed and is pulled down by its own weight alone, this should be denoted as AD160 Lower Lip Relax. The appearance of these two actions is differs in terms of the apparent tension in the lip as AU16 pulls the lips downwards towards the chin, with AD160 Lower Lip Relax the Lip is not pulled downwards downward towards the chin, but rather droops and protrudes away from the lower teeth and gums.

**Figure 4.16 AD160 Lower Lip Relax**

This action usually causes the lips to part and AU25 Lips Part should also be coded. Opening the mouth with AU26 Jaw Drop or AU27 Jaw Stretch will alter the perception of AU16 as the appearance of the lips and mouth alter. Strong action may cause tenseness in skin of neck and lower jaw and wrinkles may appear in the skin under the chin, but the presence of facial hair and viewing angle makes this difficult to see.
Figure 4.17 Neutral and increasing depression of lower lip with AU26 Jaw Drop

Subtle Differences

In most cases AU16 will cause the lips to part and the mouth to open, so AU25 should be recorded. If the lips do not part, another AU must be acting to push the upper lip down. Combined action of AU16 with AU10 Upper lip Raiser and AU12 Lip corner Puller will cause the lower lip to flatten and thicken (and not protrude).

If the jaw is lowered with AU26 Jaw Drop or AU27 Jaw Stretch, it may appear as if the lower lip is depressed. Careful attention to the degree of lip lowering from the neutral position, and the other appearance changes should confirm whether this is the case. When the lower jaw is lowered (AU26 Jaw Drop) it may reveal the inner lower lip, giving the false impression that the lower lip has depressed.

Figure 4.18 Effect of AU10 Upper Lip Raiser and AU12 Lip Corner Puller on the appearance changes of AU16 Lower Lip Depressor.

Figure 4.19 AU25 Lips Parted rather than AU16 Lower Lip Depressor
Figure 4.20 Subtle difference between AU16 Lower Lip Depressor and AU26 Jaw Drop

If the lips are funnelled (AU22) they will protrude and it may appear as if the lower lip is depressed. Unlike in humans, chimpanzees are capable of funnelling the upper and lower lips independently, so if only the lower lip section of the orbicularis oris contracts, it may be particularly difficult to correctly discriminate from AU16. However, AU22 Lip Funneler gives the lips a distinctive shape, whereby the centre of the lips protrudes as a point, while AU16 pulls the entire lower lip downwards. We have no examples of AU22 in the bottom lip alone.

If AU9 Nose Wrinkler or AU10 Upper Lip Raiser act on the upper lip and so the lips part, it may appear as if the lower lip is depressed because more of the inner area of the lower lip is visible. Careful notice of other AUs present should confirm whether the lower lip has been depressed. Figure 4.15 shows the upper lip being raised (AU10, Upper Lip Raiser) giving the false impression that the lower lip has been depressed.

In addition, action of AU17 Chin Raiser can cause the lower lip to protrude. However, AU16 Lower Lip Depressor and AU17 Chin Raiser are antagonistic, the former leads to lowering of lip and the latter pushes slightly upwards and outwards. Careful attention to the position of the lower lip in relation to other facial features should help to establish whether the protrusion of the lip and increased visibility of inner lip are due to AU16 or AU17.

Figure 4.21 Subtle differences between AU16 Lower Lip Depress and AU10 Upper Lip Raise

Comparison to Human FACS AU16

The different mouth shapes in human and chimpanzees mean that there are differences in the appearance change. The absence of a chin boss in chimpanzees means that the lower lip attaches at the jaw; depressing the lower lip can therefore result in the chimpanzee lower lip hanging much more loosely than with this action in humans.
Figure 4.22 Example of extreme AD160 Lower Lip Relax

Wrinkles and indentations are sometimes formed over the chin boss when AU16 acts in humans, whereas chimpanzee lack the defined chin boss and do not show the same texture when AUs move the skin in this area. In humans, the muscle underlying AU16 has greater differentiation from the platysma, and is therefore, likely to be capable of independent movement to a larger extent. However, we also do not see movement in the skin of the neck in chimpanzees, though it is unclear whether this is due to independent action of AU16 or lack of visibility due to hair covering this area.

The degree to which the inner area of the lower lip is visible in the neutral varies across individuals so that this feature alone may act as a false indicator should not be used as criterion for coding AU16.

Video 4.6. Example AU16
Video 4.7. Example AD160
Chimpanzee Action Unit 17: Chin Raiser
AU17 pushes chin upwards, and causes the lower lip to protrude.

Proposed Muscular Basis
The mentalis muscle arises from the base of incisor of the mandible and descends to insert into the skin of the chin in humans. Chimpanzees do not have a bony chin boss but the mentalis in chimpanzees is small and distinct. Action of this muscle pulls the chin upwards.

Appearance Changes
1. Pushes the chin upwards.
2. Pushes lower lip upwards and also causes it to protrude.
3. May alter shape of mouth as it may appear that the mouth corners are lowered as medial area is pushed upwards.

Figure 4.23 Action of AU17 Chin Raiser

Figure 4.24 Action of AU17 Chin Raiser (note altered head angle)

Video 4.8 Example AU17
**Reference AU17**

Changes in head orientation or viewing angle can impact upon AU17 in terms of the perceived distance from jaw-line to mouth and perception of the lips themselves, for example, by changing the degree of inner lip which is visible. Therefore, before coding AU17 Chin Raise, ensure that appearance changes are not simply due to changed in perspective.

