Innovation and Technology

Biometrics: foresight

ico.
Information Commissioner's Office

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Introduction

Biometric technologies are now playing an important role in unlocking innovation, personalising consumer experience and augmenting security. The technology is advancing rapidly and it is critical regulators, firms and policymakers understand both the potential challenges and opportunities for data protection in order to prepare for the coming biometric future.

This report considers the privacy implications of these important technologies in the near future, in contrast to our Biometrics: Insight report which unpacks current developments and trends. We set out scenarios and use cases for emerging biometric technologies across finance, entertainment, wellbeing, employment and education. These scenarios raise key issues about gathering and using biometric data including:

- The need to clarify key terminology and definitions surrounding biometric technologies and data.
- The increased use of biometric technologies for classification and where this sits under existing data protection legislation.
- The need for compliance with transparency and lawfulness requirements when processing ambient data.
- The need to understand and appropriately manage high risk biometric technologies, such as emotional AI.

We will address these issues by producing specific guidance on biometrics by spring 2023. The guidance will set out core definitions and approaches, link to existing ICO guidance, identify emergent risks and user based or sector specific case studies to highlight good practice. As part of the development of this work we set out a call for views from interested organisations at the end of this report.

Context

The Biometrics: Insight report explores potential definitions of biometrics both under the UK GDPR and in broader senses to better understand how we can critically consider these technologies and the challenges that may emerge. For the specific purposes of this report we have considered biometric technologies as:

> "Technologies that process biological or behavioural characteristics for the purpose of identification, verification, categorisation or profiling".

This broader definition allows us to also consider uses of data that are considered to be 'biometrics' by researchers and specialists but which may not necessarily fall within the definitions of biometric data as set in the UK GDPR and therefore fall outside the scope of UK data protection legislation as it currently stands.

We have identified the following sectors where we anticipate that biometric technology will have a major impact in the near horizon (two to five years):

2-3 years

- The **finance** and **commerce** sectors are rapidly deploying behavioural biometrics and technologies such as voice, gait and vasal analysis for identification and security purposes.
- The **fitness and health** sector is expanding the range of biometrics they collect, with consumer electronics being repurposed for health data.

4-5 years

- Even as employee tracking expands, the **employment sector** will begin to deploy biometrics for interview analysis and staff training.

4-5 years

- Behavioural analysis in early **education** is becoming a significant, if distant, concern.
- Biometrics will also be integral to the success of immersive **entertainment**.

Please note that the scenarios that follow are intended to explore in brief some possible developments and uses of technology. While the scenarios include high level commentary on relevant data protection compliance issues, you should not interpret this as confirmation that this processing is either desirable or legally compliant.

Sector scenarios

Short term scenarios

In the short term (two to three years), these are the sectors where biometric technologies are likely to have the greatest impact:

The **finance and banking sector** is likely to see significant uptake of behavioural and two factor authentication (2FA) biometric technologies for secure transactions. These will build on well-established technologies with clear purpose. For example, enhanced security incorporating behavioural analysis (such as pattern tracking and phone angle) when using in-app banking. Additional Know Your Customer (KYC) approaches are also likely to be introduced, with the use of FRT in shops as a primary or an additional layer of security such as Mastercard's emerging 'Payface' system.[1] Low friction biometric deployments such as FRT can offer faster, hygienic means of payment within shops without physical contact or use of cash. However, this raises concerns about proportionality, fairness and accessibility for those who lack easy access to digital services.

The **commercial sector** is likely to see a rapid uptake in the use of technologies such as voice recognition, gait recognition and vasal analysis in centres and staff-less shops. This will improve customer identification as well as home IoT devices. This may go beyond payment systems, to include customer tracking via gait analysis. It may include more complex approaches, such as Bluetooth beacon activated gaze tracking on store shelves in order to monitor where customer interest lies. In turn this will provide personalised offers, as well as aggregated consumer data. Other approaches may include smart menus in fast food outlets offering personalised special offers and quick access to items recognised as favourites.

