



# Cat Facial Action Coding System (CatFACS) and Scientific Illustration

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## Abstract:

This study explores the complex world of feline communication, focusing on analyzing facial expressions. It utilizes the Cat Facial Action Coding System (CatFACS) with art theory for scientific illustration, presenting a novel approach in this field. CatFACS is employed for a detailed, objective analysis of feline facial expressions. However, as CatFACS does not inherently examine the emotional component, art theory is integrated to interpret these expressions. This combination provides a comprehensive understanding of cats' emotional states by focusing on both observable physical cues and inferred emotional contexts. Integrating CatFACS with scientific illustration reveals intricate insights into feline emotions and communication. This approach uncovers complex behavioural patterns, enhancing the accuracy of behavioural interpretation. This study significantly contributes to feline welfare and understanding of human-cat relationships. Highlighting the importance of nuanced approaches in animal behaviour studies provides practical insights for pet owners and veterinary professionals, aiding in better understanding and caring for cats.

**Keywords:** Feline; Facial expression; Communication; Illustration



## 1. Introduction

Research into feline facial expressions is pivotal in unravelling the complexities of feline behaviour and enhancing human-cat interaction. Recognized as vital members of households worldwide, cats employ a variety of facial expressions as a means of communication. Deciphering these expressions is crucial for gaining deeper insights into their emotional states and fostering closer bonds between humans and their cats. This study specifically delves into the importance of studying feline facial expressions, utilizing scientific illustrations and advanced methods, such as the Cat Facial Action Coding System (CatFACS) (Caiero et al., 2017), decoding the nuanced language of cats. The face serves as a critical tool for visual communication in felines. Facial expressions, encompassing elements such as posture, gestures, and movement, provide critical indicators of a cat's internal state. Various visual tools are employed to analyze these expressions in depth. For instance, the Facial Grimace Scale (FGS) (Evangelista et al., 2019) and Geometric Morphometrics (GM) (SLice, 2007) offer detailed assessments. In pain evaluation in felines, professionals often rely on instruments like the UNESP-Botucatu Multidimensional Composite Pain Scale (Belli et al., 2021) and the Glasgow Composite Measure Pain Scale-Feline (rCMPS-F) (Reid et al., 2017). The Feline Grimace Scale© application is also available for cat owners, providing an accessible means to interpret their pets' discomfort or distress.

The primary aim of this article is to demonstrate how integrating CatFACS with scientific illustration can significantly enhance our understanding of feline facial expressions. This study advances welfare practices and deepens human-cat relationships by emphasizing the importance of nuanced approaches in animal behaviour studies, which are crucial for enhancing the well-being of domestic cats and strengthening their bonds with humans.

## 2. Methods and Results

### 2.1 Cat Facial Action Coding System (CatFACS)

The CatFACS manual is used to analyze the intricacies of feline facial movements. Like ethograms (Stanton, 2015), CatFACS is not an emotion labelling system. It adopts an anatomically-based, standardized, and systematic approach to studying feline facial behaviour. This manual enables the meticulous coding of individual cat movements on their faces, utilizing a comparative and evolutionary framework (Caiero et al., 2013). The Facial Action Coding System (FACS) provides a standardized coding system for individual movements or action units (AUs) involving specific muscle groups (Figure 1), generating various facial changes or cues. Action Descriptions (ADs) are also used to code broader movements or non-mimetic actions. Fifteen individual facial movements (Action Units), six miscellaneous movements (Action Descriptors), and seven Ear Action Descriptors have been identified in the domestic cat.

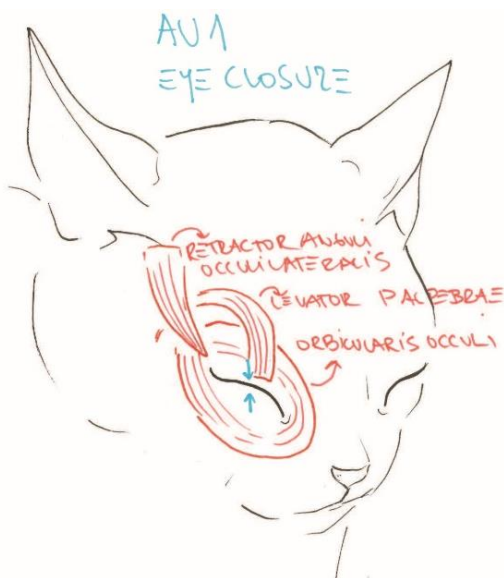


Figure 1: Illustration of the Action Unit 143 eye closure and muscles (P. Kovačič).