**Subtle Differences**

Protrusion of lips alone should not be attributed to AU17 as AU22 Lip Funneler and AU16 Lower Lip Depressor also make the lower lip protrude. The chin may be pulled upwards by extreme protrusion of the lips by other AUs such as AU22 Lip Funneler, AU24 Lip Presser or AU28 Lip Suck but identifying any independent action of AU17 in these combinations is problematic. AU17 Chin Raise should only be coded if this action can be discriminated from these combinations by asynchronous onset and offsets.

Some individuals have more everted or defined lips than others. It is important to compare images to a good neutral before deciding that AU17 has acted to protrude lips.

**Comparison to human FACS for AU17**

As chimpanzees lack a distinct chin boss, some of the cues that are used to identify AU17 in humans are not available for deciding whether to code this action in chimpanzees. For example, there is not the same distinctive wrinkling on chin boss as in humans and no depression appearing medially under lower lip. Also, the presence of hair on the chin area may make any changes difficult to discern. The texture of the chimpanzee chin differs from that of humans and wrinkling on the chin alone may be a false indicator and should not be taken as action of AU17.
Section 5 Lower Face Orbital Actions

This section describes movements of the mouth due to action of the orbital muscle orbicularis oris which alters the mouth aperture. AU22 Lip Funneler which flares the lips outwards, AU24 Lip Presser which describes the lips being pushed together, AU28 Lip Suck and AU32 Lip Bite which describe the actions which result in the lips being taken into the mouth itself.

AU25 Lips Parted, AU Jaw Drop and AU27 Mouth Stretch are then described. As in the original FACS, these three AUs are considered together because they all describe mouth opening. Although these AUs may describe different degrees of mouth opening, these AUs represent different actions and are not simply indicators of intensity. AU25 describes how far the lips are parted. AU26 describes how far the jaw drops with the relaxation of the muscles that act to close the jaw (so like AU43 this AU describes a relaxation of a muscle). AU27 describes mouth stretching, this is opening of the jaws beyond that achieved through relaxation (AU26) and reflects the action of muscles that open the mandible.

Two Action Descriptors AD35 Cheek Suck and AD30 Jaw Sideways are briefly described.

Morphology of Chimpanzee Lips

Chimpanzees lack the distinctive lip morphology of humans; the lips are far less everted and lack the striking colouration seen in humans. There is considerable variation in lip definition in chimpanzees; in some individuals the outline of both lips can be seen, while in others only the bottom lip can be distinguished. In humans, AU23 (Lip Tightener) is identified primarily by the narrowing of the red area of the lip; due to the lack of more fully everted lips, AU23 Lip Tightener (if present) is not clearly observable in chimpanzees and is not described here.
Chimpanzee Action Unit 22: Lip Funneler

Chimpanzee AU 22 is an action which pushes the lips forwards and flares the lips into a funnel shape.

Proposed muscular basis
Orbicularis oris, action of this orbital muscle de-elongates the mouth as the corners are pulled forwards and the lips protrude.

Appearance changes
1. Pushes the medial part of the lips forward and outwards into a shape which resembles a diamond shape (or duck-bill shape).
2. The lips protrude most in the centre.
3. De-elongates the mouth by pulling the lip corners in medially so that the lips are pulled together at the corners.
4. The vertical wrinkles of the top lip can clearly be seen to deepen as they are pulled obliquely towards the centre of the lip.
5. Exposes the inner side of the lips (which are often a different colour) and there is usually more of the bottom lip visible.
6. There is a usually a small circular opening in the medial section of the lips, in which case AU25 (Lips Parted) should also be coded.
7. In profile, AU22 has a distinctive shape; the lips can be seen to flare outwards.
8. Pulls the chin upwards slightly.

Figure 5.1 AU22 Lip Funneler

[Images of chimpanzees with AU22 action highlighted]

Video 4.9. Example AU22
Fig 5.2 AU22 Lip Funneler in profile

Figure 5.3 Appearance of AU22 from different views

Figure 5.4 AU22 in frontal, ¾ view and profile
Minimum coding criteria

The lips must be drawn forward at the corners (although this can be influenced by other co-occuring AUS, see below) and protrude in the medial section.

Reference AU22

As funnelling also parts the lips, AU 25 should also be coded. AU22 is often accompanied by hooting so AU50 (vocalisation) should be coded.

If AU22 is only seen in the top lip, this is denoted by a T22 while independent action of the bottom lip would be B22. If seen only in the bottom lip B22 should be coded. While this may resemble the appearance of AU16 (Lower Lip Depress; or perhaps even AU17 which also causes the lower lip to protrude) these can be differentiated by the shape of the lip; B22 would describe the lower lip being flared outwards and protruding in the centre, while AU16 describes the lower lip being pulled downwards but without the distinctive flaring. We have no example of B22.

Some chimpanzees may have more everted lips than others in the neutral and this should be considered before coding appearance as due to slight action of AU22.

Subtle differences

Opening the mouth more widely (AU26 Jaw Drop or AU27 Mouth Stretch) in combination with AU22 may alter the shape of the mouth. AU22 may be seen in combination with other AUs that alter its appearance. For example, if combined with action of AU12 Lip Corner Puller the lip corners will not be pulled forward in the same way. Currently, we only have examples of AU22 in the top lip alone (T22) in combination with AU12.

To discriminate AU22 from AU16 Lower Lip Depress and AU17 Chin Raise, which also cause lip protrusion and reveal the inner side of the bottom lip, look for any sign of flaring in the upper lip and for tension at the mouth corners.

Figure 5.5 AU22 Lip Funneler in upper lip only T22
Chimpanzees are capable of independently funnelling at least the upper lips, while in humans, this is described as "not common". The appearance of the funnel is quite different; in chimpanzees the lips stretch out furthest at the centre of the lips, while in humans the funnel has a distinctive squareness to the shape of the top lip (possibly due to the absence of the philtrum in chimpanzees).

