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# User Expectations of Facial Recognition in Schools and Universities: Mixed Methods Analysis

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## ABSTRACT

This project explores the relationship between community perception, expectations, and experiences with privacy risk and facial recognition technology used in schools and universities. The methodology includes a meta-analysis of current literature and content analysis of social media content on the subject matter. The meta-analysis revealed that positive attitudes about facial recognition technology used in schools only reflect a portion of the total surveyed. A sentiment analysis of tweets about facial recognition technology used in schools and universities revealed that concerns skyrocketed in 2020, probably caused by the pandemic forcing courses and academic activity online, thereby heightening awareness about facial recognition technology and its implications. Tweets expressed concern about privacy, ethics, and data management. Negative emotion spiked in discussions about unrest and conflicts, possibly due to news about facial recognition used in crowd control. Concerns about power differentials spiked in conversations about how facial recognition would affect academics and education. The trends in attitudes directly pertain to current and projected problems and negative implications of facial recognition on vulnerable populations, including children, seniors, ethnic minorities, and transgender populations. The heterogeneity of the U.S. market requires sensitivity to issues of diversity, equity, and inclusion. Recommendations include operationalizing lessons learned from user experience research. Future studies should investigate trade-offs between privacy, safety, and autonomy.

**Keywords:** Facial recognition technology, Schools, Universities, Integrative review, Meta-analysis, Social media, Twitter, Sentiment analysis, Topic modelling, Text classification, Natural language processing

## INTRODUCTION

This project explores the relationship between perception, expectations, and experiences with risks and trustworthiness of facial recognition technology (FRT). It offers analyses of privacy attitudes—particularly those about applications on university and school campuses—using recent surveys and social media comments. It employs a framework derived from UX, beyond fairness, and decolonized data science to analyze the data to help focus on the human experience and social engagement in setting privacy policy and practice. The UX framework invites community participation in all stages of research and design. Beyond fairness is an emerging ethic framework revising

traditional approaches (that generalize and make presumptions from homogenous hypothetical premises and reinforce inherent inequities) and inviting ethical principles sensitive to real-world heterogeneity, outliers, and marginalization. Decolonized data science invites communities to lead discussions and set agendas about data collection, management, use, protection, security, and other parameters. All three influenced data analyses and reporting in this manuscript. This project will provide comprehensive public attitudes about using FRT in schools and universities.

## **BACKGROUND**

Prior studies have examined facial recognition technology's ethics, communication, and user-centeredness. Codes of ethics that govern professionals who use and create facial recognition technology hold the technology accountable for honoring human rights, consent, and accountability (Roundtree, 2022). FRT research that includes user testing has revealed that the FRT needs to be more accurate and often fails to meet sampling standards necessary for validating and generalizing findings, particularly about vulnerable populations such as young adults and marginalized groups (Roundtree, 2021a). The FRT software tested, study design, and topics covered in the literature left lingering questions about the technology's potential clinical and ethical applications. The literature overwhelmingly needed to address the complexities of facial change over time and the ethnicities that confound the accuracy of facial recognition software. Facial recognition bodes promising in scenarios that require identification validation, but human factors research and policy intervention is needed to improve their development and use. The research calls for FRT algorithms to be held accountable for transparency about errors and bias. The codes of ethics reflect the responsibilities required of FRT leadership, professional organizations, and professionals, but fewer expectations for the accuracy and external validity of the software itself. Partnerships with the FRT industry may help focus FRT technology design on user-centered concerns (Roundtree, 2021b). Ethics research usually makes the business, financial, and economic case for FRT, with limited discussions about the downsides or real-world cases of FRT successes and failures. According to the research, consumers weigh trade-offs between trust and convenience. The value of using FRT for safety in schools and health is often weighed against the risks of using visual data on minors and other vulnerable populations. What level of benefit was sufficient to outweigh risks remained a lingering question (Roundtree, 2021c). The technology has room for improvement in accuracy and precision in assessments of young adults and diverse populations. Developers and industry leaders must uphold FRT to fairness, responsibility, and transparency standards. Human-centered research on FRT has revealed that the development and testing of the technology could be expanded, as could the data sets used to test and refine the technology.

