



BEHAVIORAL FACIAL RECOGNITION IN PUBLIC SAFETY

O RECONHECIMENTO FACIAL COMPORTAMENTAL NA SEGURANÇA PÚBLICA

RECONOCIMIENTO FACIAL COMPORTAMENTAL EN SEGURIDAD PÚBLICA

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ABSTRACT

This article presents an integrative review of the literature on the use of Behavioral Facial Recognition in public safety, highlighting its application through the analysis of static photos of faces and how repeated microexpressions can leave permanent marks on the skin. Throughout the study, the relationship between facial expressions and emotions is explored, and how trauma and recurrent emotional states, such as stress, influence the formation of wrinkles and visible marks, which become points of behavioral analysis. The article also addresses the role of neuroscience, showing how certain hormonal states, such as high levels of cortisol, can be visible on a person's face. Finally, the effectiveness of behavioral facial recognition in security environments is discussed, with a focus on ethical implications.

KEYWORDS: Behavioral Facial Recognition. Microexpressions. Static Photo Analysis. Neuroscience. Public Safety.

RESUMO

Este artigo apresenta uma revisão integrativa da literatura sobre o uso do Reconhecimento Facial Comportamental em segurança pública, destacando sua aplicação por meio da análise de fotos estáticas de rostos e como as microexpressões repetidas podem deixar marcas permanentes na pele. Ao longo do estudo, explora-se a relação entre as expressões faciais e as emoções, e como traumas e estados emocionais recorrentes, como o estresse, influenciam a formação de rugas e marcas visíveis, que se tornam pontos de análise comportamental. O artigo também aborda o papel da neurociência, mostrando como certos estados hormonais, como altos níveis de cortisol, podem ser visíveis no rosto de uma pessoa. Finalmente, discute-se a eficácia do reconhecimento facial comportamental em ambientes de segurança, com foco nas implicações éticas.

PALAVRAS-CHAVE: Reconhecimento Facial Comportamental. Microexpressões. Análise de fotos estáticas. Neurociência. Segurança Pública.

RESUMEN

Este artículo presenta una revisión integradora de la literatura sobre el uso del Reconocimiento Facial Comportamental en seguridad pública, destacando su aplicación mediante el análisis de fotos estáticas de rostros y cómo las microexpresiones repetidas pueden dejar marcas permanentes en la piel. A lo largo del estudio, se explora la relación entre las expresiones faciales y las emociones, y cómo los traumas y estados emocionales recorrentes, como el estrés, influyen en la formación de arrugas y marcas visibles, que se convierten en puntos de análisis comportamental. El artículo

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también aborda el papel de la neurociencia, mostrando cómo ciertos estados hormonales, como altos niveles de cortisol, pueden ser visibles en el rostro de una persona. Finalmente, se discute la eficacia del reconocimiento facial comportamental en entornos de seguridad, con un enfoque en las implicaciones éticas.

PALABRAS CLAVE: Reconocimiento facial comportamental. Microexpresiones. Análisis de fotos fijas. Neurociencia. Seguridad pública.

1. INTRODUCTION

Behavioral Facial Recognition is an advanced technique that, among several approaches, uses the fixed marks of facial expressions to assess recurring emotions and the behavioral profile of individuals. Traditionally, this technique is applied through observation, but recent advances have allowed analysis to also be performed using static photos of faces. This is because repeated microexpressions over time — the result of frequent emotions or psychological trauma — cause marks and wrinkles that become permanently fixed on the skin. These marks, combined with the study of neuroscience, provide valuable clues about a person's emotional and health state, contributing to the use of technology in public safety contexts (Oliveira, 2020).

Furthermore, neuroscience has shown that certain hormonal states, such as increased levels of cortisol — the stress hormone — can be "imprinted" on people's faces in a noticeable way. People who experience high levels of stress often have characteristics such as reddened eyes, more rigid features and exacerbated expression lines (Khan; Lewis, 2020).

Behavioral Facial Recognition is different from other facial recognition techniques because it can go beyond conventional biometric identification, such as identity verification based on static facial features. While traditional systems focus on aspects such as facial geometry, distance between the eyes and facial proportions to authenticate individuals, Behavioral Facial Recognition delves deeper into the analysis of micro-expressions and fixed features associated with emotions and psychological states. This approach uses insights from neuroscience to identify behavioral signals, such as elevated levels of stress or emotional tension, captured in static photos or videos, making it a more comprehensive and strategic tool.