In humans, AU22 (Lip Funneler) flattens or wrinkles the chin boss, as chimpanzees lack a chin boss this distinctive appearance is not present though the chin may be raised by this action (see AU17 Chin Raiser).

[Video 4.10. Example AU22] with AU50 (vocalisation).
Chimpanzee Action Unit 24: Lip Presser

AU24 Lip Presser describes the pushing together of upper and lower lips (this action cannot be scored for upper or lower lip alone).

**Proposed Muscular Basis:** Orbicularis oris

**Appearance changes**
1. Presses the lips together without pushing the chin upwards (AU17 Chin Raiser)
2. Top lip bulges in stronger actions.
3. The infra nasal furrow can also deepen in stronger actions
4. Deepening of the vertical wrinkles in the top lip

**Figure 5.8 AU24 Lip Presser**

[Images of chimpanzees demonstrating AU24 Lip Presser]

**Video 4.11, Example AU24**

**Minimum Criterion**

There must be evidence that the lips are being pressed together; signs of tensions in the lips are the best indicator of this action.

**Reference AU24**

This action cannot be scored separately in top and bottom lips.
Subtle Differences

The lower lip may protrude more than the upper lip so look carefully for sign of AU17 Chin Raiser also acting to protrude the lower lip.

AU28 Lip Suck and AU32 Lip Bite also change the appearance of the mouth area. Moreover, movement around the mouth can be difficult to categorise due to the mobility of the orbicularis oris muscle which underlies many actions in this area. Tension along the lips, which must be in contact with one another, is the best indicator that AU24 Lip Presser has acted.

Figure 5.9 AU24 Lip Presser

Comparison to Human FACS AU24

The tightening and narrowing of the lips which indicate this action in humans will not be so apparent in chimpanzees as they lack the lip eversion and colouration seen in human lips. As in the original FACS, this action causes tension in the lip area and may cause bulging above and below the lips. The difference in lip definition and colouration between species means that lack of visible marginal parts of the lips in chimpanzees may be a false indicator that does not mean that the lips have been narrowed by AU24 Lip Presser.
Chimpanzee Action Units 28 & 32: Lip Suck & Lip Bite

These actions involve sucking or biting the lips. Both actions are similar and describe the lips being taken into the mouth, with AU32 being coded only when there is clear evidence of biting.

**Appearance changes for AU28 Lip Suck**

1. Sucks the lip into the mouth so that the teeth are covered.
2. Stretches the skin around mouth as lips are pulled inwards.
3. Jaw is normally lowered to enable AU28, so AU26 is usually coded.
4. AU25 should only be coded with AU28 when lips are parted.
5. If only one lip is involved code T28 or B28 (but it must be completely absent in other lip to code as only occurring in one lip).

**Additional Appearance changes for AU32 Lip Bite**

N.B. If you can see biting code as AU32, appearance changes which provide evidence for biting:

1. The teeth can be clearly seen to be biting the lip (other AUs may have raised or lowered a lip so that this may be seen).
2. If only part of one lip cannot be seen then biting may be inferred

**Figure 5.10 Neutral, AU28 Lip Suck and AU32 Lip Bite**
Minimum Criterion

The best cue for these AUs is the pulling inwards of the lips into the oral cavity which causes tightness in the lip area.

Reference AU28 & AU32

Subtle Differences

AU28 Lip Suck and AU32 Lip Bite are clearly very similar actions: AU32 should only be coded if there is some clear evidence of biting.

Due to the shape of the chimpanzee lower face, it may appear as if there is a slight bulging of the top lip as the lip is stretched over the upper teeth, which can also be used to identify AU24 Lip Presser. AU28 Lip Suck and AU24 Lip Presser can be distinguished by the shape of the bulging upper lip; in AU28 the lip is pulled downwards into the mouth, while in AU24 the lips are pushed together and this may reduce the distance between the bottom of the nose and the lips. Visibility of the lips and tension in the lips can also help distinguish these actions; AU28 Lip Suck reduces the amount of marginal lip seen while AU24 Lip Presser often increases visibility of the marginal part of the lips.

Comparison to human FACS AU28 and AU32

Chimpanzee lips do not have the eversion or contrast evident in humans. It may therefore be more difficult to ascertain whether the lips have been pulled into the mouth or are being bitten. The absence of visible outer lip may act as false indicators for AU28 Lip Suck or AU32 Lip Bite as in chimpanzees the lips are not always easily defined.
Chimpanzee Action Unit 25: Lips Parted

Appearance Changes
1. The lips part, this may reveal more of the inner lip (mucosal area)
2. The teeth and gums may be exposed
3. The oral cavity may be exposed (dependent on action of AU26 and AU27)

Figure 5.11 Neutral and AU25 Lips Parted

There are several actions that may part the lips (e.g. AU10 Upper Lip Raiser and AU16 Lower Lip Depressor). In these cases AU25 should also be coded (e.g. AU10 +AU16 +AU25).

Figure 5.12 AU25 Lips Parted caused by AU12 Lip Corner Puller, AU16 Lower Lip Depressor and AU10 Upper Lip Raiser.

Minimum Criteria

There should be some evidence that the lips are not touching, this may be visibility of the teeth, gums or inner lip area.