Other research in communication studies reveals more about regulations and public attitudes toward FRT in North America. FRT is underregulated, save for some state and local laws with limited regulatory protection (Rinkel & Reid, 2023). There is tension between freedom of speech and personal,

private data—rules that protect first amendment rights versus those that would impose restraints on how FRT is used. The spectrum of possible regulation ranges from an FRT moratorium to regulations allowing states to impose FRT use requirements. First Amendment challenges are the least likely to impose an actual restraint on technology use. Two surveys of the U.S. public found that political ideology, trust in and deference to government and science, and beliefs about police predict FRT attitudes, as do factors such as crime television viewing (Brewer et al., 2021). Suspicion of police and government corresponded to negative FRT attitudes, and trust in science and police corresponded to positive FRT attitudes. A case study of FRT use by police in Canada found that use violated regulations by using images without consent (Gildaris, 2023). The study discussed how privacy protections should include changes to different aspects of culture and life, including selfies, smartphone use, and phone upgrades and backups. Other vectors, such as attitudes about the government and police, inform public perception of FRT. Regulation should reflect the public's interest and attitudes. Questions persist regarding public perception of FRT in school and university settings, particularly in self-reporting scenarios such as surveys and in settings such as social media content.

Prior studies also examined facial recognition technologies in school and university settings. The literature does not document the pervasive use of FRT in school and university settings. Instead, most of the literature reports alpha and beta tests of small-scale, short-term implementations and shares the hypothetical benefits of widespread, long-term implementations. Studies report FRT to use in schools to save time and repetitiveness of taking attendance, student and campus security and safety from predators, and identification verification as a part of two-step authentication processes, registration, and participation in school activities (de Azevedo et al., 2022; Pimpan & Chorus, 2021; Hammash, 2022; Ratanaubol et al., 2020; Alghamdia et al., 2020; Pillay and Adebajo 2022, La et al. 2020). These systems automate other mundane tasks, such as email alerts about absences. The justification for testing and developing these systems included providing convenience, time-saving, accuracy, and safety. However, the studies indicate that such systems, real or hypothetical, would require training on standardized photos and good lighting to map faces and make differentiations in cases such as twins.

Existing studies on pilot implementations of FRT in schools and universities also often did not report samples or populations where these technologies were tested, leaving lingering questions about the generalizability of their findings. Furthermore, the systems faced false positives and negatives, even when the sample was small and relatively homogeneous (Hammash, 2022). There were also limitations with insufficient image resolution and quality, particularly cameras in public spaces and crowds or groups (Ratanaubol et al., 2020). The specter of real-world implementation of these technologies raises concerns about privacy, civil liberties, constant surveillance, and data misuse (Levy, 2010; Godett & Eckes, 2020). Other hypothetical implementations included using FRT to detect levels of engagement in learning. However, such prospective implementations are controversial given the variety of facial

and cultural variables that would make standardizing such subjective implementations difficult and inaccurate, if not impossible (Andrejevic & Selwyn, 2019). Expansion of FRT implementations into subjective assessments such as engagement threatens dehumanizing students, discriminating against vulnerable populations (i.e., minorities, LGBTQ+, etc.) for whom FRT has proven less than accurate and precise, invading the right to be forgotten and obscure, the increase of authoritarianism and automation to the detriment of autonomy and personal and civil liberties. Questions linger about whether the issues FRT is meant to resolve in school and university settings are severe enough to warrant FRT and the trade-offs and risks they present. Current installations provoke potential violations of fourth amendment rights to privacy, and some implementations have been halted due to unconstitutionality and potential FERPA violations (LoSardo, 2019). There is a lack of regulation and protocols necessary for ensuring best practices. Such regulations are essential to promote safety and privacy.