In the context of public safety, this technology offers significant advantages over traditional facial recognition. While the latter is widely used for access control, surveillance and suspect identification, behavioral facial recognition allows the detection of suspicious intentions and behaviors based on emotional and hormonal patterns. For example, in urban operations, it can identify individuals who show signs of extreme anxiety or emotional agitation in public spaces, potentially preventing crimes before they occur. This functionality broadens the scope of action of security forces, transforming facial recognition into a predictive tool rather than just a reactive one.

In a territorial security scenario, such as borders or airports, Behavioral Facial Recognition can be used to identify risky behaviors or malicious intent in real time. In highly sensitive environments, such as immigration control, its ability to analyze emotional and hormonal signals can provide



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valuable information for screening passengers and identifying potential threats. Furthermore, in areas vulnerable to terrorist attacks, this technology provides an additional layer of defense by allowing authorities to analyze patterns of micro-expressions associated with high levels of stress or nervousness, often present in individuals with dangerous intentions.

In the context of wars and conflicts, Behavioral Facial Recognition emerges as a strategic weapon, capable of providing crucial tactical advantages. In combat scenarios, this technology can be used to monitor and analyze emotions and behaviors of enemy soldiers or even civilians in conflict areas, helping to identify hostile intentions or situations of imminent risk. Furthermore, its application in intensive surveillance environments, such as military bases or conflict zones, allows military commands to detect subtle emotional changes in individuals, assisting in preventive operations or defense strategies. This strategic use of Behavioral Facial Recognition reinforces its potential as a differentiated and indispensable tool for public security in its most diverse dimensions.

1.1. Objective

The objective of this article is to explore how Behavioral Facial Recognition can be used in public safety to analyze behaviors through static photos.

1.2. Problem Question

How can Behavioral Facial Recognition, using static photos, contribute to public safety while respecting the ethical implications associated with this practice?

2. LITERATURE REVIEW

2.1. Analysis of Behavioral Facial Recognition Techniques

Table 1 below presents a detailed analysis of different approaches related to the study of facial expressions and human behavior, differentiating Phrenology from other approaches such as Physiognomy, Morphopsychology, Vegetotherapy, Visagism, Facial Microexpressions and the FACS Code. Each of these approaches has its own origins, methods and levels of scientific validation, as well as different levels of applicability in modern contexts of facial behavioral recognition. The objective of this comparison is to distance oneself from Phrenology and identify the contributions and limitations of the other approaches in the specific context of static photo analysis, highlighting the most relevant methods for practical and ethical use.



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Table 1: Survey of Behavioral Facial Recognition Techniques

Criterion	Phrenology	Physiognomy	Morphopsychology	Vegetotherapy	Visagism	Facial Microexpressions	FACS Code
Definition	Study of the protuberances of the skull to infer character and personality traits.	Study of facial features to interpret character and emotions.	Analysis of facial shapes and their correlation with emotional and behavioral tendencies.	Therapy that explores emotional expression through the body and facial muscles.	Aesthetic technique that harmonizes appearance with personality and personal goals.	Identification of quick and involuntary facial expressions that reveal hidden emotions.	Facial action coding system that describes specific muscle movements.
Scientific Basis	Pseudoscience discredited by the scientific community.	Historical and cultural basis, little scientific research.	Biological and psychological basis, with little empirical evidence.	Based on body psychology, but without strong scientific basis.	Based on aesthetic perception and subjective visual communication.	Based on studies of universal emotions and behavioral neuroscience.	Highly scientific, based on facial anatomy and experimental psychology.
Application	Classification of mental and behavioral characteristics.	Interpretation of behavior and personality.	Identification of emotional and behavioral trends.	Emotional therapy and relaxation.	Aesthetic harmonization and personal/professional image.	Identifying specific emotions in contexts such as interrogations and negotiations.	Objective and standardized description of all facial movements.
Focus	Structure of the skull.	Facial features and shape.	Facial proportions and psychological traits.	Body and muscular expression.	Appearance and visual communication.	Quick (1/25 to 1 second) micro facial expressions that reflect unconscious emotions.	Facial muscle movements (Action Units) that make up all expressions.
Relationship with Facial Recognition	Irrelevant due to lack of scientific basis.	Little usefulness due to lack of modern validation.	Moderate potential in emotional facial patterns.	Application limited to the therapeutic context.	Little practical application in behavioral facial recognition.	High relevance for identifying emotions in real time or from photos/videos.	Technical basis for facial recognition systems, with wide application in AI and psychology.

