Facial Recognition: A cross-national Survey on Public Acceptance, Privacy, and Discrimination

Léa Steinacker [1] **Miriam Meckel** [1] **Genia Kostka** [2] **Damian Borth** [1]

Abstract

With rapid advances in machine learning (ML), more of this technology is being deployed into the real world interacting with us and our environment. One of the most widely applied application of ML is facial recognition as it is running on millions of devices. While being useful for some people, others perceive it as a threat when used by public authorities. This discrepancy and the lack of policy increases the uncertainty in the ML community about the future direction of facial recognition research and development. In this paper we present results from a cross-national survey about public acceptance, privacy, and discrimination of the use of facial recognition technology (FRT) in the public. This study provides insights about the opinion towards FRT from China, Germany, the United Kingdom (UK), and the United States (US), which can serve as input for policy makers and legal regulators.

1. Introduction

Deep learning has been able to demonstrate great potential in many domains such as computer vision, natural language processing or times series analysis with the consequence of deep neural networks becoming the core technology of many products and services. One of the most successful machine learning applications deployed into the real world is *facial recognition* as it is currently running on millions of mobile phones for access control. As major international companies like Apple, Facebook, Google, Alibaba, and Baidu have integrated facial recognition into their platforms for recreational purposes, an ever-expanding trove of data is now available for processing to detect and identify billions of human faces.

[1]University of St.Gallen, Switzerland [2]Freie Universität Berlin, Germany. Correspondence to: Léa Steinacker <lea.steinacker@student.unisg.ch>.

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In addition to its myriad applications on personal devices, facial recognition technology (FRT) is used by law enforcement agencies around the world to monitor the public space via biometric data collection. In particular in this context, researchers have voiced concerns of FRT's discriminatory effects (Braca, 2017; Ngan et al., 2015), racial bias in accuracy (Buolamwini & Gebru, 2018), flawed data (Garvie, 2019), and privacy violations (Milligan, 1999; Schwartz, 2012). This debate has spurred calls for greater accountability and oversight of FRT (Mann & Smith, 2017; Naker & Greenbaum, 2017).

While some local US governments have banned the use of FRT by city and state agencies, there is currently no federal legislative consensus despite extensive activism for regulation. Similarly, neither the European Commission nor any of its member states have explicitly ruled on FRT. However, the General Data Protection Regulation (GDPR) does protect and require consent for the collection of personal data, particularly sensitive information about an identifiable living individual, and some nations have specified it to include biometrics. It remains unclear though if facial images always fall under the GDPR's scope, depending, for example, on the legal justification for processing because substantial public interest such as national security or public safety may afford a path for circumventing consent (Buckley & Hunter, 2011). In China, FR technology fused with other big data collection tools have become central to the government's plan to be the world's leader in artificial intelligence.

Evidently, FRT and the law interact in two important ways: First, the technology directly serves purposes of law enforcement with consequences for citizens around the world. Second, as regulation often lags behind technological innovation, laws to systematically manage the application of FRT in the private and public realm are currently largely lacking.

Amidst global protests against police brutality in June 2020, Amazon announced a year-long moratorium on police use of its widespread FRT software Rekognition, and Microsoft subsequently pledged not to sell their technology to US police departments until there is national regulation. IBM announced the discontinuation of their development and deployment of FRT altogether (Magid, 2020). However, com-

panies like Clearview AI continue to serve law enforcement around the world with its unprecedented facial recognition database of more than three billion images scraped from major online platforms (Hill, 2020). Such influential decisions of multinational technology companies do not only fill the regulatory vacuum but may also impact the future trajectory of FRT.

Given its growing global usage and despite scarce regulatory consensus so far, the question of *what drives international public acceptance* of FRT is of timely importance and of value to inform the discussion of policy. In this paper, we focus on people's impressions of various policy-relevant dimensions and their effects on acceptance of FRT used in public across four countries: China, Germany, the United Kingdom (UK), and the United States (US). Our contribution is threefold:

1. We present survey results of a cross-national study on attitudes towards FRT used in public
2. We demonstrate the impact of policy-relevant concerns such as privacy and discrimination on acceptance of FRT
3. We derive conclusions that serve the ML and law communities

The remainder of this paper is structured as follows. In the next section we present work related to facial recognition advances, its use for law enforcement purposes, and research on public approval. We then describe the methodology and partial results of our cross-national survey. Finally, we discuss our findings and synthesize conclusions.