2.2 Observation and Measurement

Our observational and measurement procedures involve estimating time and distance and constructing ethograms to delineate behaviour patterns before, during, and after specific events involving objects or subjects in various locations. Initially, we establish a baseline for what is considered normal or neutral for each cat breed and individual. The system utilizes facial landmarks for coding to account for individual differences in facial morphology, such as the cephalic index, fatty deposits, and wrinkles. We acknowledge that visual communication is limited when studied as unimodal; thus, we combine it with other communication modes like olfactory, auditory, gustatory, and tactile. Furthermore, certain forms of signalling, such as vocalization, are adapted for bimodal or multimodal communication, especially with visuals.

Contextualizing the situation (**Figure 2**) allows us to measure various parameters, including the duration of emotions and emotional states, the time required for a cat to return to a normal state or behavioural homeostasis, and the spatial distance relative to the situation. Emotions manifest in the face; hence, the facial muscular plan is adapted to encompass muscle origin, insertion, fibre direction, and movement. We then focus on the natural face and spontaneous facial behaviour, explicitly targeting the head (neck, face, and ears). Spatial representation (cranial-caudal, dorsal, ventral, rostral-caudal; medial-lateral; proximal-distal) (**Figure 3**) mirrors planes in a spatial cross in art, albeit with slightly different terminology (frontal plane, medial plane, ocular plane, and ground plane) (**Figure 4**). This approach is significant for dividing the cat's face into planes and directions, facilitating a more straightforward interpretation.



Figure 2. Illustration of affiliative context.

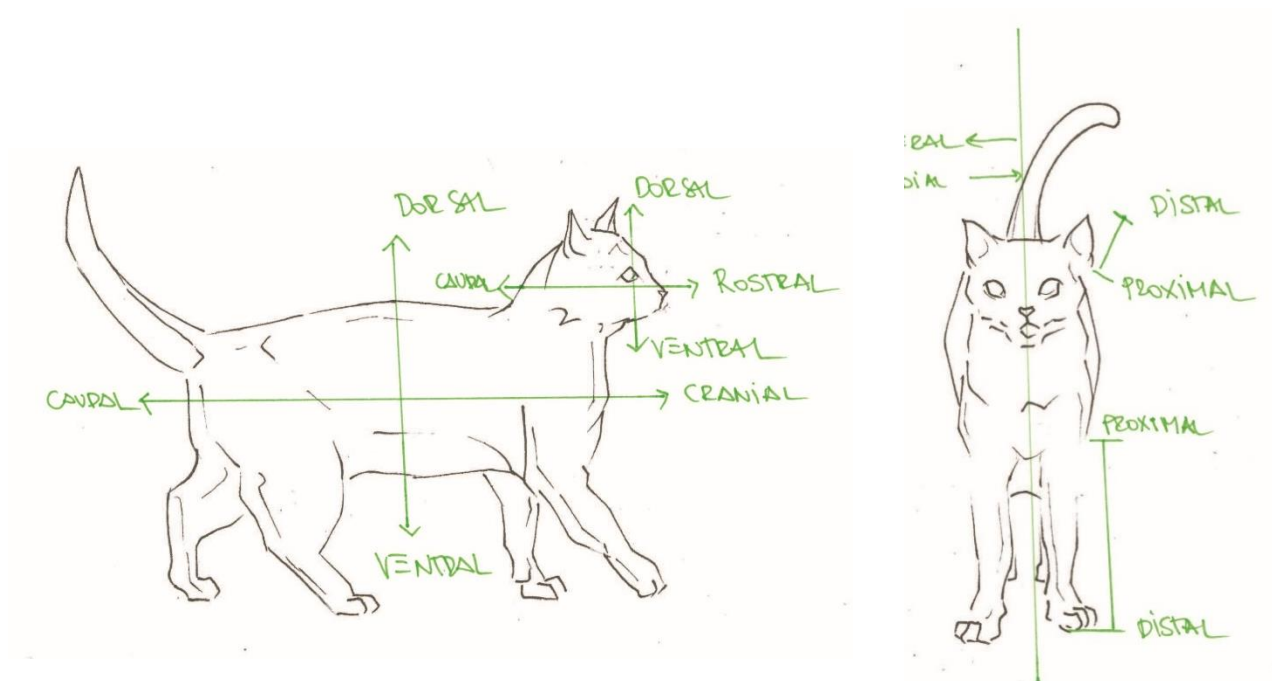


Figure 3. Illustration of spatial representation side view (left) and front view (right).