Source: Research data (2025)

As observed in Table 1, there are different techniques and approaches for personality recognition from static photos. For this article, the concept of Behavioral Facial Recognition will be defined as the cautious and judicious use of approaches such as Physiognomy, Morphopsychology, Facial Microexpressions and FACS Code for the analysis of static photos. These approaches will be considered in their potential to identify expressions, emotions and behavioral traits, always with an ethical bias and a clear understanding of their limitations. It is important to highlight that the Phrenology approach will not be used, as it is a widely discredited pseudoscience with no valid scientific basis.

Physiognomy, despite its scientific weakness, will be analyzed as a complementary tool to raise initial hypotheses about emotional traits or behavioral tendencies in static photos. It will be



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applied cautiously, only as an interpretative starting point, avoiding any generalizations or stereotypes based on fixed facial features. Its use will be restricted to the exploratory context, without assuming definitive correlations or causalities.

Morphopsychology will be considered for its focus on the relationship between facial shapes and emotional or behavioral tendencies. Although it also lacks robust scientific validation, it can offer useful insights into the analysis of proportions and patterns in a person's face. As with physiognomy, its use will be treated with caution, seeking to complement more precise analyses, without replacing evidence-based approaches such as the FACS Code.

Facial Microexpressions and the FACS Code, in turn, will form the core of Behavioral Facial Recognition in this article. Microexpressions, being rapid and involuntary, can reveal underlying emotions that the person has not been able to suppress, while the FACS Code provides a detailed technical system for mapping and interpreting facial muscle movements. These two approaches are highly reliable and scientifically based, allowing for more accurate analysis of emotions and behaviors from static photos, as long as the limitations of the absence of movement in photos are overcome.

2.2. Facial Recognition in Static Photos

Behavioral Facial Recognition applied to static photos makes it possible to observe facial features marked by repeated emotions and microexpressions. When a person frequently expresses certain emotions, such as anger, worry, or nervousness, these repetitive expressions end up leaving visible marks on the face, such as wrinkles around the eyes and mouth (Smith; Jones, 2020). These characteristics, which could previously go unnoticed in conventional analyses, become an important point of observation in public safety contexts, allowing authorities to identify individuals based on emotional patterns recorded on the skin. However, it is worth noting that this technique differs from traditional "phrenology" because it does not typify an individual based on bone formations in the skull, but rather on facial features caused by real microexpressions in addition to the presence of neurotransmitters in the individual, a field of study in neuroscience.

These analysis of facial features and expression marks are complemented by advances in neuroscience, which show how certain emotional states manifest themselves physically over time (LIMA, 2021). An example of this are the marks of tension on the forehead and around the eyes in individuals who experience chronic stress, which can be detected through photo analysis.

2.3. Neuroscience and the Impression of Emotional States on the Face

Neuroscience provides crucial insights into the interpretation of visible facial cues related to emotional and hormonal states. Studies have shown that increased cortisol levels associated with stress can be perceptibly "imprinted" on people's faces. People who experience high levels of stress often exhibit features such as reddened eyes, more rigid features, and exacerbated expression lines



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(Khan; Lewis, 2020). These cues are not only physiological consequences of stress but also become valuable behavioral clues in a more detailed analysis of static photographs.

In addition, the presence of other hormones, such as adrenaline, can cause pupil dilation and visible facial tension, which are important indicators in a behavioral analysis based on static images (Henderson, 2020). Adrenaline, often released in situations of danger or excitement, tends to activate involuntary reactions that manifest themselves on the face, such as arching the eyebrows or pursing the lips. These expressions, although subtle, offer valuable clues about an individual's emotional state at the time the image is captured.