Smarthome IoT devices may well make increased use of vocal analysis to not only identify users and guests within systems but also offer tailored responses to perceived emotional and behavioural states. Again, all these approaches may offer convenience, but risk a loss of transparency given challenges

[1] Mastercard launches biometric 'smile to pay' programme (siliconrepublic.com)

around providing privacy notices as well as around obtaining consent, when applicable.

Fitness and health sectors have also been early adopters of biometric technologies and are heavy consumers of biometric data. The next few years are likely to see an increase in the types of data that can be potentially gathered and shared, such as ambient light analysis for blood oxygen levels and more detailed ECG analysis. For example, devices such as earphones may become capable of in-ear health checks.[2]

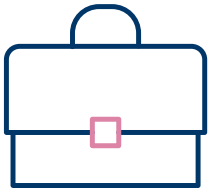
It is also likely that wearable devices as a whole will be able to gather and, if desired, share increasingly granular data with healthcare providers and professionals. This will allow medical care to become further personalised and tailored to peoples' specific needs. While this offers the opportunity of targeted and cost effective treatment, it also raises the prospect of:

- complex data sharing;
- challenges to transparency and the accessibility of data driven decisions; and
- an increased pressure to repurpose data for research purposes.

Assistive technology is another related area of potential development. Assistive devices can offer an indication of how biometric behavioural or emotional analysis may link with augmented reality devices to support disabled people in their daily interactions.[3] However, these approaches also present significant potential risks in terms of accuracy and fairness; the devices and the analytical systems using the biometric data may further embed systemic or active biases, resulting in discrimination.

[2] ASE Technology likely to process ALS devices for new AirPods (digitimes.com)
[3] Using AI, people who are blind are able to find familiar faces (microsoft.com)

Medium term scenarios



In the medium term (four to five years), further biometric techniques will be deployed in the **employment sector.** Employee tracking is a well-established, if contentious, form of processing, that may increasingly make use of behavioural or sentiment analysis. In addition, other novel techniques for interview analysis and virtual staff training are likely to take longer to come into use.

In interviews (remote or otherwise recorded), it will become increasingly possible to use behavioural analysis to interpret candidate's responses and reactions. Delays in deployment appear to be due, in part at least to public scepticism and resistance to perceived biases and flawed science. There are also legal compliance challenges such as meeting fairness and proportionality requirements under UK GDPR.[4]

Virtual staff training may make increased use of the joining up of augmented reality devices (such as head and hand sets) and biometrics. This provides a wide range of immersive training, from familiarising people with a particular environment through to teaching complex processes. This is likely to include modalities such as gaze tracking or heart-rate monitoring, or both. Our research indicates that the cost and current immaturity of immersive technologies like augmented reality remain a barrier to all but the most basic implementation.

Long term scenarios

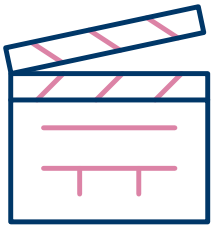
In the long term (five to seven years), we expect to begin to see novel developments in the use of biometrics in the education and entertainment sectors.

Beyond online proctoring and the use of verification methods to ensure safe access to schools, wide deployment of biometric technologies in **primary and secondary education** appears to be a distance off. This is due to the high sensitivity around utilising behavioural and educational analysis based on children's data in schools. Potentially, this could involve the detailed tracking of classes to analyse student responses to pedagogical approaches through modalities as diverse as EEG analysis, gaze tracking and behavioural analysis via cameras or augmented

[4] Citizens_Biometrics_Council_final_report (2).pdf

reality devices. This could then be used to offer tailored responses to students' progress. It may also include the wider use of digital spaces in the delivery of lessons, such as the metaverse (see below) and vocal analysis. However, our understanding is that significant barriers about systemic and active bias, perceived trust, cost and demonstrated impact will need to be overcome before further deployment.[5]

'Educational' toys and programmes delivered via smart TVs or tablets that make use of behavioural and emotional analysis are also likely to encounter similar challenges. While these may potentially offer adaptable responses to the child, issues arise about transparency, accuracy, bias and 'training' people.[6]