Reference AU25

This AU should be coded with any other AU which acts to part the lips. For example, AU10 Lip Raise, AU12 Lip Corner Puller, AU16 Lower Lip Depress, AU26 Jaw Drop, AU27 Mouth Stretch are all usually seen in combination with AU25 Lips Parted. For AU22 Lip Funneler, the lips may be parted only in the central section.
Chimpanzee Action Unit 26: Jaw Drop

Appearance Changes
1. The mandible is lowered by relaxation of the muscles which close the jaw, lips can be parted (score AU25) or together (score AU26 alone).
2. If the lips part, a space between the upper and lower teeth may be seen.
3. Mouth appears as if jaw has dropped or fallen but there is no sign that the mouth has been pulled open (e.g. lips stretched by wide jaw opening)

Figure 5.13  i) Mouth closed  ii) lips parted AU25 iii) lips parted AU25 and jaw dropped AU26

Reference AU26

Subtle Differences
AU26 may be confused with AU16 Lower Lip Depressor or AD160 Lower Lip Relax. AU26 and AU16 may seem to result in a similar appearance change with the lips separating (AU25 Lips Parted). However, AU16 does not lower the jaw only the lower lip.

Figure 5.14 AU26 Jaw Drop should not be confused with AU16 Lower Lip Depressor
Figure 5.15  i) Mouth closed ii) AU16 Lower Lip Depressor & AU26 iii) AU16 (AU26 cannot be
determined due to viewing angle)
**Chimpanzee Action Unit 27: Mouth Stretch**

1. The mandible is actively pulled down (it is not dropped as in AU26).
2. The shape of the mouth changes with this action: the usual horizontal oval becomes elongated in the vertical plane.
3. Lips may be parted and stretched by wide mouth opening (though AU27 need not necessarily be accompanied by lips parted AU25)

**Figure 5.16: a) Mouth closed b) AU26 Jaw Lowerer c) AU27 Mouth Stretch**

*Video 1.14. Example AU27*
Reference AU27

AU26 Jaw Drop is easier to detect if the lips have also parted by AU25 Lips Parted. It is unlikely that the stronger action of AU27 Mouth Stretch would not cause the lips to part. Determining whether the jaw is lowered by AU26 Jaw Drop or AU27 Mouth Stretch
Chimpanzee Action Descriptor 35: Cheek Suck

Appearance Changes

4. The cheeks are sucked into the mouth cavity.
5. The jaw is lowered to allow cheeks to be sucked into mouth.

Figure 5.17 AU35 Cheek Suck

Reference AU35

AU35 Cheek Suck should not be confused with AU28 Lip Suck or AU32 Lip Bite. The cheek suck only pulls in lateral parts of the mouth and lips and causes the central portion of the lips to protrude.

Comparison to Human FACS AU35

This AU is easily recognisable in the chimpanzee and produces a similar change of appearance with only medial section of lips visible outside the mouth cavity.
Chimpanzee Action Descriptor 30

AD30 Jaw sideways

Appearance changes
1. Chin and lower lip are displaced from the midline to one side. Off to the left is scored L30 and right R30.
2. If mouth is open upper and lower teeth may appear misaligned.

Figure 5.18: Action L30 Jaw Sideways

Reference AD30

This action should not be confused with appearance changes due to head movements and changes in camera angle.

Comparison to human FACS for AU

This action is similar in both chimpanzees and humans. However, the less defined lips of the chimpanzee may make the movement more difficult to detect.
# Notes for Investigators

## Table A: Summary of AUs in the FACS (from Ekman, Friesen & Hager, 2002)

<table>
<thead>
<tr>
<th>Upper Face AUs</th>
<th>Lower Face AUs</th>
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<tbody>
<tr>
<td>1. Inner Brow Raise</td>
<td>9. Nose Wrinkler</td>
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<tr>
<td>2. Outer brow raise</td>
<td>10. Upper Lip Raiser</td>
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<tr>
<td>5. Upper Lid Raiser</td>
<td>12. Lip Corner Puller</td>
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<td>6. Cheek raise</td>
<td>13. Sharp Lip Puller</td>
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<td>7. Lower Lid Tightener</td>
<td>14. Dimpler</td>
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<tr>
<td>43. Eye closure</td>
<td>15. Lip Corner Depressor</td>
</tr>
<tr>
<td>45. Blink</td>
<td>16. Lower Lip Depress</td>
</tr>
<tr>
<td>46. Wink</td>
<td>17. Chin Raiser</td>
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<tr>
<td>70. Brows Not Visible</td>
<td>18. Lip Pucker</td>
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<tr>
<td>71. Eyes Not Visible</td>
<td>20. Lip Stretch</td>
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<td></td>
<td>22. Lip Funneler</td>
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<td><strong>Head Positions</strong></td>
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<td>51. Turn Left</td>
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<td>52. Turn Right</td>
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<td>53. Head Up</td>
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<td>54. Head Down</td>
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<td>55. Tilt Left</td>
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<td>56. Tilt Right</td>
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<td>57. Forward</td>
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<td>58. Back</td>
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<td><strong>Eye Positions</strong></td>
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<td>61. Eyes Left</td>
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<td>62. Eyes Right</td>
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<td>63. Eyes Up</td>
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<td>64. Eyes Down</td>
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<td>65. Walleye</td>
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<td>66. Cross eye</td>
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<tr>
<td><strong>Lip parting and jaw opening</strong></td>
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<tr>
<td>25. Lips Part</td>
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<td>26. Jaw Drop</td>
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<td>27. Mouth Stretch</td>
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<tr>
<td><strong>Miscellaneous AUs</strong></td>
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<td>8. Lips Towards Each Other</td>
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<td>19. Tongue show</td>
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<td>21. Neck Tightener</td>
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<td>29. Jaw Thrust</td>
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<td>30. Jaw Sideways</td>
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<td>31. Jaw Clencher</td>
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<td>32. Bite</td>
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<td>33. Blow</td>
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<td>34. Puff</td>
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<td>35. Cheek Suck</td>
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<td>36. Tongue Bulge</td>
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<tr>
<td>37. Lip Wipe</td>
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<td>38. Nostril Dilate</td>
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<td>39. Nostril Compress</td>
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Neutral Code

If there is no evidence of any AU or AD on the face, AU0 which identifies a neutral face can be scored. This AU cannot be used in combination with any others; it may only be applied to a face in which there is no evidence of movement in any area. The neutral code can however be used in combination with codes for head and eye movements.