Reading these hormonal and emotional manifestations through facial expressions offers practical opportunities for a variety of areas. In the field of security, for example, identifying high levels of stress or adrenaline can be crucial for predicting risky behavior. In scenarios such as airports or large-scale events, photographs can be analyzed to identify potential threats, such as individuals who show signs of nervousness or high anxiety. Integrating this analysis with facial recognition algorithms further enhances its applicability in highly sensitive situations.

Beyond the context of safety, the interpretation of facial expressions related to hormonal states also finds application in areas such as health and well-being. Mental health professionals can use this analysis to assess signs of chronic stress or anxiety in patients, especially in populations where direct access to therapy may be limited. Static photographs, when interpreted appropriately, can reveal clues about an individual's overall emotional state, facilitating more targeted interventions.

However, it is important to emphasize that this analysis should not be taken as definitive interpretations without considering the context. Facial cues related to hormonal and emotional states can be influenced by external factors such as lighting, photography angle, and momentary physiological conditions. Therefore, to ensure accuracy and reliability, it is essential that these analysis are conducted in conjunction with other contextual data and complementary scientific tools. Neuroscience, in this case, acts as a fundamental guide, but it must be applied with caution and ethics.

Finally, the ability to identify facial patterns associated with hormones such as cortisol and adrenaline, combined with neuroscience-based methodologies and advanced facial recognition technologies, opens the door to an interdisciplinary field of study. This allows for the development of solutions not only for security and health, but also for innovation in areas such as behavioral marketing and applied psychology. Thus, the analysis of static photos can be a powerful resource, as long as it is used with scientific responsibility and respect for human individuality.

2.4. Ethical Implications of Using Behavioral Facial Recognition

Despite the benefits of Behavioral Facial Recognition, there are serious ethical implications associated with its use, especially in the context of analyzing static photos. The issue of privacy is one of the main challenges, since the analysis of facial images captured without consent can violate



individual rights (Baeza-Yates, 2021). Furthermore, the use of facial features and microexpressions to infer a person's emotional state or intention can result in misinterpretation, which can have serious consequences in public safety environments.

Another relevant ethical aspect is algorithmic bias. Facial recognition systems often have difficulty accurately analyzing individuals of different ethnicities or those with less common facial features, which can result in false identifications or discrimination (SMITH et al., 2020). Therefore, the development of more inclusive algorithms and human oversight are crucial to ensure that the technology is applied fairly.

3. METHODOLOGY

3.1. Rationale for the Integrative Literature Review

This study conducted an Integrative Literature Review, combining academic evidence, government reports and case studies on the use of Behavioral Facial Recognition. The focus was to analyze the impact of the repetition of microexpressions in static photos and how hormonal states manifest themselves on the face, as well as their implications for public safety.

The choice of the Integrative Literature Review was motivated by its ability to gather and synthesize data from different sources. This method is particularly useful in emerging areas, such as Behavioral Facial Recognition, where there is a convergence between technology, neuroscience and public safety (Whittemore; Knalf, 2005).

3.2. Research Procedures

The research was conducted in the Scopus, Web of Science and Google Scholar databases, using terms such as "Behavioral Facial Recognition", "Facial Microexpressions", "Neuroscience" and "Public Safety". Articles published between 2010 and 2022 that discussed the analysis of static photos, the influence of permanent facial features and the neuroscience associated with emotional states were selected.

3.3. Selection and Analysis Process

The selected studies were analyzed based on the following criteria:

1. Application of behavioral facial recognition in static photos and public safety environments.
2. Impact of repeated microexpressions on facial appearance.
3. Ethical implications and challenges in using these technologies on a large scale.

4. RESULTS AND DISCUSSION

This chapter presents a detailed analysis of the practical applications, technical challenges, and ethical implications of behavioral facial recognition, with a specific focus on the use of static



photographs to identify microexpressions and fixed features. Based on the results obtained in the integrative literature review, this chapter explores comparisons between traditional and behavioral facial recognition, highlighting the technological advances that allow the analysis of individuals' emotions, intentions, and hormonal states.