In the **entertainment sector**, firms have indicated a strong interest in developing novel biometric techniques linked to immersive technologies in the development of a 'metaverse'.[7] They are likely to continue developing work in and around augmented reality devices, such as glasses and headsets, and in the related area of assistive technology. Other major stakeholders may become involved in this area, but have not yet expressed their interest or intention to do so. In practice, these technologies are likely to draw on a diverse range of biometric modalities to deliver immersive, responsive customer experiences. For example, gaze tracking, GSR analysis, vocal analysis and potentially EEG analysis. Challenges will remain including about transparency of processing, systemic biases and accessibility.

Key issues in biometric futures

Issue 1: Clarification of terminology and production of guidance

Stakeholders have highlighted the need for further clarity and guidance about the data protection compliance issues that arise from the use of biometric technologies. In particular, they are seeking context specific guidance and

[5] The Ada Lovelace Institute's Citizens' Biometrics Council final report (2).pdf highlights the public reluctance to see biometrics deployed in this fashion for example.
[6] Children — Emotional AI Lab
[7] The concept of the Metaverse is that it will be a simulated digital environment which will create spaces for rich user interaction that mimics the real world; one where users can work, socialise, lean, shop and be entertained.

explicit case studies to promote good practice. In our call for views, some stakeholders feel that there is a lack of clarity over terminology about processing (such as the perceived differences between authentication and verification noted in Annex A). Also, there is further uncertainty for organisations in the definitions of behavioural and emotional analysis used across differing regulatory bodies.

Issue 2: Increasing use of biometric technologies for classificatory purposes

In many cases, the data acquired and processed through biometric technologies is being directly used to identify a natural person. In other words, it is special category biometric data that falls under Article 9(1) of the GDPR.

However, it is also clear that much of the data in these scenarios is not used for this purpose. Instead it focusses on classifying people and making inferences about them. In these cases, where the data **may** permit identifying people through the initial processing, it remains biometric data and therefore personal data but not special category data. (Special category data requires personal data to be processed for the purpose of unique identification). There is also significant scope for large scale collection of classificatory data via biometric technologies that cannot, through its initial processing, identify an individual. Although, this may be possible through links to other forms of data. This data may be identified as 'biometrics' by third parties, but is not automatically recognised as 'biometric data' under the UK GDPR.

There are cases when the data collected is considered special category data for other reasons (eg where it can be classified as health data). However, frequently classificatory biometric data may be used extensively without requiring the additional safeguards that apply to processing special category data. In these cases, we have data that does not meet the Article 9 UK GDPR definition of special category biometric data, but still might carry substantial harm if misused. (In particular, loss of autonomy, discrimination, chilling effects and personal distress on an individual level).[8]

For example, many of the scenarios discuss opportunities for classifying people, emotionally and behaviourally, for purposes including health, advertising, safety, security, entertainment and education. In some cases, this data is not (and cannot) be used for the purpose of uniquely identifying an individual. However, given the complexity of the information gathered and the increased ease with which data can be associated with a person, there is a risk of re-identification or inference. In other cases, data may be purposefully linked to an person post-identification or verification in order to realise the maximum benefit of the data.

There are robust protections in place for processing all personal data under the GDPR. However, this reinforces the need to implement safe and appropriate approaches to ensure such sensitive non-special category data is protected. It

[8] regulatory-policy-methodology-framework-version-1-20210505.pdf (ico.org.uk)

also raises important questions, such as at what point biometric data is considered data about health for the purposes of Article 9 UK GDPR. Is biometric data immediately health data simply because it relates to an individual's physiology or psychology? Or, is there a threshold for quantity or purpose that must be met?