Visibility Codes

When coding it is often important to record when observations cannot be made due to visibility; this makes it clear that a facial action cannot be determined due to visibility rather than definitive absence of the action. As noted in the introduction, visibility is more likely to be a problem for research with chimpanzees. The visibility codes below allow the description of which facial areas cannot be clearly seen; coding in other areas can proceed so that the observation is not discarded entirely. The visibility codes are the same as for the original FACS.

These codes should not be used when any AU in the region can be identified and scored, even if all potentially acting AUs in an area cannot be clearly seen. That is, these codes are incompatible with other AUs in the congruent face area. For example, if most of the brow cannot be clearly seen but evidence for AU1+2 Brow Raise is observable, then AU1+2 should be coded rather than AU70.

These codes (excluding AU74 Unscoreable) can be used to describe lack of visibility for either side of the face by identifying whether the left or right side cannot be clearly seen (prefix code with L and R, respectively).

Table B: Codes for scoring visibility of face areas

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>Brows not visible</td>
<td>This code denotes situations in which the brow and forehead cannot be clearly seen and coded.</td>
</tr>
<tr>
<td>71</td>
<td>Eyes not visible</td>
<td>This code denotes situations in which the eyes cannot be clearly seen and coded.</td>
</tr>
<tr>
<td>72</td>
<td>Lower face not visible</td>
<td>This code denotes situations in which the lower face cannot be clearly seen and coded.</td>
</tr>
<tr>
<td>73</td>
<td>Entire face not visible</td>
<td>This code denotes situations in which the entire face is out of view and cannot be clearly seen and coded.</td>
</tr>
<tr>
<td>74</td>
<td>Unscoreable</td>
<td>This code is used when it appears that there is something to code but that for whatever reason (for example, movement and blurring of footage) the precise AUs cannot be clearly observed and coded. This code should only be used for entire facial area and not used for unilateral problems with visibility.</td>
</tr>
</tbody>
</table>
Head and Eye Direction

Permanent and temporary changes in head can be coded. Human FACS coding is usually from the basis of the ideal viewing position, which is at face level and subject in frontal orientation. With chimpanzees, viewing perspective is likely to be less than ideal with many variations in the subject’s position. Head positions may also affect the appearance of other AUs and so general orientation of the head should always be considered when coding any AUs.

Head and eye orientation can influence perception of each other; head and eye movement should always be examined independently (with the other feature occluded if possible) in order to ascertain whether the movement is genuine or due to perceptual bias.

Subtle movements of the head should not be coded; these codes should only be applied to examples of distinct shifts in orientation for the central starting position.

Due to the difficulties in determining appearance changes in the eye region in the chimpanzee, eye movement codes are extremely difficult to reliably identify and code. The following codes are compatible with those used in the original FACS. Small deviations in eye direction should not be coded as these codes are used to denote distinct deviations from central fixation.

Table C: codes for denoting head and eye direction

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD51</td>
<td>Head Turn Left</td>
<td>This denotes movement to the left along vertical axis.</td>
</tr>
<tr>
<td>AD52</td>
<td>Head Turn Right</td>
<td>This denotes movement to the right along vertical axis.</td>
</tr>
<tr>
<td>AD53</td>
<td>Head Up</td>
<td>The head is moved upwards.</td>
</tr>
<tr>
<td>AD54</td>
<td>Head Down</td>
<td>The head is moved downwards.</td>
</tr>
<tr>
<td>AD61</td>
<td>Eyes Turn Left</td>
<td>Eyes moved to the right</td>
</tr>
<tr>
<td>AD62</td>
<td>Eyes Turn Right</td>
<td>Eyes moved to the left</td>
</tr>
<tr>
<td>AD63</td>
<td>Eyes Up</td>
<td>Eyes moved upwards</td>
</tr>
<tr>
<td>AD64</td>
<td>Eyes down</td>
<td>Eyes moved downwards</td>
</tr>
</tbody>
</table>

Table D: Gross behaviour codes: These codes denote much general actions which can be coded using the FACS system

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Sniff</td>
</tr>
<tr>
<td>50</td>
<td>Vocalisation</td>
</tr>
<tr>
<td>81</td>
<td>Chewing</td>
</tr>
<tr>
<td>84</td>
<td>Head shake back and forth</td>
</tr>
<tr>
<td>85</td>
<td>Head nod up and down</td>
</tr>
</tbody>
</table>
Describing appearance of the lips and mouth

The chimpanzee mouth is particularly mobile and AUs can dramatically alter its appearance. The original FACS identifies specific terms which are used in describing the appearance changes and the chimpanzee FACS is consistent with this terminology (see table A & B). However, it is important to note, that chimpanzee lips lack the everted lips seen in humans so that the permanently seen red of the lips is no longer a key indicator. The degree to which the lips can be seen in neutral varies across individuals, however, the lips usually appear to be slightly everted in the chimpanzee (as noted by Duckworth, 1910) so that a distinct line may be seen or a change in skin texture and/or colour. The bottom lip is usually more defined than the top lip, at least in neutral, but it is unclear whether this is due to a greater degree of eversion of the lip itself. With movement, more of the inner lip area may become visible as indicated again by changes in texture and colour.