2. Related Work

2.1. Robustness and Vulnerability of Facial Recognition

In machine learning, the development of facial recognition technology has a rich history covering early days of face detection (Viola & Jones, 2004) until the use of deep neural networks (Parkhi et al., 2015) for robust face recognition. An important component fueling the development of more robust systems was the availability of datasets and defined performance evaluation metrics (Phillips et al., 2005). Initially, datasets were curated to represent different poses and illumination conditions (Schroff et al., 2015) to evaluate recognition robustness from a computer vision point of view. But research effort quickly moved from controlled conditions to the use of face recognition in the wild (Huang et al., 2008; Huang & Learned-Miller, 2014), where accuracies of more than 92% could be achieved (Zhu et al., 2015).

Almost in parallel research about the vulnerability of facial recognition was able to demonstrate significant challenges for the robustness of such systems (Kose & Dugelay, 2013; Scherhag et al., 2019). The robustness of face recognition systems was even more challenges with the rise of adversarial attacks (Sharif et al., 2016) and the lack of explainability or interpretability of deep neural networks (Goswami et al., 2018). In particular (Sharif et al., 2016) was able to show that face recognition system can be explicitly confused by simple adversarial attacks to impersonate people cross-gender and cross-race i.e. confuse and impersonate a South-Asian female with a Middle-Eastern male.

2.2. In the Face of Law Enforcement

Like with other forms of surveillance technology, increasing applications of FRT by law enforcement have prompted debates about the balancing of privacy rights and security measures (McCoy, 2002). Legal scholars who consider existing privacy law insufficiently suited for FRT that may scan publicly available images without requiring consent of individuals have argued for the need of a user opt-out regime (McClurg, 2007). In combination with live-tracking and body-worn cameras, some posit the use of FRT by law enforcement might also redefine public spaces by erasing anonymity therefore endangering free speech protections (Ringrose, 2019).

Concerns about the technology's variations in accuracy are particularly noteworthy when FRT is expected to produce reliable, admissible evidence to be used for law enforcement. Studies have demonstrated that bias in performance disproportionately impacts women and people of color (Klare et al., 2012) as well as transgender and non-binary persons (Scheuerman et al., 2019). First cases were already reported where a person was wrongfully accused by FRT[1].

Given the high stakes of consequences for already vulnerable populations, potential abuse of FRT is another concern. Controversial research efforts to demonstrate a correlation between facial features and criminality (Wu & Zhang, 2016) or sexual orientation (Wang & Kosinski, 2018) signify the possibilities for misappropriating the technology, such as applying FRT for tracking ethnic minorities (Leibold, 2020).

2.3. Public Recognition

Previous studies have shown that people are most likely to accept technologies, including facial recognition, that they are most familiar with (Buckley & Nurse, 2019). This suggests prevalence of FRT may affect familiarity and thus acceptance. International implementation of FRT by both governments and private companies vary widely. In China, the administration's agenda for AI expansion has pushed FRTs to the forefront of governmental surveillance and com-

[1] https://www.nytimes.com/2020/06/24/technology/facial-recognition-arrest.html

mercial smartphone applications are widespread. Similarly in the UK, a nation long equipped with extensive CCTV particularly in its capital, both law enforcement actors and private companies have employed FRT. In the US, public and commercial use of FRT has become increasingly widespread. While the 9/11 terror attacks prompted a surge in the implementation of technology-driven public safety measures including FRT, major US platform companies' integration of the technology has rapidly expanded facial databases. In Germany, by contrast, two historical precedents of oppressive surveillance states in the recent past form the backdrop to FRT adoption that has been lower in terms of speed and scope.

Research of FRT acceptance by the public has largely focused nationally. While no cross-cultural study has been done in the four countries investigated in our focus, approval rates of biometric surveillance technologies vary international comparison.