Issue 3: Compliance with transparency and lawfulness requirements when processing ambient data will present significant challenges

Foresight research and scenario development highlighted that biometric technologies will present the opportunity for increasingly low friction deployments (biometric sampling events or BSEs)[9]. This is where little, if any, physical contact is required to gather extensive biometric data beyond the current focus of FRT. For example, gaze tracking systems or even fingerprint recognition systems could be deployed by a camera at a distance to gather verifiable data on a person without physical contact with any system being required. This presents several challenges:

- How can fair notice of processing be provided in an accessible fashion? How might this be done in virtual environments and areas of rapid transit where people are unlikely to be pausing to assess the environment?
- If consent is the basis for processing biometric data (eg for advertising or entertainment purposes) how and when can this be obtained? Can this be done in a one-off fashion, or is consent required for each instance of biometric processing?

Issue 4: Emotional AI is developing at pace despite being considered a high risk biometric technology

Our research has highlighted the growing interest in emotional AI as a technology. Increasing levels of funding are being allocated to its development and the volume of academic papers on the technology is steadily increasing. Major stakeholders have indicated that they see this area as too high risk to be of current interest. This is due to the risks both ethically and in terms of data protection compliance. However, civil society and academic stakeholders believe there will be significant commercial activity in this area due to perceived windfalls.[10]

The deployment of emotional AI is an area of high risk. This may reveal highly sensitive data via subconscious behaviours and responses, interpreted through highly contested forms of analysis. The risks may be amplified when combined with the use of children's data in areas such as education and entertainment, or for other people in the workplace or via public surveillance. However, it also has the potential to offer significant benefits through assistive technology, as well as

[9] Implications of biometrics for individuals and their close kin (University of Oxford) | ICO
[10] See for example: Emotional AI, soft biometrics and the surveillance of emotional life: An unusual consensus on privacy - Andrew McStay, 2020 (sagepub.com)

through improved interaction with devices and new forms of entertainment and healthcare support.

The science underpinning the analysis of human emotion is highly debated. Many stakeholders and scholars cite significant concerns about the ability of algorithms to accurately detect emotional cues. In particular, for ethnic minorities, those from non-European cultures or neuro-divergent individuals. Without robust and independent verification of these models, there is a risk that these approaches will be rooted in systemic bias and likely to provide inaccurate and discriminatory data about someone. This data may then feed into automated systems in many instances, raising further questions over Article 22 processing and transparency.

This processing is particularly novel and poses a significant risk because of the intimate nature of the information that is potentially revealed, which could be information that the person may not even be aware of. Much personal data is consciously provided but the modalities of emotional AI draw on subconscious bodily responses and functions, further obscuring the information being processed. Information derived and processed in this way can include estimations of direct emotional states, workplace or educational effectiveness and engagement and medical data relating to mental health. All of these forms of processing can have a high impact on a person if done inappropriately.

Potentially high risk data processed via related modalities may not be considered special category biometric data or even biometric data under the UK GDPR. This is because in many cases it is not used for the purpose of or even allow for uniquely identifying a person. Not being classified as special category data reduces the legal safeguards and restrictions around its processing. This could potentially result in people failing to understand the risks associated with it. This risk around the classificatory nature of the data has been discussed above.

What's next?

Given the range of potential uses of biometric technologies in the near horizon that we've identified in this report, we understand the need for further work in this area from a regulatory perspective. As part of this process, we will continue to scrutinise the market, identifying stakeholders who are seeking to develop or deploy technology in this area. We will continue to work with stakeholders and others to explain the importance of privacy by design and compliant use of personal data.

Building upon this, we are developing specific biometric guidance as a core part of our ongoing work in this area. It will consider the interpretation of core definitions and approaches, key links to existing ICO guidance, our views on emergent risks and provide use based and sector specific case studies to highlight good practice by spring 2023.

In support of this work, we also want to issue a further call for views. We want to hear from stakeholders who are working in this sector; whether it's in developing biometric technologies, deploying them or thinking about them in a policy based or regulatory context. We'd very much like to hear from you as we continue to develop our knowledge and thinking in this area. We can be reached at:

biometrics@ico.org.uk

Annex A – Methodology and responses

We issued a closed call for views to identified organisations in February 2022.[11] We drew up a list of over 60 organisations across central government, the private sector, civil society, academia and global regulators following desk-based research and internal engagement to identify appropriate consultees. We received 17 responses across all the sectors. Where responses were particularly informative or raised issues on which we felt that further exploration would be helpful, we set up interviews. These enabled us to gain insight into a range of issues, including the biometric priorities of key stakeholders as well as emerging public and regulatory concerns in relation to the use of biometrics.