The terms listed below can also be used to describe the appearance of facial features other than the mouth, e.g. eyes may widen (increase in eye aperture). Narrowing and widening of lips are omitted as chimpanzees do not have same lip eversion as in humans.

Table E - Terms that describe the appearance changes in the lips and other features (from Ekman, Friesen & Hager, 2002 p3).

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elongate</td>
<td>The mouth appears to be longer than usual in the horizontal plane.</td>
</tr>
<tr>
<td>De-elongate</td>
<td>The mouth appears to be shorter than usual in the horizontal plane.</td>
</tr>
<tr>
<td>Flatten</td>
<td>The lips appear flattened against the teeth. They protrude less than usual. Does not involve sucking in the lips.</td>
</tr>
<tr>
<td>Protrude</td>
<td>The lips appear flattened against the teeth. They protrude less than usual. Does not involve sucking in the lips.</td>
</tr>
<tr>
<td>Tighten</td>
<td>The lips appear tight, the lips are not relaxed or loose. The muscle within the lips has contracted.</td>
</tr>
<tr>
<td>Stretch</td>
<td>The lips are pulled and the skin stretched like a rubber band.</td>
</tr>
<tr>
<td>Rolled in</td>
<td>The lips are turned, or rolled, inwards, disappearing entirely or almost entirely, but they are not tightened, pressed or stretched.</td>
</tr>
</tbody>
</table>

Appearance of the skin

In addition, we have also adopted the same terminology for describing the appearance of the skin. The texture of the skin on the chimpanzee face is very different from human facial skin, but these terms can still be applied as described below. In relation to terminology for marks in the skin, the texture of the skin means that the definitions for lines, wrinkles and furrows are slightly modified from those given in the original FACS. Namely, chimpanzee skin is full of lines, wrinkles and furrows even in the neutral state so that the consideration of cases where there are initially none of these marks visible is omitted. In addition, the chimpanzee does not have a nasiolabial furrow so this feature is omitted from the description.
Table F: Terms that describe the appearance of the skin (modified from Ekman, Friesen & Hager, 2002 p4)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulge</td>
<td>A protrusion of the skin, where the skin is pushed outwards by a muscle, or by skin being stretched over the eyeball or bone.</td>
</tr>
<tr>
<td>Bag</td>
<td>Loose skin which wrinkles as it is gathered or pushed; a bag remains loose, not taut; it may be permanent, but will thicken or become larger or more prominent with certain actions.</td>
</tr>
<tr>
<td>Pouch</td>
<td>A pocket-like shape, often protrudes like a bulge; also, may be permanent in some faces, but certain actions make it more evident.</td>
</tr>
<tr>
<td>Line</td>
<td>A surface line with no depth, usually quite fine in terms of width. Chimpanzee faces show permanent surface lines; these may deepen to a wrinkle when a certain action occurs.</td>
</tr>
<tr>
<td>Wrinkle</td>
<td>A line which has some depth and often has more width than a surface line; but they will appear with certain actions. Chimpanzee faces show permanent wrinkles which deepen with certain actions.</td>
</tr>
<tr>
<td>Furrow</td>
<td>This term describes a place on the face where certain wrinkles may appear: lower eyelid furrow or infraorbital furrow. Chimpanzee faces show a line permanently, but it will deepen to a wrinkle with certain actions.</td>
</tr>
</tbody>
</table>

Neutral baseline

Good neutral images are required for coding; individual differences in facial appearance mean that understanding facial movements requires comparison with the face prior to the movement. Ideally, a good neutral of the individual chimpanzee should be available for inspection while coding. Moreover, when coding a behavioural sequence, ‘in general, the ‘baseline’ or background position should always be explicitly noted, so that direction of movement is clear.’ (Oster, in prep). That is, the configuration of the face at onset of coding should be considered when judging the production of an expression.

Background noise

Oster and Ekman (1978) identified the problem of background noise; a subtle movement may not be detected if there are many simultaneous movements co-occurring but may be noticed on an otherwise fairly static face. In chimpanzees, as with human infants, ‘there is often much low-level, transitory, indeterminate activity, especially around the mouth region: chewing and munching movements, compression of the inside of the cheek against the gum, tongue movements inside and outside the lips, etc.’ (Oster & Ekman, 1978, p254). These movements may be noted during the coding process. Other movements, for example, the rippling of the top lip, are difficult to translate into discrete action units and these actions have therefore been termed ‘flow movements’.

Mastication

When chewing, there can be changes other than in the mouth and jaw area. Due to the large muscles used in mastication, movement may be seen on the top of the head in some cases and should not be confused with brow movements (e.g. AU1+2 Brow Raiser). In addition there may also be movement around the nose area which should not be confused with the action of AU9 (Nose Wrinkler). Other movements which are clearly unrelated to the chewing action may still be coded, much as in the case of vocalisation.
Feasibility

‘This concerns whether the proposed measurement procedure is possible, practical and worthwhile. Does the information obtained justify the cost and effort required?’ (Martin & Bateson, 1986). There are certainly practical constraints on the use of the FACS and some of these are outlined below. However, there is also great value in such detailed and objective analysis of the complexities of chimpanzee facial behaviour and its correlates. Good, thoughtful planning of the study and analysis is necessary in order for the most efficient time use. FACS coding is a labour intensive technique and therefore it is essential that sufficient consideration of these issues be given prior to the commencement of coding so that the appropriate method is applied to answer the research questions. Below are some of the practical considerations that need to be taken into account when applying the ChimpFACS to a research question.