In one study of Chinese Internet users, 80% of participants either somewhat or strongly approved of the government's social credit surveillance toolbox, which includes FRT, with higher education predicting higher acceptance rates (Kostka, 2019). While studies have assessed public opinion of surveillance technologies by German citizens (van Heek et al., 2016), none so far has concentrated on public opinion of FRT specifically. When a UK research institute surveyed 4,109 adults, 49% support its use in policing practices given appropriate safeguards, but 67% oppose it in schools, 61% on public transport, and a majority of 55% want restriction placed on its use by police (Institute, 2019). In the US, a Pew Research Center's survey of 4,272 American adults showed that more than half trust law enforcement actors to employ FRT responsibly, but only 36% think the same of technology companies, and 18% of advertisers (Smith, 2019).

3. Methodology

The results presented in this paper are based on an online survey we ran during August and September 2019 in China, Germany, the UK, and the US. A full version of the survey results can be found in (Kostka et al., 2020).

3.1. Study Design

Executed by a Berlin-based firm who cooperates with providers in each of the four countries, the survey employed a river sampling method, drawing both first-time and regular survey participants from a base of 1-3 million unique online users through mobile applications. Our survey reached respondents through more than 100 apps out of a network of over 40,000 participating partners. Formats and genres of the applications vary, including e-commerce, photo-sharing, and messaging. Within each application, offer walls provided participants options to receive small financial and non-monetary rewards, such as premium content, extra features, vouchers, and PayPal cash in exchange for taking part in the survey without knowing the topic before opting in. After an initial pre-screening that matched participants with a survey, the conversion rate of users who fully finished ours was 70% (China), 73% (Germany), $69\%(UK)$, and $67\%(US)$ respectively. Consecutive identical answer choices or disproportionately short periods of time for completion of a questionnaire were reasons for invalidation. Our sample comprised $6,633$ respondents from all four countries in total, sampled based on age (18-65), gender and region. Given the nature of conducting the survey online, this sample resembles a nationally representative group of the Internet-connected population: likely slightly younger and more technology-savvy than the overall population. Collected data was weighted by each aforementioned variable with a maximum weight of 1.8. [2]

3.2. Data Analysis

Of the $6,633$ respondents in our sample, $8.1\%(N = 534)$ had *"never heard about FRT"* prior to taking the survey. As their attitudes are nonetheless relevant for understanding overall public opinion on the matter, we did not exclude their further responses. After the initial gauge of awareness, a short prompt summarized for participants: *"Facial recognition technology is used to automatically identify people by scanning their face from an image or video."* For the purposes of this paper, we sought to understand, first, participants' stance on FR deployment in the public sphere (*"Do you accept or oppose the use of facial recognition technology in public?"*) and, second, how they interpreted related issues. We ran ordered logit regressions with the dependent variable of interest being "social acceptance" to investigate the effects of privacy threat impressions, trust in government, and perceptions of surveillance on participants' acceptance levels controlling for age, gender, and education.

4. Results

4.1. Social Acceptance

Overall, in the Chinese sample, considerably more participants accept than oppose FRT use in public, while in the UK, only slightly more do so. On the contrary, among the German and U.S. respondents, slightly more oppose than accept it.

Specifically, as Table 1 shows, 50% of the respondents from

[2] Given an estimated design effect of 1.03 for China, 1 for Germany, 1.06 for the UK, and 1.04 for the US, the overall margin of error for estimates is 2.4% for China, 2.4% for Germany, 2.5% for the UK, and 2.5% for the US.

Table 1. Results of survey question: "Do you accept or oppose the use of FRT in public?"

Response	China	Germany	UK	US
Strongly oppose	4%	18%	14%	16%
Somewhat oppose	18%	21%	19%	22%
Neither oppose nor accept	28%	24%	27%	27%
Somewhat accept	39%	29%	28%	24%
Strongly accept	11%	8%	11%	11%

China, 37% from Germany, 39% from the UK, and 35% from the US *somewhat* or *strongly accept* the use of FRT in public. Meanwhile, 22% from China, 39% from Germany, 33% from the UK, and 38% from the US respondents *somewhat* or *strongly oppose* it.

4.2. Impressions of FRT

To understand contributing factors of participants' acceptance levels, we examined their impressions of relevant dimensions related to FRT. First, we gauged perception of FRT's consequences, such as *privacy violations*, *discrimination*, and *surveillance*, as well as *convenience*, *efficiency*, and *security*.