Two studies did ask students themselves their impressions of FRT. One study surveyed 62 high school students' attitudes regarding FRT being deployed on campus (Ebsary, 2018). The student had concerns about efficacy, safety, and privacy. Most students felt that FRT is restrictive (33.9%), possibly acceptable for use at school entrances (37.7%), but uncertainly good for security (51.6%). They were also very concerned about improper data storage and use (59.7%). Most wanted the ability to opt out of FRT use and data storage (56.4%). They felt it generally appropriate to use FRT to monitor campuses for unauthorized people (36.8%) and for verifying their identity (62.1%) and surveillance (56.4%), but are suspicious of school administration using the data for punishment purposes (56.4%). Most students were white (45.2%) or Asian/Pacific Islander (24.2%) and male (64.5%), ages 16 to 18 (83.9%). In another interview and cast study, eight participants at a public university shared their experiences and concerns regarding a pilot implementation of FRT (Fu & Lyu, 2022). Initial impressions ranged from discomfort, confusion, avoidance, and protests about FRT, to concerns about the decision-making processes that FRT will inform and upon which FRT will be implemented. The small sample size makes it difficult to generalize the findings. This study extends these findings by assessing the attitudes of a broader range of public participants.

## METHODS

The methodology includes an integrative review and meta-analysis of current surveys on the subject matter. It also includes an analysis of tweets about the subject matter.

A meta-analysis of public opinion surveys provides insight into attitudes toward facial recognition in the United States. In the context of existing knowledge, this study aggregates public opinion representing several more opinions than preliminary studies reported in the background section. Information sources included original survey citations from the past ten years, dating from 2013 to 2023. Databases used included Google Scholar, Google, Scopus, ScienceDirect, Elsevier, Web of Science, PubMed, ERIC, IEEE Xplore,

JSTOR, and ACM. Keyword terms included survey, questionnaire, public, perception, attitudes, facial recognition, and facial recognition technology, among others, searched in titles and abstracts to identify articles where the keywords were the main focus. We included surveys reporting public perception. Surveys were excluded if they did not report perceptions of school or university FRT use. Inclusion criteria specified surveys published between 2010 and 2023. Reviews took place in two rounds by two reviewers. All results reported were compatible regarding the questions answered, and five-point Likert scales were converted to 3-point Likert scales for reporting (positive, neutral, or negative). Consensus determined study inclusion and data synthesis. Missing summary statistics and heterogeneous (mismatching) survey questions were excluded from the meta-analysis. Descriptive statistics were used to combine results using Excel formulas.

Natural language processing methods were applied to analyze social media content about FRT use in universities. Twitter advance search was enlisted using the keywords above (excluding the generic term schools). We followed guidelines for APIs. We used descriptive statistics about the results. One human annotator checked the sample and computer-aided results. We anonymized all data and findings and will redact full quotes for privacy. No personal data, intellectual property, or confidential data was collected. We used Orange.si, LIWC, and Text Analytics for text categorization and topic modeling. Orange is an open-source machine learning and data visualization software. LIWC, or Linguistic Inquiry and Word Count, analyses language to understand thoughts, feelings, personality, and sentiment. Text Analytics uses natural language processing and machine learning to categorize text.

## RESULTS

The search yielded 21 surveys. Some surveys contained demographic information, but some did not; therefore, this analysis does not include demographics. A public opinion survey meta-analysis provides insight into attitudes about facial recognition in the United States. Pew Research, Schoen Cooperman Research for the Security Industry Association, Nature, the Brookings Institute, *The Standard*, and Survey Monkey, among others, conducted surveys. Of all 21, most were published by organizations ( $n = 8$ ), corporations ( $n = 5$ ), news outlets ( $n = 4$ ), and peer-reviewed journals ( $n = 3$ ). A total of 59,307 participants were included in these surveys.

Five of the 21 surveys contained questions regarding FRT use in schools and universities (Capers, 2020; Huang, 2022; Rainie et al., 2022, Security Industry Association, 2020, West, 2018). Of these five surveys, non-profit organizations published three, and corporations published two. The total number of participants in these five surveys that asked school- and university-related questions was 16,202. Two surveys included a question about FRT in schools (grades K to 12), including 3,000 participants; only 18.5% of the participants asked school- and university-related questions. About half of the participants in the two surveys (50%,  $n = 1490$ ) were positive about using FRT in schools. About a third (32%,  $n = 960$ ) were negative, and about a fifth (18%,  $n = 550$ ) were neutral. Two surveys included a question about FRT

in universities, including 1487 participants, reflecting only 9% of the total participants who answered school- and university-related questions. About half (52%,  $n = 775$ ) of these were positive about using FRT in university settings. About a third (34%,  $n = 513$ ) were negative, and about a tenth (13%,  $n = 199$ ) were neutral. Three surveys included a question about FRT being used in stadiums (a feature of both schools and universities), including 14,715 participants, reflecting 91% of the participants who answered school- and university-related questions. Of these, about half were positive about using FRT in stadiums (53%,  $n = 7836$ ). Almost half were either neutral or negative (47%,  $n = 6879$ ). In this case, one survey report aggregated neutral and negative; all were reported accordingly.