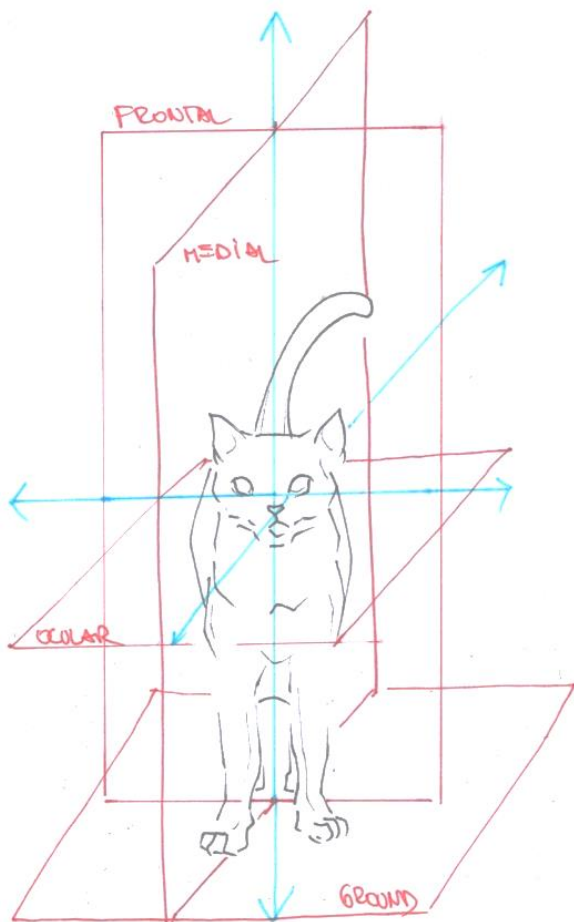


Figure 4. Illustration of the spatial cross.



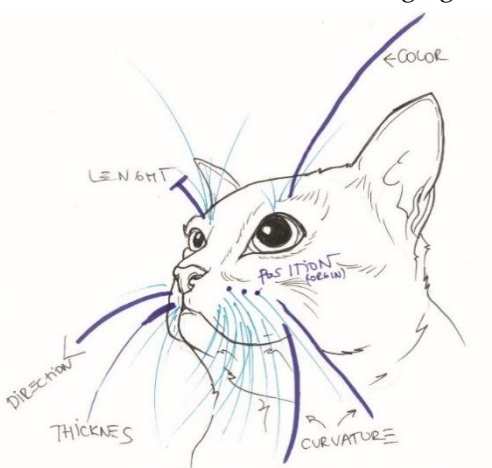
### 2.3 Scientific Illustration

The study employs scientific illustration for the rigorous analysis of feline facial expressions, body posture, limb gestures, movement, and spatial aspects, including location and distance (Case, 2010). This method enables a detailed focus on specific elements or a broader perspective through sketches and visual analyses. Techniques employed include highlighting, detailing, caricature, simplification, omission, cropping, enlargement, and comparison. Male (2017) states that such illustrations fall under non-fiction categories like documentary, referential, and instructional. Christiansen (2018) further describes these illustrations as both informative and metaphorical. The versatility of these methods allows for realistic, informative, and diagrammatic approaches, making scientific illustration indispensable for studying emotional states, motivational systems (Montag et al., 2017), behaviour, and communication in felines.