Table 2. Results of survey question: *"Do you think FRT increases any of the following?"*

Response	China	Germany	UK	US
Privacy violations	31%	48%	39%	44%
Surveillance	27%	62%	53%	52%
Discrimination	3%	15%	16%	16%
Convenience	65%	22%	20%	30%
Efficiency	56%	20%	25%	31%
Security	62%	54%	62%	64%
None of the above	3%	5%	8%	6%

As Table 2 shows, almost half of all German and US respondents (48% and 44% respectively) expect FRT to increase privacy violations, while only 31% of Chinese and 39% of UK participants do. A clear majority of Germans (62%) and roughly half of UK and US respondents believe that FRT increases surveillance, yet only 27% of Chinese agree. Given the extensive research demonstrating various discriminatory effects of FRT, it is notable that, in all four countries, very few participants, less than 1 in 5, consider FRT to be an exacerbating factor in discrimination. A majority of the participants from China (65%) yet only 22% in Germany, 20% in the UK and 30% in the US think that FRT increases convenience. More than half of Chinese respondents expect FRT to advance efficiency (56%), while 1 in 5 of German, 1 in 4 of UK, and 1 in 3 of American respondents do. Strikingly, a majority in all four countries (62%, 54%, 62%, and 64% respectively) expect FRT to increase security.

Second, given the context of FRT employed by law enforcement for official identification, we examined participants' impressions of the technology's *reliability* in comparison to previous methods.

Table 3. Results of survey question: *"Do you think that facial recognition technology is more reliable or less reliable than other identification methods (e.g.: fingerprints, identity cards)?"*

Response	China	Germany	UK	US
More reliable	43%	31%	32%	34%
Neither more nor less	40%	38%	34%	37%
Less reliable	7%	19%	17%	15%
Don't know	10%	13%	12%	13%

As Table 3 illustrates, in all countries, fewer than 1 in 5 respondents rate FRT's reliability lower than other forms of identification, though China is the only country where a majority of participants perceive it as actually more reliable.

4.3. Concerns, Trust, Surveillance

For further examination, we analyzed various dimensions relevant to policy-making for FRT: *Issue concerns* involving law enforcement, levels of governmental *trust*, and perceptions and support of *surveillance* more generally. Across all four countries, a majority of participants is worried about crime (59%, 67%, 74%, 74%) and, except for China, about terrorist threats (47%, 56%, 66%, 67%). As Table 4 shows, the UK and the US stand out with over 40% of their participants respectively indicating that they are concerned about the control of their nations' borders, while less than 30% in both China and Germany do. Around half of Chinese respondents are concerned about violations of rules & regulations, while around 38% of Germans, 36% of UK and 41% of US participants are. Finally, a majority in both China (51%) and the UK (54%) find socially unacceptable behavior concerning.

Table 4. Results of survey question: *"Are you concerned about any of the following issues in your country?"*

Response	China	Germany	UK	US
Crime	59%	67%	74%	74%
Terrorist threats	47%	56%	66%	67%
Border control	29%	28%	42%	43%
Violations of rules & regulations	49%	38%	36%	41%
Socially unacceptable behavior	51%	42%	54%	36%
None of the above	14%	14%	9%	10%

Linking the previous question into the context of trusting the local government (Table 5), we observe that with the exception of China (7%), that people in Germany (37%), the UK (48%), and the US (40%) only trust their government *very little* or *not at all*. On the contrary, while a majority of 61% in China trust their administration *a lot*, only 23% in Germany, and merely 10% in both the UK and the US do.

Finally, we investigated participants' judgment of their government's domestic surveillance history and their current

Table 5. Results of survey question: *"How much do you trust governmental institutions in your country?"*

RESPONSE	CHINA	GERMANY	UK	US
NOT AT ALL	1%	14%	17%	12%
VERY LITTLE	6%	23%	31%	28%
SOMEWHAT	24%	32%	37%	42%
A LOT	61%	23%	10%	10%
PREFER NOT TO ANSWER	7%	7%	5%	8%

Table 6. Results of survey question: *"Do you think that the government in your country has used surveillance against its own citizens in a negative way in the past?"*

RESPONSE	CHINA	GERMANY	UK	US
YES	13%	46%	41%	54%
NO	37%	23%	19%	15%
DON'T KNOW	50%	30%	41%	32%

support of governmental surveillance. While 46% of respondents in Germany, 41% in the UK, and 54% in the US believe their country's government has employed domestic surveillance negatively in the past, only 13% of Chinese do (Table 6). While in China and the UK, considerably more people somewhat or strongly support (52% and 44%) surveillance than somewhat or strongly oppose it (16% and 24%), in Germany (34% vs 40%) and the US (31% vs 37%) the two sides appear roughly equal. About a third of all respondents in each country neither oppose nor support surveillance in their country (Table 7).

