**Journal of Law, Psychology, and Communication Studies**
*An Interdisciplinary Journal Bridging Legal, Psychological, and Communicative Research*

# AI-driven Content Recommendation Systems for Children: Privacy Protection and Algorithm Governance in TikTok

*Hongqiang Zhao* [1], *Zhen Cao* [2*], *XinCheng Li* [2]

[1] Henan Mudu Law Firm, 471500, Luoyang, China

[2] Faculty of Law, University of Malaya, 50603, Kuala Lumpur, Malaysia

## Abstract

*This paper examines the dual framework of privacy protection and algorithm governance in AI-driven content recommendation systems targeting children on short video platforms, with a specific focus on TikTok. As the platform increasingly shapes children's digital experiences through personalized content recommendations, significant concerns regarding children's privacy rights, safety, and developmental wellbeing have emerged. Through an in-depth analysis of TikTok's "For You" algorithm, this research investigates the regulatory landscape, ethical considerations, and technical implementations. The paper analyzes TikTok's privacy protection measures and algorithm design choices, evaluates their effectiveness through the lens of regulatory compliance and child safety, and examines key regulatory actions including the landmark COPPA enforcement cases of 2019 and 2024. The findings suggest that effective protection requires a multi-stakeholder approach combining technical safeguards, industry self-regulation, enhanced regulatory oversight, and algorithm literacy development. This paper contributes to ongoing discourse on ethical AI development in recommender systems for children and provides actionable recommendations to ensure that AI-driven recommendation systems respect children's privacy while delivering age-appropriate content.*

***Keywords:*** *children's privacy, AI governance, TikTok algorithm, digital rights, algorithm literacy*

**DOI:** 10.63802/jlpcs.v1.i1.31

Corresponding author: Zhen Cao; e-mail: thxwu17@163.com

## Introduction

The rapid proliferation of short video platforms has fundamentally transformed how children consume digital content. TikTok has become an integral component of children's daily media consumption, with its sophisticated recommendation algorithm curating personalized content streams that continuously adapt to children's viewing patterns and preferences. According to recent data, children between the ages of 4 and 15 spend an average of 80 minutes daily on TikTok alone (Vogels et al., 2022). The platform's unprecedented ability to capture and maintain children's attention stems largely from its advanced AI-driven recommendation system.

TikTok's content recommendation algorithm, commonly known as the "For You" algorithm, functions primarily through a sophisticated hybrid approach combining collaborative filtering with content-based filtering techniques (Zhou, 2024). While collaborative filtering suggests content based on similar users' preferences, content-based filtering recommends videos similar to those previously engaged with by the user. Recent research has found that between one-third to half of the first 1,000 videos shown to new users are selected based on TikTok's predictions of their preferences (Roesner, 2024). This capability to rapidly build detailed user profiles from minimal interaction signals distinguishes TikTok from traditional social media platforms.

While this technology enhances user experience through personalization, it simultaneously raises profound questions regarding children's privacy, autonomy, and vulnerability to exploitation. The recommendation system requires vast amounts of personal data collection, processing, and profiling to function effectively—processes that present unique risks when applied to children who may lack the capacity to provide informed consent or understand the implications of their digital footprint.

The current regulatory landscape addressing children's privacy and digital rights primarily consists of legislation such as the Children's Online Privacy Protection Act (COPPA) in the United States and the General Data Protection Regulation (GDPR) in Europe. These frameworks establish baseline requirements for the collection and processing of children's personal information, but they were largely developed before the emergence of sophisticated AI recommendation systems on short-form video platforms, creating significant gaps in protection (Federal Trade Commission, 2020). Recent high-profile enforcement actions, such as the FTC's $5.7 million settlement with TikTok (then Musical.ly) in 2019 and the subsequent August 2024 lawsuit alleging continued COPPA violations, highlight the growing recognition that existing protections may be insufficient in the algorithmic age (FTC, 2019; DOJ, 2024).

This paper examines the intersection of children's privacy rights and AI governance in TikTok's recommendation system. It investigates the technical functioning of the "For You" algorithm, analyzes its impact on children's privacy and wellbeing, evaluates current regulatory approaches, and proposes a comprehensive governance framework to address existing gaps. The research also introduces the concept of algorithm literacy as a critical

component for empowering children in algorithmic environments. By synthesizing technical, legal, ethical, and developmental perspectives, this research aims to contribute meaningful solutions to one of the most pressing digital rights challenges of our time: ensuring that AI-driven recommendation systems respect children's privacy while providing age-appropriate content in an increasingly algorithmic media environment.