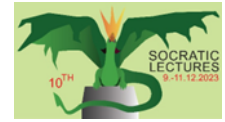
Analyzing social behaviour and visual communication through scientific illustration enables a nuanced understanding of feline communication. Artists achieve a connection between art theory and facial anatomy, viewing facial features as visual elements adhering to foundational art principles such as point, line, shape, geometric body, light-dark, and colour. Facial attributes like ears, eyes, nose, muzzle, and whiskers (Illustration 6) encompass various visual variables, including position, distance, direction, size, shape, weight, density, abundance, importance, and texture (Butina, 2003). Wrinkles, muscle tension, piloerection, colours, and patterns are also considered for comprehensive communication analysis. Combining these facial parts and movements with emotional components and contextual situations gives us an overview of felines' expressive repertoire and emotional spectrum. This approach allows us to transition seamlessly from analyzing individual facial features to understanding their role and relationships within the social-physical environment. Through this method, we utilize art as a conduit for scientific communication, harmonizing creativity with accuracy (Gould, 2023) and making the invisible aspects of feline communication visible (Christiansen, 2018).

### 2.4. Integration of Methodologies

Integrating the Cat Facial Action Coding System, observational and measurement techniques, and scientific illustration forms the backbone of our research approach. CatFACS provides a detailed and systematic method for coding feline facial movements. At the same time, our observational and measurement procedures offer a broader context for these expressions, considering the cat's overall behaviour and environment. Scientific illustration further enhances our understanding by visually representing these complex behaviours and expressions. Together, these methodologies create a comprehensive framework for analyzing and interpreting the multifaceted aspects of feline communication. A more complex approach is possible with this integrated approach to understanding feline behaviour, bridging the gap between scientific analysis and visual interpretation.



**Figure 5.** Illustration of art theory and anatomy.



### 3. Discussion

Integrating CatFACS with observational techniques and scientific illustration has provided a comprehensive understanding of feline communication. This study faced challenges in standardizing assessments across different breeds, highlighting the complexity of feline behaviour. However, these challenges were mitigated through a rigorous methodology and artistic interpretation. The findings have practical applications in veterinary practice and enhance pet owners' understanding, contributing significantly to animal behaviour research.

#### 3.1 *Integration of Methodologies and Their Implications*

The seamless transition from observational and measurement procedures to scientific illustration underscores the comprehensive nature of our study. We have gained a profound understanding of feline behaviour by meticulously constructing ethograms and establishing baselines for normal or neutral behaviours in various cat breeds. This detailed observation and contextual analysis have allowed us to measure various parameters crucial for interpreting feline emotions and reactions.

The integration of scientific illustration has significantly enhanced this process. The study has bridged the gap between cat visual communication and artistic expression by employing diverse artistic elements, variables, and compositions. This approach captures physical and physiological aspects and delves into the psychological realm of feline communication. The illustrator's role in organizing and presenting this information artistically has been instrumental in enriching the understanding of both researchers and viewers alike. This aspect of our study highlights the profound connection between scientific observation and artistic representation, as Butina (2020) emphasized, where scientific accuracy and artistic interpretation converge to provide a deeper understanding of the subject matter.

#### 3.2 *Enhancing Viewer Understanding Through Artistic Interpretation*

The illustrative aspect of our research plays a pivotal role in making complex scientific data more accessible and understandable to a broader audience. By translating intricate behavioural patterns into visual formats, we facilitate a better comprehension of feline behaviour among pet owners, veterinary professionals, and the general public. This approach contributes to academic discourse and has practical implications for improving human-feline interactions and welfare.

#### 3.3 *Future Directions*

This study's methodologies and findings open avenues for further research. Future studies could explore applying these techniques in different contexts or with diverse feline populations. The potential for developing more refined behavioural assessment tools and exploring other aspects of feline communication also presents exciting opportunities for continued research in this field.

### Conclusions

This study highlights the integral role of CatFACS and scientific illustration in advancing our understanding of feline behaviour and communication. By integrating these methodologies, we have gained novel insights into feline communication, significantly impacting welfare and human-cat relationships. This research contributes to academic knowledge and offers practical applications for veterinary professionals, feline behaviourists, and cat owners, fostering a deeper appreciation and understanding of our feline companions.

Future research directions include

- applying these techniques in different contexts or with diverse feline populations,
- aiming to develop more refined behavioural assessment tools and
- exploring other aspects of feline communication.

This study serves as a foundation for further exploration of felines' rich emotional lives, bridging the gap between scientific analysis and visual interpretation.



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**Conflicts of Interest:** The author declares no conflict of interest.

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