4.4. Effects on Social Acceptance

To gauge the effects of a number of these factors on public approval we ran an ordered logit regression with social acceptance of FRT use in public as our dependent variable and privacy threat perception, consequences of FRT, and national issue concerns as independent variables.

Our analysis shows that the interpretation of privacy threat is a strong and significant negative predictor of acceptance (see Table 8). In other words, the more a participant perceives the technology as a risk to their privacy, the less likely they are to accept FRT use in public. This finding is statistically significant across all four countries and in each setting individually.

Convenience has a significantly positive effect on acceptance overall, and in each country individually, with the exception of Germany, where the sign turns. That is to say, the more likely German participants perceive FRT to increase convenience, the less likely they are to accept it, pointing perhaps to cultural skepticism towards a hyped comfort of technology.

Across all countries, overall and individually, impressions of increased efficiency as well as security raise the likelihood of acceptance as the corresponding coefficients are significant and positive. Discrimination is a significantly negative predictor overall as well as in Germany and the UK specifically while in China and the US, the coefficients are not statistically significant.

Table 7. Results of survey question: *"Do you generally support or oppose the use of surveillance by your government in your country?"*

RESPONSE	CHINA	GERMANY	UK	US
STRONGLY OPPOSE	4%	15%	9%	12%
SOMEWHAT OPPOSE	12%	19%	15%	19%
NEITHER OPPOSE NOR SUPPORT	32%	27%	31%	32%
SOMEWHAT SUPPORT	34%	32%	31%	26%
STRONGLY SUPPORT	18%	8%	13%	11%

In international comparison, the more a participant perceives FRT to increase surveillance the more likely they are to accept it, with the exception of China, where the effect is negative, and the US, where the result is not significant.

Our analysis shows that the perception of terrorist threats is a significant positive predictor across all four countries. When perceived as a national concern, socially unacceptable behavior has a significant, positive relationship to approval of FRT in public overall and in Germany. On the other hand, neither concerns about violations of rules and regulations, nor about crime or border control are significantly linked with higher rates of acceptance.

5. Conclusion

How the scientific community continues to improve FRT and the law oversees it bears far-reaching implications for people worldwide. Public funding, young researchers in this area, and investments by tech companies are currently under pressure because of the uncertainty of what defines an *acceptable* use of FRT. Such uncertainty can be resolved by guidelines from regulatory or legal entities. Such guidelines however work best when they reflect a consensus of the people's opinion about what an acceptable and valid use of FRT is. The machine learning community needs such guiding policies to reduce the current uncertainty towards future research. This is in particular important because of the challenges FRT is currently facing with regard to its vulnerability, adversarial attacks, or lack of interpretability or explainability.

The insights presented in this paper into some of the most salient factors influencing acceptance can inform the further development of applications and the formulation of policy. First, there appears to be no consensus on the public use of FRT across the four countries studied. Varying international acceptance levels signal that there might not be a feasible unified approach to governing FRT. Respondents

from China and the UK express more acceptance than disavowal, compared to the opposite in Germany and the US. Similarly distributed are the frequencies of who perceives FR to increase privacy violations. When they do perceive the technology as a privacy threat, though, people across all countries are more likely to oppose its use in public. This finding suggests that a rise in reports and investigations of privacy violations related to FR might contribute to a decline in global acceptance in the future.

Second, a majority of respondents in all four countries expect FR to increase security. This emphasizes that in the nations studied, the perceived main trade-off of FR appears to be between security and privacy.

Third, awareness of the discriminatory effects of applied FRT are very low across all four countries and our findings imply greater awareness would lead to lower acceptance. Given wide-ranging research showing their disproportionate impacts on vulnerable and minority populations, including women, people of color, and members of the LGBTQ community, this gap underlines the responsibility of developers to improve accuracy and biased performance and of law enforcement to ensure protection against discrimination, particularly through the use of FR in public.