The percentages are smaller in light of the total number of participants in all five surveys. See Table 1.

The meta-analysis of public opinion surveys on public attitudes toward facial recognition revealed mixed attitudes about facial recognition used in schools and university settings. It only reflected a small proportion of the total participants surveyed. In aggregate, the trends reveal lingering questions. The studies reported various positive attitudes about using facial recognition in school and university settings. However, these findings only reflect a small number of all participants surveyed.

A sentiment analysis of 7184 tweets about facial recognition used on university campuses revealed that negative sentiment increased in 2020, probably caused by the pandemic forcing courses and academic activity online, heightening awareness about facial recognition technology and its implications. See Figure 1. Social media content expressed concern about protecting privacy ( $n = 687$ ) and compromising rights on campus ( $n = 364$ ). Negative content included words about unrest and conflicts, possibly due to news about facial recognition being used in crowd control during protests. There were concerns about power differentials in how facial recognition would affect academics and education, labor, politics, social issues, and unrest. See Figure 2. The trends in attitudes directly pertain to current and projected problems and negative implications of facial recognition on vulnerable populations, including children, seniors, ethnic minorities, and transgender populations.

**Table 1.** Survey findings.

Category	Citations	n	Subtotal	Subtotal %	All % ( $n = 16,202$ )
School+	SIA, West	1490	3,000	50%	9%
School-	SIA, West	960	3,000	32%	6%
School=	SIA, West	550	3,000	18%	3%
University+	Capers, SIA	775	1487	52%	5%
University-	Capers, SIA	513	1487	34%	3%
University=	Capers, SIA	199	1487	13%	1%
Stadiums+	Huang, Rainie, et al., West	7836	14,715	53%	48%
Stadiums=	Huang, Rainie, et al., West	6879	14,715	47%	42%

Key: +positive, -negative, =neutral

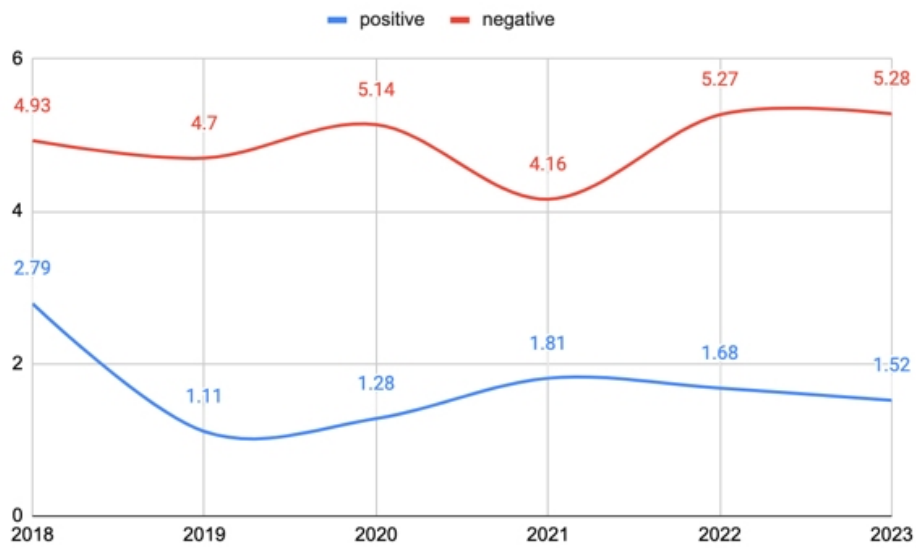


Figure 1: Overall sentiment.