Sampling and recording methods

Timing

As with the original FACS, the ChimpFACS is designed for discriminating movements and subsequently relies on video analysis. While static images may be coded this may be problematic as AUs are more difficult to discern without movement. In addition, coding static images still requires that a neutral of the same individual is available for comparison.

When using video footage, AUs can be coded using a continual method (such as frame by frame video analysis in the Observer, Noldus). The benefit of using continuous coding method is that combinations of AUs (e.g. prototypical expressions) can be studied as co-occurrence data is available. In addition, details about the duration of an action are also available. Continuous recording is essential if the aim is to explore sequences of behaviours and for the complex measurement of interactions to be made (Martin & Bateson, 1986, van Hooff, 1973) Continual data collection is time consuming and it may be that coders use event-based sampling. For example, coding what occurs in the 10s or 60s following a particular event, such as the focal animal receiving aggression.

In addition, with the human FACS there have also been studies which not only record when an AU occurs, but also the time-course of the movement itself. When coding video footage, the coder can record timings of AUs in three ways:
- Onset of an AU – when the movement first becomes visible
- Apex or peak of an AU – when the movement is at its most extreme point
- Offset of an AU – when the movement is longer observable

Coding in such detail is time-consuming as footage needs to be viewed repeatedly frame by frame to obtain this information. Timing will be of more significance to some research questions than others, for example, if studying startle reactions accurate measurement of timing is crucial (Ekman, Friesen & Hager, 2002). Research with humans, has shown that this level of analysis can be extremely informative in terms
Frequency Data

AUs may also be recorded simply as frequencies. For example, if a study were interested in the overall levels of facial activity (e.g. when alone versus when with conspecifics) then specific combinations of AUs may be of less interest than the overall expressivity of the face. Simple frequency data has the advantage of being the most economical approach to coding facial movement. Of course, frequency data under represents actions which are of longer duration and over represents fleeting movements (Martin & Bateson, 1986). Moreover, most research focuses on facial expressions and this requires that configurations and co-occurring movements be recorded. Ekman (1982) also warns against measuring single actions even if timing is coded; an AU may be a component of many expressions and without co-occurrence data this will not be apparent.

Selective coding

If a study is only interested in certain combinations of AU then the timing may not be of as much interest as the frequency of variants of a given facial configuration. For example, a study looking at the meaning and context of the bared teeth display may be interested in whether the lips are retracted (AU10 Upper Lip Raiser and/or AU16 Lower Lip Depressor) rather than temporal analysis of when they are retracted relative to the action of AU12 (Lip Corner Puller). This selective coding has the advantage that it allows for feature combinations to be examined rather than simply a tally of all movements seen over a time period, but it also requires some sort of a priori assumptions about which features are of interest. Preliminary exhaustive coding that reveals relevant combinations would be a valuable process in such analysis. For example, when developing the Baby FACS the sequences that the infants produced were analysed; focusing on what the baby face actually did rather than immediately searching for a recognisable repertoire of expressions (Oster & Ekman, 1978). The ChimpFACS also uses this bottom-up approach; starting with individual movement prior to examining configurations (rather than vice versa).

Reliability

Reliability is central to any coding system. In terms of coding, there should be agreement in terms of both what any individual observer codes over time (intra-observer or within-observer reliability) and also that other observers are coding in the same manner (inter-observer or between-observer reliability). In terms of individual coding, there are issues related to observer drift whereby an individual’s coding decisions change over time; ideally a coder should recode the same sample at regular intervals to assess reliability (Martin & Bateson, 1986). FACS helps to maintain intra-observer reliability by using an explicit and detailed reference manual which coders continue to use extensively even after completing training.

To measure inter-observer reliability, two observers need to code the same sample in order to obtain a measure of the agreement between them. When two or more individuals are participating in the coding
process it is important to show that they are coding in the same way. However, even if there is only one coder for a study, intra-observer reliability is still desirable on a sample of the data to ensure that the primary coder is coding consistently.

With a coding system such as FACS, which is designed as a usable research tool, it is important that researchers other than the developers can make well-informed coding decisions. That is, if the aim is to create a coding system that can be more widely used to the same standard, it is important that other researchers are able to understand how the coding system works and that all descriptions and definitions be clearly detailed and explained (Ekman, Friesen & Hager, 2002). Ekman (1982, p69) suggests that a coding system should show reliability in a number of ways; some of the issues are not applicable to the ChimpFACS e.g. spontaneous versus posed expressions, but those that are relevant are given here:

1. Reliability should be given for individual actions rather than a global reliability score – some actions are more readily identified than others.
2. Reliability should be shown for motion records and not just static images.
3. Reliability should be shown separately for all age groups that are studied (as the appearance of the face changes with age).
4. Reliability can be improved by the use of explicit detailed coding thresholds that aid in decision making.
5. Reliability should be reported for individuals outside the development team as a technique that can be learned independently is more accessible to other researchers.
6. Reliability should not just be for the type of action observed but also for timing and intensity (the latter is not yet a feature of ChimpFACS; see discussion above).

The FACS manual (Ekman, Friesen & Hager, 2002) identifies that reliability can be measured for both description (identifying AU) and for location (timing of AU). Coding the precise timing of an AU may be more difficult than simply agreeing that a given AU has been seen. It has also been found that coders show better reliability for identifying the apex of an action rather than its onset and offset. This is reasonable as the apex is the point at which the movement is at its strongest and therefore most easily observed, while onsets and offsets can require that decisions be made about very subtle or trace movements.