Fourth, across all countries studied a concern about terrorist threats affected acceptance rates more significantly than perceptions of crime or border control. This suggests that respondents have distinct thresholds of justification for FRT used by law enforcement.

When applied with such consequential social ramifications, mitigating FRT's current discriminatory effects must be a focus of both the scientific and legislative communities. Furthermore, the scope of privacy protections must match technological advances and implementation purposes.

References

Braca, A. An investigation into Bias in Facial Recognition using Learning Algorithms. 2017.

Buckley, B. and Hunter, M. Say cheese! privacy and facial recognition. *Computer Law & Security Review*, 27(6): 637–640, 2011.

Buckley, O. and Nurse, J. R. The language of biometrics: Analysing public perceptions. *Journal of Information Security and Applications*, 47:112–119, 2019.

Buolamwini, J. and Gebru, T. Gender shades: Intersectional accuracy disparities in commercial gender classification. In *Conference on fairness, accountability and transparency*, pp. 77–91, 2018.

Garvie, C. Garbage In. Garbage Out. Face Recognition on Flawed Data, May 2019. URL https://www.flawedfacedata.com. Library Catalog: www.flawedfacedata.com.

Goswami, G., Ratha, N., Agarwal, A., Singh, R., and Vatsa, M. Unravelling robustness of deep learning based face recognition against adversarial attacks. In *Thirty-Second AAAI Conference on Artificial Intelligence*, 2018.

Hill, K. The secretive company that might end privacy as we know it. *New York Times*, 18, 2020.

Huang, G. B. and Learned-Miller, E. Labeled faces in the wild: Updates and new reporting procedures. *Dept. Comput. Sci., Univ. Massachusetts Amherst, Amherst, MA, USA, Tech. Rep*, pp. 14–003, 2014.

Huang, G. B., Mattar, M., Berg, T., and Learned-Miller, E. Labeled faces in the wild: A database forstudying face recognition in unconstrained environments. 2008.

Institute, A. L. Beyond face value: public attitudes to facial recognition technology, 2019. URL https://www.adalovelaceinstitute.org/beyond-face-value-public-attitudes-to-facial-recognition-technology/. Library Catalog: www.adalovelaceinstitute.org.

Klare, B. F., Burge, M. J., Klontz, J. C., Bruegge, R. W. V., and Jain, A. K. Face recognition performance: Role of demographic information. *IEEE Transactions on Information Forensics and Security*, 7(6):1789–1801, 2012.

Kose, N. and Dugelay, J.-L. On the vulnerability of face recognition systems to spoofing mask attacks. In *2013 IEEE International Conference on Acoustics, Speech and Signal Processing*, pp. 2357–2361. IEEE, 2013.

Kostka, G. China's social credit systems and public opinion: Explaining high levels of approval. *New media & society*, 21(7):1565–1593, 2019.

Kostka, G., Steinacker, L., and Meckel, M. In the Eyes of Citizens: Attitudes Towards Facial Recognition Technology in China, Germany, the UK and the US. *Available at SSRN: https://ssrn.com/abstract=3518857*, 2020.

Leibold, J. Surveillance in china's xinjiang region: Ethnic sorting, coercion, and inducement. *Journal of Contemporary China*, 29(121):46–60, 2020.

Magid, L. IBM, Microsoft And Amazon Not Letting Police Use Their Facial Recognition Technology, 2020. URL https://www.forbes.com/sites/larrymagid/2020/06/12/ibm-microsoft-and-amazon-not-letting-police-use-their-facial-recognition-technology/. Library Catalog: www.forbes.com Section: Innovation.

Mann, M. and Smith, M. Automated facial recognition technology: Recent developments and approaches to oversight. *UNSWLJ*, 40:121, 2017.

McClurg, A. J. In the face of danger: Facial recognition and the limits of privacy law. *Harvard Law Review*, 120(7): 1870–1891, 2007.

McCoy, S. O'big brother where art thou?: The constitutional use of facial-recognition technology. *Order*, 20, 2002.

Milligan, C. S. Facial recognition technology, video surveillance, and privacy. *S. Cal. Interdisc. LJ*, 9:295, 1999.