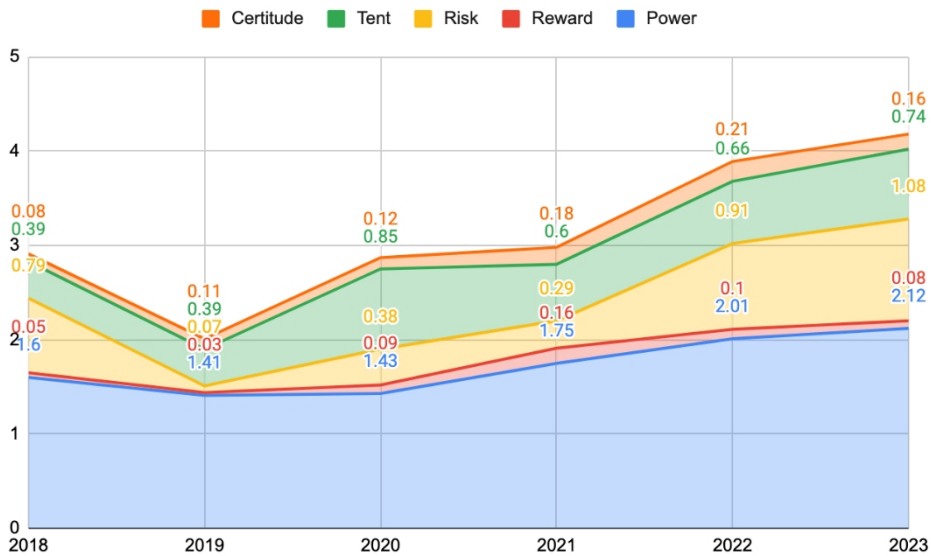


Figure 2: Certitude, tentativeness, risk, reward, and power dynamics.

Analysis of social media content about facial recognition on college and university campuses posted from 2018 to 2023 provided insights. Negative tweets about facial recognition on campus rose in 2020 and 2022, probably caused by the pandemic forcing courses and academic activity online, thereby heightening awareness about the technology and its implications. Positive sentiment increased in 2021, and negative emotions (including anger and anxiety) decreased. Topics included mentions of surveillance (n = 850), security (n = 632), police (n = 460), ethics (n = 418), law (n = 501), and

access control ( $n = 351$ ) surrounding FRT. There were mentions of banning facial recognition in schools and universities ( $n = 475$ ). There were mentions of FRT compromising civil liberties and individual rights ( $n = 364$ ). They mentioned concerns about FRT used to identify students instead of suspects. Mentions of law and privacy increased over time, as did mentions of surveillance and FRT reliability. Over the years, social media content tended to increase discussions about the power dynamics of facial recognition, even while the discussion of rewards and risks of facial recognition evened out. Tweets became more tentative about facial recognition over the years. Concerns about power differentials spiked in conversations about how facial recognition would affect academics, education, labor, politics, social issues, and unrest.

Statements with certitude about FRT in schools and universities varied but grew from 2018 to 2023. See Figure 2. However, tentative statements about FRT in schools and universities increased over time and remained larger than statements with certitude. Furthermore, statements about risk increased over time, while statements about reward remained low or decreased. Overall, power differentials were a reoccurring sentiment. Questions and statements about power (i.e., the power of FRT, who has authority over FRT, and the power to opt out of FRT) persisted and were the most prominent sentiment.

Topic modeling and categorization revealed several domains of interest. See Table 2. Social media content discussed the politics of FRT used in schools and universities ( $n = 2351$ ). Terms unique to the politics category include access control and ethics of using FRT in schools and universities. News about FRT in schools and universities was also a topic of discussion ( $n = 2081$ ), such as using FRT for booking services and activities such as sections of classes. FRT as a computer application ( $n = 600$ ) and as a technology ( $n = 593$ ) used in schools and universities was also discussed, particularly in authentication, verification, security steps for managing remote work and remote classes, and time savings in tracking students for attendance. Using FRT at stadiums during sports events, at recess, and other leisure related to schools and universities was also mentioned ( $n = 909$ ), particularly in the context of surveillance for security purposes. Similar discussions emerged around governmental ( $n = 331$ ) and social ( $n = 218$ ) intervention in FRT used in schools and universities regarding FRT systems ensuring public safety and detecting weapons and suspects. Finally, discussions about bans and protests at particular schools and universities in Michigan, China, and other location-specific stories also emerged ( $n = 398$ ).