Validity

Does the ChimpFACS measure what it claims to measure? Chimpanzee facial expressions can certainly be described in great detail using this technique and a standardised tool of measurement will facilitate further research in this field. For the human FACS, understanding of facial movement was partially based upon the coding of posed expressions (Ekman, 1982). In addition, Ekman also used electrodes to innervate the facial muscles in order to identify their actions. In chimpanzees, facial innervation has identified that most facial muscles are capable of independent movement (Waller et al, in press). The human FACS has also been studied in relation to the autonomic nervous system and in relation to self-report measures of emotion (Ekman, Friesen & Ancoli, 1980). In terms of validation of the ChimpFACS, it is feasible that facial expressions can be studied in conjunction to autonomic arousal and indeed that this should be pursued.
Parr (2001) has already demonstrated that chimpanzees can match expressions to context and that physiological measures taken during the task discriminated between contexts; peripheral skin temperature decreased in response to viewing conspecifics in negative contexts (see also Boysen & Bernstein, 1986 for physiological responses to social stimuli).

**EMFACS**

The EMFACS (EM from emotion) is a system developed for human facial expression study which although using FACS coding has categorised movements in terms of facial expression. The most commonly seen components of recognisable expressions such as happiness and disgust are described in terms of AU combinations and these configurations are coded when seen. EMFACS has the advantage that this selective coding is less time consuming than a more comprehensive approach. Thus, EMFACS codes whether a specific group of actions has occurred and does so without measuring timing of expressions (e.g. onset, apex and offset) or intensity (though intensity of a given AU may be included in criteria for coding a configuration). While this may seem like a return to the more traditional ethogram, it still allows for extremely detailed coding of major expressions. We have not yet developed an EMFACS for chimpanzees.
Problems with coding chimpanzee facial movements

Visibility

Recording or coding the facial movements of chimpanzees is challenging because of their high levels of mobility, often making them more difficult to film close up or for a reasonable duration. For example, the Relaxed Open Mouth display which is seen during play bouts can be obscured by the movement and close proximity of individuals. Human facial expressions are recognisable at distances of up to 45m, with the suggestion that the range may be up to 100m for some expressions (Hager & Ekman, 1979). It is not clear whether chimpanzee facial expressions are as readily recognisable at such distances; it would be interesting to examine average social distance between group members and distance of facial expression recognition (Schmidt & Cohn, 2001).

Viewing angle may influence the perception of some facial expressions more than others. Angle of observation may influence perception (see e.g. Lyons et al, 2000). For example, viewing angle can alter the appearance of facial landmarks required to determine whether an AU has acted. The FACS manual includes a consideration of how extreme deviations of the head from a level position (up/down) may impede the perception of certain AUs. Head position is also an issue in coding chimpanzee facial movements, for example, the appearance of the protruding brow can be altered considerably by changes in the angle of the head. In addition, due to the shape of the chimpanzee face, AUs may appear differently when seen in profile rather than a frontal view. The ChimpFACS will identify viewing factors when relevant and offer cues for coding profile views whenever possible.

All time spent out of view should be noted and taken into account when analysing the data. However, observers also need to consider the possibility that out of view data may vary systematically, for example, if the focal animal tends to engage in different behaviours in different locations (Thomsen, 1997). For example, it may be that variations in head positions which impact upon visibility of AUs are themselves part of communicatory repertoire and so show systematic variation.

Effects of observation on chimpanzee behaviour

There is some evidence that observing nonhuman primates can affect their behaviours. For example, in a zoo setting, visitors may try to attract attention or disturb the animals and there is evidence that this influences behaviour (e.g. Chamove & Hosey, 1988; Lambeth, Bloomsmith & Alford, 1997).

In some cases, it seems that experience with the aversive bright lights of flash photography may result in idiosyncratic facial responses to photographic and even video equipment; the chimpanzee may therefore have a ‘camera’ expression. The expression is displayed when the camera is directed towards the chimpanzee and disappears again once the camera is directed away. This is a response based on individual experience and only noted in a few of the many chimpanzees used in the development of the FACS. However, coders should be aware of this phenomenon as they may also observe responses to filming.
Data collection

The FACS is based upon the collection and analysis of high quality video footage. Subsequently, most FACS research with humans has used highly controlled experimental settings for data collection. For example, when analysing interactions it is necessary to have good, clear video footage of both interactants. For this method, two well positioned video cameras are usually used in synchrony. However, such an approach is not as straightforward with chimpanzees, although work with laboratory housed chimpanzees is certainly feasible. For example, data could be collected of an individual chimpanzee's facial movement while watching video footage of conspecifics. Anderson, Myowa-Yamakoshi and Matsuzawa (2004) studied chimpanzee responses to yawning at the expression level, but more detailed consideration of component movements would be interesting. Facial behaviour could also be examined during tasks of varying cognitive demand, as done with scratching as a measure of stress (Leavens et al, 2001).

For more naturalistic observations of the chimpanzee within the group context, one camera focused close-up on the focal animal and one more widely focused on the context may be desirable. This is labour-intensive; due to the mobility of the animals it requires that there are two researchers required to collect the footage; the cameras cannot simply be positioned and recording started. The start and end of a focal period needs to be clearly identified so that the videos can be readily synchronised for analysis. Once the footage has been coded, the data from the two cameras can be easily merged so that the relationship between facial movements and wider context may be addressed. However, the limited field of view, compared to live observation may mean that some aspects of the context are difficult to determine (Martin & Bateson, 1986).

The investigator’s guide for the FACS manual suggests that coding requires repeated viewing of movements so that live coding is inappropriate (Ekman, Friesen & Hager, 2002). However, it may be possible to code one or two AUs during live observation. For example, if the movement of interest were brow-raising (AU1+2 Inner and Outer Brow Raise), regardless of any co-occurring AUs, then perhaps coders could be sufficiently reliable in real time observation.
References