In the responses to the call for views, stakeholders identified the following areas as key challenges to the effective and appropriate use of biometric technologies, only some of which raise issues which we may address as part of our regulatory remit:

- A lack of consensus about terminology, including forms and purposes of processing (verification, authentication, identification and classification for example). A lack of broader public understanding of emergent technologies (eg the difference between behavioural analysis and emotional analysis) was also identified.
- Linked to the above, sector specific guidance is seen as desirable and key to building both public and stakeholder understanding of what is best practice for data protection compliance around the use of biometric technologies.[12]
- While the focus of the research and the call for views focussed on the means of gathering biometrics and biometric data, stakeholders have continued to highlight the need to address the risks associated with the processing of data via AI, algorithms and machine learning. In particular, stakeholders identified the ongoing risk of systemic and active bias being ignored as biometric technologies are presented as 'new' alternatives to previously flawed means of processing (an example provided was switching from CV analysis to interview focussed behavioural analysis) without addressing remaining issues around systemic and active bias.
- A perceived lack of regulatory coherence across various UK regulators such as the ICO, Financial Conduct Authority (FCA) and Competition and Markets Authority (CMA) and a perceived lack of legislative coherence across different data protection regimes. Stakeholders have advocated for

[11] See Annex B for questions provided.
[12] For example, some have suggested using a risk-based approach for guidance suggesting that this would allow flexibility regarding purpose. What might be high risk of misidentification under security purposes could differ significantly from inaccurate data for advertising purposes.

the development of external standards and certifications as well as codes of practice.

- The cost and friction of introducing the use of emerging biometric technologies is seen as likely to inhibit early deployment for stakeholders such as SMEs and local government.

Alongside this engagement, we conducted bibliometric research using tools such as Primer, Primer Science, Lens and Google Scholar to identify quantitative data and understand the organisations and trends driving biometrics in the present and future.

We held a driver development session to identify the key influences on emerging biometric technologies and plot the public facing scenarios. Key drivers included:

- a potential growing public awareness of biometric technologies as they become increasingly embedded in everyday technology;
- an increased affordability of sensor tech and a move towards multi-purpose devices, reducing the need for expensive and specialised technology;
- an increased need for online security as banking and sensitive data processing moves increasingly online and mobile;
- physical shifts in technology (such as fewer keyboards) emphasising the need for new ways to interact with technology and;
- increased public need for convenience and accessibility of technology and services.

Using the above, initial scenarios were developed and then shared with an external panel of experts. This external workshop drew upon red teaming methodology to critically examine the scenarios and their assumptions, from the drivers used, to the sectors and technologies focussed upon. These were used to develop the scenarios presented above.

Annex B – Call for view questions

ICO call for views on emerging biometric technologies

1. In your opinion, what emerging biometric technologies (defined as technologies processing biological or behavioural characteristics for the purpose of identification, verification, categorisation and profiling) are likely to be widely adopted in the market (ie likely to see market penetration of 20% +) in the next two to seven years?

2. Do you plan to develop or deploy, or both, an emerging biometric technology as an organisation within this timeframe? If so, please provide any detail that you are able to.

3. What sets the emerging technology apart from existing solutions and approaches?

4. What forms of biometric data are these likely to capture and how?

5. Are these technologies likely to focus on verification and identification or classification of individuals?

6. How might these technologies benefit people and the use of their personal data?

7. How might these technologies present risks to people and the uses of their personal data? How could these risks be mitigated?

8. What do you believe may be the key regulatory challenges to deployment of the technologies?

9. How do you believe regulators, such as the ICO, can best support the regulation of the delivery and implementation of these technologies in the future? For example, is sector specific regulation or guidance likely to be beneficial?

10. What additional technological, legal and regulatory measures may be needed to realise the benefits of the biometric technologies across a wide range of communities?