Term or mention frequency parallels topic modeling. See Table 3. The most common terms included concerns, statements, and questions about FRT use ( $n = 1794$ ), FRT as artificial intelligence ( $n = 1672$ ), and how FRT manages data ( $n = 1098$ ). Privacy ( $n = 823$ ) and surveillance ( $n = 899$ ) were the subsequent most common mentions. Also, while there were mentions of FRT being used for security purposes ( $n = 625$ ), there were also questions, comments, and concerns about the ethics of using FRT in schools and universities ( $n = 409$ ).



**Table 2.** Topic modelling and categorization.

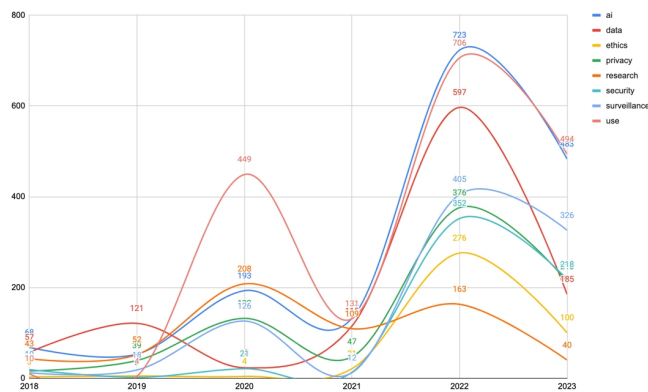
Topic	Mentions	Coherence	Unique Identifiers
Politics	2351	0.7	access control, advocates, artificial intelligence, ethical
News	2081	0.7	booking
Computers	600	0.77	management, reasons, reliability, remote workers, save time, tracking
Leisure	909	0.78	physical security, video surveillance
Tech	593	0.79	authentication, biometric security, cyber security, aim, verification
Education	398	0.8	ban, discipline, Michigan, protesters, schools
Government	331	0.8	public safety
Society	218	0.79	digital displays, retail tech, store as a medium, systems, weapon detection

Key: +positive, -negative, =neutral

**Table 3.** Most mentioned terms.

	2018	2019	2020	2021	2022	2023	total
artificial intelligence	68	53	193	132	723	483	1652
data	57	121	23	115	597	185	1098
ethics	3	5	4	21	276	100	409
privacy	16	39	132	47	376	213	823
research	43	52	208	109	163	40	615
security	19	2	21	13	352	218	625
surveillance	12	18	126	12	405	326	899
use	10	4	449	131	706	494	1794

Over time, mentions of these key terms grew. See Figure 3. Particularly mentions about FRT being an artificial intelligence (and inheriting the issues



**Figure 3:** Most mentioned terms.

and concerns about AI) grew almost seven times from 2021 to 2022. Questions, comments, and Mentions of how FRT manages data grew almost five times from 2021 to 2022. Comments about the ethics of FRT grew about ten times from 2021 to 2022. Comments about privacy grew almost nine times from 2021 to 2022. Questions, comments, and concerns about FRT used for security grew almost 27 times from 2021 to 2022. Any questions, comments, and concerns about FRT being used for surveillance grew 33 times from 2021 to 2022. Comments about the need for or publication of FRT research grew less (about 0.5 times) from 2021 to 2022.

## **CONCLUSION**

The findings from each analysis provide a rich network of insights. Quantitative findings provided a wide-range baseline measure of public opinions. In aggregate, survey findings reported various positive attitudes about using facial recognition in school and university settings. However, these findings only reflect a small number of all participants surveyed. Social media findings helped provide more context for the quantitative findings. Negative sentiment remained consistently higher than positive from 2018 to 2023, as did tentativeness (more than certitude) and discussions about the power and authority of and over FRT. The risk was also a more common point of discussion than the rewards of FRT. Topic modeling also reveals that politics and news about FRT were the most common topics, as were FRT as a technology for remote work and class, as well as for sports events and leisure activities at schools and universities. However, bans and protests against FRT applications in schools emerged as a less common but still coherent topic. Finally, FRT was increasingly associated with artificial intelligence (pros and cons). Questions, comments, and concerns about FRT used for surveillance and security grew over time, as did, to a lesser extent, questions about the ethics of using FRT in schools and universities. The combination shows that even though safety and security are compelling messages in deliberations about FRT used in schools and universities, tentativeness emerged across all domains, as did discussions of risks over rewards.