4.1 Comparison between Traditional Facial Recognition Applications and Behavioral Facial Recognition in Static Photos

Table 2: Comparison between Traditional vs Behavioral Facial Recognition

Aspect	Traditional Facial Recognition	Behavioral Facial Recognition in Still Photos
Objective	Identification of individuals through facial features	Analysis of fixed facial features and behaviors
Focus	Identity verification	Assessment of intentions, emotional traits and hormonal signals
Application	Access control, site surveillance	Crime prevention, behavior monitoring through photos
Challenges	Need high resolution images	Requires accuracy in reading facial and hormonal signals from photos
Ethical concerns	Privacy, use of biometric data	Privacy, bias, misinterpretation of fixed traits

Source: the authors (2025)

Table 2 highlights a comparison between traditional facial recognition and behavioral facial recognition in static photos, elucidating their differences in objectives, focuses, applications, and challenges. One of the most relevant points is how behavioral facial recognition distances itself from the traditional model by incorporating the analysis of fixed features and hormonal signals. While traditional facial recognition is limited to identifying individuals based on static facial features, the behavioral model expands its application to assess emotions, intentions, and psychological states. This approach broadens the scope of the technology, making it a tool not only for identity authentication, but also for crime prevention and behavioral analysis in sensitive contexts.

Another important detail is the emphasis on the technical and ethical challenges associated with behavioral facial recognition. The table indicates that, unlike traditional facial recognition, which faces problems mainly related to image resolution, behavioral recognition requires precision in the interpretation of facial and hormonal signals. This presents a significant technical challenge, as the analysis needs to capture subtle nuances of facial expressions and marks. Furthermore, ethical concerns are even more complex in this context, since the use of fixed features and microexpressions to infer intentions can lead to misinterpretations and discrimination. This requires the development of more inclusive and rigorous algorithms, as well as greater human oversight in the analysis process.



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Finally, the table provides an important reflection on the potential applications and ethical implications of these technologies in different contexts. In the case of behavioral facial recognition, its use in public safety environments, such as airports and surveillance areas, highlights its potential to prevent high-risk situations, such as terrorist attacks. However, the table also warns of the need to balance technological efficiency and individual privacy. While behavioral facial recognition can be a powerful tool, it must be used with caution, accompanied by clear regulations that protect the rights of individuals. This analysis highlights the need for an ongoing debate on how these technologies should be implemented ethically and effectively.

4.2. Recommendations to avoid bias and ensure the effectiveness of Behavioral Facial Recognition

To prevent the use of Behavioral Facial Recognition from perpetuating biases and resulting in misinterpretation, the following recommendations are suggested:

1. Developing inclusive algorithms: Technology should be based on data that represents different ethnic and age groups, ensuring that algorithms are trained to identify facial expressions and features fairly and accurately (Adams; Murray, 2019).
2. Scientific validation of hormonal analysis: Neuroscience must continue to validate hormonal indicators visible on the face to ensure that behavioral interpretations based on hormonal signals, such as red eyes and rigid features, are scientifically robust and reliable (Khan; Lewis, 2020).
3. Training for security operators: Professionals who use facial recognition must be trained to correctly interpret the data generated by the technology, especially when the analysis involves static photos and visible hormonal signals (Smith; Jones, 2020).
4. Independent audits of AI systems: To ensure transparency and effectiveness of Behavioral Facial Recognition, frequent audits must be carried out to verify the accuracy of the systems and correct any failures (Baeza-Yates, 2021).

4.3. Contributions to Public Safety and Prevention of Terrorist Attacks

Behavioral Facial Recognition, by analyzing fixed facial features and microexpressions recorded over time, can also play an important role in public safety, especially in preventing terrorist attacks. In highly sensitive environments, such as airports and borders, the analysis of static photos can identify individuals under great emotional stress or with suspicious behavioral patterns (Rodrigues, 2021).

Furthermore, in times of war, the ability to analyze hormonal signals on the face, such as the effects of cortisol, can provide crucial information to identify people who are in high-risk situations or involved in dangerous activities. The use of these technologies, when applied ethically, can increase



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the effectiveness in preventing violent acts and ensure greater security in places of intensive surveillance (Müller; Schmidt, 2020).