Naker, S. and Greenbaum, D. Now you see me: Now you still do: Facial recognition technology and the growing lack of privacy. *BUJ Sci. & Tech. L.*, 23:88, 2017.

Ngan, M., Grother, P. J., and Ngan, M. *Face recognition vendor test (FRVT) performance of automated gender classification algorithms*. US Department of Commerce, National Institute of Standards and Technology, 2015.

Parkhi, O., Vedaldi, A., and Zisserman, A. Deep face recognition. pp. 1–12. British Machine Vision Association, 2015.

Phillips, P. J., Flynn, P. J., Scruggs, T., Bowyer, K. W., Chang, J., Hoffman, K., Marques, J., Min, J., and Worek, W. Overview of the face recognition grand challenge. In *2005 IEEE computer society conference on computer vision and pattern recognition (CVPR'05)*, volume 1, pp. 947–954. IEEE, 2005.

Ringrose, K. Law enforcement's pairing of facial recognition technology with body-worn cameras escalates privacy concerns. *Va. L. Rev. Online*, 105:57, 2019.

Scherhag, U., Rathgeb, C., Merkle, J., Breithaupt, R., and Busch, C. Face recognition systems under morphing attacks: A survey. *IEEE Access*, 7:23012–23026, 2019.

Scheuerman, M. K., Paul, J. M., and Brubaker, J. R. How computers see gender: An evaluation of gender classification in commercial facial analysis services. *Proceedings of the ACM on Human-Computer Interaction*, 3(CSCW): 1–33, 2019.

Schroff, F., Kalenichenko, D., and Philbin, J. Facenet: A unified embedding for face recognition and clustering. In *Proceedings of the IEEE conference on computer vision and pattern recognition*, pp. 815–823, 2015.

Schwartz, A. Chicago's video surveillance cameras: A pervasive and poorly regulated threat to our privacy. *Nw. J. Tech. & Intell. Prop.*, 11:ix, 2012.

Sharif, M., Bhagavatula, S., Bauer, L., and Reiter, M. K. Accessorize to a crime: Real and stealthy attacks on state-of-the-art face recognition. In *Proceedings of the 2016 acm sigsac conference on computer and communications security*, pp. 1528–1540, 2016.

Smith, A. More than half of us adults trust law enforcement to use facial recognition responsibly. *Pew Research Center*, 2019.

van Heek, J., Arning, K., and Ziefle, M. The surveillance society: Which factors form public acceptance of surveillance technologies? In *Smart Cities, Green Technologies, and Intelligent Transport Systems*, pp. 170–191. Springer, 2016.

Viola, P. and Jones, M. J. Robust real-time face detection. *International journal of computer vision*, 57(2):137–154, 2004.

Wang, Y. and Kosinski, M. Deep neural networks are more accurate than humans at detecting sexual orientation from facial images. *Journal of personality and social psychology*, 114(2):246, 2018.

Wu, X. and Zhang, X. Automated inference on criminality using face images. *arXiv preprint arXiv:1611.04135*, pp. 4038–4052, 2016.

Zhu, X., Lei, Z., Yan, J., Yi, D., and Li, S. Z. High-fidelity pose and expression normalization for face recognition in the wild. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pp. 787–796, 2015.

Table 8. Ordered Logit Regression, weighted, dependent variable: social acceptance of FRT in public