The findings enrich conclusions from prior research. Codes of ethics might need to reflect the unique nuances of each setting where FRT is deployed. Superficial public concerns about the fairness and accuracy of FRT parallel some of the issues reflected in the media and research regarding FRT's false positives and negatives. Public tweets mentioned did not mention company names, so awareness of industry expectations and advancements might be low. However, almost half of the surveys were commissioned by industry, so findings might reflect a bias. Furthermore, questions and conversations lingered regarding data management ethics and using FRT for school and university surveillance. Ethical questions remain regarding the trade-offs between security, safety, surveillance, privacy, and ethics regarding FRT used in schools and universities. Policies still do not regulate or help ensure fairness, transparency, integrity, safety, and responsibility of the technology. All agents involved--developers, industry leaders, and the artificial learning models they create--must be fair, responsible, safe, and transparent.

Future studies should examine real-world longitudinal cases of FRT implemented in schools to gain a better perspective on the wide adoption of the technology in schools and universities. Future studies should also weigh the trade-offs or ask the public to interview or survey the public to describe the critical inflection points and trade-offs that ensure their trust in the technology. These policies must account or address account for or address privacy, ethics, and responsible data management that gives the public some autonomy over their participation in testing, training, and implementation. Any literature or studies published about the pilot use of FRT in schools and universities should report the software's benefits, risks, limitations, and weaknesses. Given the levels of tentativeness and questions about risk over reward, it will become necessary for public policymakers and others, human and other human referees, to have an integral role in RT deployment to ensure checks, balances, and fairness before widespread use.

More discreet testing and training are necessary *in situ*, and human factors and user-centeredness should be the guiding or governing principles. User testing should include more than just the practitioners deploying the technology. It should also include the publics and groups upon whom the technology will be trained. FRT used in schools and universities must not violate existing privacy policies, laws, and regulations, especially in school and university settings. However, given the tentativeness of the public that might require additional levels of regulation and expectation formalized into policy and law, as the literature itself reveals to a limited extent, student concerns about efficacy, safety, privacy, and deployment in intimate settings like classrooms as well as concerns about data, privacy, ownership, and management.

Recommendations for best practices must attend to lessons learned from user experiences, perception, and ethics of deployment in vulnerable populations such as children, seniors, and marginalized groups, including black, brown, and transgender populations. Questions linger about the bigger picture of privacy, bias, safety, and autonomy in new technology in preliminary findings, particularly regarding vulnerable populations. The heterogeneity of the U.S. market requires sensitivity to issues of diversity, equity, and inclusion. Systems engineers and others are beginning to understand humans' role in technology systems. The core challenge is to balance successful hardware and software solutions with human-friendly implementations.

The trends in attitudes directly pertain to current and projected problems and negative implications of facial recognition on vulnerable populations, including children, seniors, ethnic minorities, and transgender populations. Best practices must attend to lessons learned from user experiences, perception, and ethics of deployment in vulnerable populations such as children, seniors, and marginalized groups, including black, brown, and transgender populations. Questions of bias, safety, and autonomy persisted in preliminary findings, particularly regarding vulnerable populations. The heterogeneity of the U.S. market requires sensitivity to issues of diversity, equity, and inclusion. Limitations of this study include the constraints that Twitter imposes on tweet collection, redacting full quotations to respect best practices in internet research methodologies and respect of human subjects, inability to collect the entire year of 2023 data, and limitations inherent to natural language

processing software chosen for the project. Despite these limitations, the article uses mixed methods to verify and reveal valuable insights into the nuances of public attitudes about FRT used in schools and universities. Future studies should explore the value systems underpinning trade-offs between surveillance and privacy, as well as real-world applications, to assess the strengths and weaknesses of FRT in schools and universities.

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