Behavioral Facial Recognition has emerged as a powerful tool in a variety of public safety contexts, enabling detailed analysis of facial features and emotional patterns captured in static images. This approach goes beyond traditional identification by providing behavioral and psychological information, expanding the possibilities for prevention and intervention in risk situations. Table 3 below presents 10 hypothetical scenarios in which this technology can be applied, demonstrating its usefulness in urban and territorial security and in high-risk contexts, such as wars and terrorist attacks.

Table 3 – Hypothetical Situations for the Application of Behavioral Facial Recognition

Hypothetical Situation	Application of Behavioral Facial Recognition
1. Behavioral analysis of suspects detained after a criminal act	Examine still photos to identify signs of tension, nervousness, or guilt reflected in fixed facial features and microexpressions.
2. Identifying leaders in criminal organizations during investigations	Analyze facial features from obtained photos to infer authoritarian or dominant behavior in suspects.
3. Monitoring behaviors of border and immigration controllers	Detect signs of deceit or anxiety in people trying to enter illegally or with fraudulent documents.
4. Crime prevention in urban areas with high rates of violence	Use photo analysis of suspects to identify behavioral patterns that indicate a propensity for violent acts.
5. Identifying potential terrorists at airports or sensitive areas	Evaluate photos of passengers with extremely nervous expressions or signs of intense stress before boarding.
6. Surveillance at protests to identify leaders instigating violence	Analyze captured images to find individuals with facial features and expressions that indicate high aggression or leadership.
7. Monitoring teams in war zones or occupied territories	Examine photos of soldiers or civilians for signs of emotional exhaustion, fear,



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	or hostile intentions.
8. Assessment of behaviors in people involved in kidnappings or extortion	Using static photos of suspects to infer intent or lack of cooperation based on reading their facial features.
9. Detection of suspicious behavior in shopping areas and large fairs	Identify individuals with facial features that indicate stress or possible intent to commit theft or attacks.
10. Analyzing faces in historical or intelligence photos to predict patterns of criminal behavior	Use physiognomy to interpret emotions or facial features that may indicate recurring behavioral characteristics in suspects.

Source: The authors (2025)

The analysis of the situations described in Table 3 highlights the strategic role of Behavioral Facial Recognition in public safety. One of the main benefits of these techniques is their ability to detect behaviors or intentions that could go unnoticed in traditional observations. In contexts such as airports and borders, for example, identifying extreme nervousness or facial features marked by stress can be crucial in preventing criminal or terrorist actions. This reinforces the idea that, by integrating these tools into surveillance systems, authorities can act more proactively and efficiently.

Another relevant aspect highlighted by the table is the applicability of these techniques in highly complex scenarios, such as war zones and criminal investigations. In conflict zones, the analysis of static photos can be used to monitor emotional signals in soldiers or civilians, helping to identify risks and in strategic planning. In investigations, the reading of fixed features can help to draw behavioral profiles of suspects or leaders of criminal organizations, offering a significant advantage to police and military intelligence.

Furthermore, Table 3 illustrates how these techniques can be used in urban contexts to improve the security of large events or public spaces. Identifying aggressive or dominant behavioral patterns, captured through photos or cameras, allows authorities to take preemptive action to avoid disturbances or violent actions. This type of application is especially useful in protests, demonstrations, and other situations where emotional tension can quickly escalate into conflict.

Finally, the analysis of the situations presented in Table 2 also raises ethical and technical issues that cannot be ignored. Although these tools are promising, it is essential that they are used responsibly, ensuring that the data analyzed is interpreted accurately and does not perpetuate bias or discrimination. The implementation of inclusive algorithms and human oversight are crucial steps to ensure that these technologies are applied fairly and effectively. In this way, Behavioral Facial



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Recognition can consolidate itself as an important ally in public safety, without compromising individual rights.

5. FINAL

Behavioral Facial Recognition, which includes the analysis of fixed features in static photos and the influence of visible hormonal signals, presents itself as a powerful tool for public safety. However, to ensure fairness and accuracy in the use of this technology, it is necessary to develop inclusive algorithms and carry out regular audits to avoid bias and misinterpretation.

The application of Behavioral Facial Recognition to static photos could be especially useful in preventing terrorist attacks and in war contexts, where identifying signs of stress or emotional tension can save lives. As the technology advances, it is crucial that its use is ethical and accompanied by policies that protect individual rights.

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