ORDERED LOGIT REGRESSION, WEIGHTED, DV: SOCIAL ACCEPTANCE OF FRT (PUBIC)					
	TOTAL	CHINA	GERMANY	UK	US
AGE	0.00400**	0.00695	0.00042	0.00247	0.01023***
	(0.00180)	(0.00484)	(0.00358)	(0.00339)	(0.00366)
GENDER	-0.08896*	0.00598	-0.20971**	-0.10834	0.00739
	(0.04606)	(0.09362)	(0.09382)	(0.09307)	(0.09572)
EDUCATION					
MEDIUM	0.25815**	0.30059	0.51652***	0.00630	-0.34853
	(0.10351)	(0.24525)	(0.19545)	(0.17221)	(0.23558)
HIGH	0.49870***	0.60922**	0.59164***	0.31901*	-0.03548
	(0.11129)	(0.25556)	(0.22217)	(0.18750)	(0.25031)
PRIVACY THREAT					
MAYBE	-1.19227***	-0.88714***	-1.47814***	-1.25455***	-1.13848***
	(0.06499)	(0.12911)	(0.13558)	(0.12816)	(0.13783)
YES	-2.56136***	-2.05615***	-2.83184***	-2.73087***	-2.24377***
	(0.09095)	(0.19423)	(0.17812)	(0.19148)	(0.17547)
DON'T KNOW	-1.10769***	-0.61900***	-1.65456***	-1.14611***	-1.14786***
	(0.08928)	(0.18081)	(0.19379)	(0.18921)	(0.17015)
CONSEQUENCES					
CONVENIENCE	0.39866***	0.65575***	-0.21672*	0.61789***	0.48929***
	(0.05601)	(0.10862)	(0.12242)	(0.13169)	(0.11290)
PRIVACY VIOLATIONS	-0.47910***	-0.30679***	-0.51169***	-0.53786***	-0.50424***
	(0.05638)	(0.11384)	(0.11292)	(0.11722)	(0.11150)
EFFICIENCY	0.38049***	0.27139***	0.26869**	0.48286***	0.48989***
	(0.05647)	(0.10358)	(0.12690)	(0.11988)	(0.12034)
DISCRIMINATION	-0.39427***	-0.15615	-0.57354***	-0.29403**	-0.20140
	(0.07769)	(0.30014)	(0.14208)	(0.13921)	(0.14378)
SECURITY	0.71487***	0.77954***	0.90220***	0.61509***	0.62676***
	(0.05372)	(0.10211)	(0.10722)	(0.12419)	(0.11347)
SURVEILLANCE	0.15870***	-0.26568**	0.39048***	0.22459**	0.13438
	(0.04934)	(0.10949)	(0.10508)	(0.10463)	(0.09962)
NONE OF THE ABOVE	0.21330*	0.91277***	0.06282	0.22159	0.20214
	(0.11358)	(0.34577)	(0.25441)	(0.20607)	(0.20929)
ISSUE CONCERN					
VIOLATION OF RULES	0.06854	0.01662	0.15430	-0.06003	0.10645
AND REGULATIONS	(0.05191)	(0.10302)	(0.10442)	(0.11323)	(0.10658)
CRIME	-0.00350	0.01879	0.18941	-0.15639	0.00426
	(0.06169)	(0.11331)	(0.12497)	(0.13409)	(0.13524)
TERRORIST THREATS	0.27710***	0.05836	0.53743***	0.36463***	0.29392**
	(0.05478)	(0.11117)	(0.10782)	(0.11341)	(0.12003)
BORDER CONTROL	0.02710	0.05025	0.03798	0.09390	0.07452
	(0.05257)	(0.11220)	(0.11135)	(0.10449)	(0.10537)
SOCIALLY	0.17819***	-0.08294	0.36925***	0.14626	0.07795
UNACCEPTABLE BEHAVIOR	(0.05030)	(0.10296)	(0.10088)	(0.11036)	(0.11076)
NONE OF THE ABOVE	0.16217*	0.00412	0.32852*	-0.07788	0.35713*
	(0.09183)	(0.18155)	(0.17772)	(0.20161)	(0.19948)
CUT1	-2.45276***	-2.84157***	-2.28142***	-2.83727***	-2.32633***
CONSTANT	(0.15142)	(0.35387)	(0.29993)	(0.29328)	(0.32109)
CUT2	-0.90108***	-0.71077**	-0.74262**	-1.36520***	-0.83437***
CONSTANT	(0.14857)	(0.32728)	(0.29838)	(0.28760)	(0.31508)
CUT3	0.54876***	0.76550**	0.70624**	0.15652	0.62404**
CONSTANT	(0.14808)	(0.32551)	(0.29969)	(0.28672)	(0.31392)
CUT4	2.70489***	3.11178***	3.17540***	2.27897***	2.40178***
CONSTANT	(0.15249)	(0.33614)	(0.31234)	(0.29421)	(0.32154)
OBSERVATIONS	6633	1651	1677	1685	1620

STANDARD ERRORS IN PARENTHESES
P <0.10, ** P <0.05, *** P <0.01