## Literature Review

### Children's Privacy in the Digital Age

The concept of children's privacy in digital environments has evolved significantly over the past two decades. Early frameworks focused primarily on parental consent mechanisms and explicit data collection practices (Montgomery & Chester, 2015). However, as AI technologies have become more sophisticated, scholars have identified three main categories of privacy concerns specific to children in algorithmic environments: data risks, function risks, and surveillance risks (Office of the Privacy Commissioner of Canada, 2021). Data risks involve the extensive collection of children's personal information, while function risks relate to how AI systems use this data to make decisions that impact children's digital experiences. Surveillance risks encompass the continuous monitoring of children's behaviors, both online and offline, as facilitated by AI systems.

The vulnerability of children in digital contexts has been well-documented. Research by Livingstone and Stoilova (2021) demonstrates that children have limited understanding of how their data is collected and used by platforms, particularly in relation to recommendation algorithms. This information asymmetry is compounded by children's developmental characteristics, including their susceptibility to persuasive design elements and tendency toward impulsive decision-making (UNICEF, 2019). These vulnerabilities place children at particular risk in environments where recommendation algorithms are designed to maximize engagement rather than prioritize wellbeing.

A growing body of research also suggests that current protection mechanisms, such as age verification systems and parental consent requirements, are often ineffective. Reyes et al. (2018) found that 73% of Android applications popular with children transmitted sensitive data to third parties, often in violation of existing privacy laws. Additionally, the reliance on parental consent models has been criticized for creating barriers to children's autonomous media use while simultaneously failing to provide meaningful protection (Barassi, 2020).

### TikTok's "For You" Algorithm and Its Impact on Children

TikTok's "For You" algorithm represents one of the most sophisticated and influential recommendation systems in the social media landscape. Unlike traditional recommendation algorithms that rely heavily on explicit user choices and social connections, TikTok's system has several distinctive features that affect how children interact with the platform. According to Zhou (2024), the algorithm employs a hybrid approach combining content-based filtering

with collaborative filtering, but places unusual emphasis on implicit behavioral signals captured through granular interaction data.

The technical architecture of TikTok's algorithm involves multiple components working in concert. First, candidate generation algorithms identify potentially relevant videos from the platform's vast library. Ranking algorithms then score these candidates based on predicted user engagement. Finally, filtering mechanisms remove inappropriate content or add diversity to recommendations (Zhou, 2024). Recent empirical investigations have determined that the follow feature has the strongest influence on recommendations, followed by the like feature and video view duration (Sch et al., 2022). What distinguishes TikTok's approach is its rapid adaptation to user behavior; the system can build detailed preference profiles from minimal interaction signals, often within a single viewing session (Bhandari & Bimo, 2022).

Several characteristics of TikTok's recommendation system have particular implications for children. First, the brevity of content (typically 15-60 seconds) enables rapid collection of engagement signals, allowing for more immediate algorithm adaptation (Taylor & Choi, 2022). Second, the continuous feed design, which automatically plays the next recommended video, reduces friction in consumption and may diminish children's agency in content selection (Lee et al., 2022). Third, the algorithm creates what researchers have termed "rabbit holes" of content—a phenomenon where initial engagement with certain topics triggers algorithmic amplification that rapidly narrows content recommendations to increasingly focused and potentially problematic streams. This effect can quickly lead children to age-inappropriate material or create harmful filter bubbles that limit exposure to diverse content.

Research has identified concerning patterns in how the TikTok algorithm responds to children's usage patterns. A technical investigation by the Center for Countering Digital Hate found that changing a user's name from "Sarah" to "Sarah Lose Weight" resulted in 12 times more self-harm content being shown to that user (Rawlinson, 2023). Another study by Amnesty International and the Algorithmic Transparency Institute (2023) found that after 5-6 hours on the platform, almost half of the videos shown to research accounts mimicking 13-year-olds were mental health-related and potentially harmful—roughly ten times the volume served to accounts with no interest in mental health content. Even more concerning, the study found that between 3 and 20 minutes into manual research sessions, more than half of the videos in the "For You" feed were related to mental health struggles, with multiple videos recommending potentially harmful content in a single hour.

This research suggests that TikTok's algorithm may amplify potentially problematic content based on brief engagement signals from child users, potentially exposing them to age-inappropriate material or creating problematic filter bubbles. The rapid adaptation of the algorithm to user signals raises questions about children's capacity to make informed choices about their content consumption when the system is designed to maximize engagement rather than promote wellbeing.

**Regulatory Approaches to Children's Privacy on TikTok**

The regulatory landscape governing TikTok's practices with respect to children is complex and evolving. In the United States, COPPA represents the primary federal framework addressing children's online privacy. Enacted in 1998 and revised in 2013, COPPA requires operators of websites and online services directed at children under 13 to obtain verifiable parental consent before collecting personal information, implement reasonable security procedures, and provide parents with the ability to review and delete children's information (FTC, 2020).

TikTok's relationship with COPPA compliance has been contentious. In February 2019, the FTC announced a settlement with Musical.ly (which had been acquired by ByteDance and rebranded as TikTok) for $5.7 million—at that time, the largest civil penalty in a children's privacy case (FTC, 2019). The settlement alleged that the platform violated COPPA by collecting personal information from children under 13 without parental consent, even though many accounts contained obviously underage users and the platform received thousands of complaints from parents. The consent decree required TikTok to comply with COPPA going forward and delete all personal information for users under 13.

Despite this settlement, concerns about TikTok's practices continued. In August 2024, the Department of Justice, acting on behalf of the FTC, filed a lawsuit against TikTok and ByteDance alleging continued "flagrant" violations of COPPA and the 2019 consent order (DOJ, 2024). The lawsuit claimed that TikTok knowingly allowed millions of children under 13 on the platform, collected their personal information without parental consent, and failed to delete children's information when requested by parents. According to the complaint, TikTok's human reviewers spent an average of only 5-7 seconds reviewing accounts suspected of belonging to children under 13, and the platform built "back doors" into its age verification mechanisms that allowed children to bypass restrictions (FTC, 2024).

The 2024 lawsuit also alleged that even TikTok's "Kids Mode," specifically designed to comply with COPPA, collected "far more data" than needed, including information about users' in-app activities and identifiers that TikTok used to build profiles and shared with third parties to increase engagement among less active users (DOJ, 2024). The lawsuit seeks civil penalties of up to $51,744 per violation per day, which could amount to billions given the scale of the alleged violations (DOJ, 2024).

In Europe, TikTok's practices have faced scrutiny under the GDPR, which provides broader protections for all data subjects but includes specific provisions for children. Article 8 requires parental consent for processing children's data (with age thresholds ranging from 13-16 depending on the member state), while Article 12 mandates that privacy notices be presented in clear, child-appropriate language. In 2021, the Irish Data Protection Commission opened an investigation into TikTok's processing of children's data, focusing on age verification measures and the platform's information practices (DPC, 2021).

Beyond these major regulatory frameworks, a significant development has been the implementation of the European Digital Services Act, which specifically addresses algorithm governance and content recommendation systems targeting minors (European Commission,

2023). This legislation represents a more comprehensive approach to platform regulation that goes beyond data protection to address algorithmic design and transparency requirements.

**Ethical Frameworks for Child-Focused AI Systems**

Ethical considerations specific to AI systems targeting children have emerged as a critical area of research. Jobin et al. (2019) identified 11 common ethical principles across 84 AI ethics guidelines: transparency, justice and fairness, non-maleficence, responsibility, privacy, beneficence, freedom and autonomy, trust, sustainability, dignity, and solidarity. While these principles provide a foundation for ethical AI generally, additional considerations arise in child-focused contexts.

Research by Milkaite and Lievens (2020) highlights the need for "age-appropriate AI" that considers children's developmental stages and vulnerabilities. This approach emphasizes that ethical AI for children must go beyond protecting privacy to actively promoting children's rights to development, education, and play. Similarly, the IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems has developed specific recommendations for AI systems used by children, emphasizing the importance of transparent design, developmentally appropriate interfaces, and safeguards against manipulation (IEEE, 2019).

UNICEF's AI for Children project proposes nine requirements for child-centered AI: support children's development and well-being, ensure inclusion and equity, protect children's data and privacy, ensure safety for children, provide transparency, empower governments and businesses, prepare children for present and future developments, create an enabling environment, and put children at the center (UNICEF, 2019). These frameworks collectively suggest that ethical AI for children must balance protection with empowerment, recognizing children as rights-holders with evolving capacities rather than merely vulnerable subjects.

Several ethical tensions specific to recommendation systems have been identified in the literature. First, the fundamental business model of many platforms relies on maximizing engagement, creating potential conflicts with children's best interests (Zuboff, 2019). Second, personalization of content may conflict with children's right to access diverse information and develop autonomous preferences (Kidron et al., 2018). Third, the use of persuasive design elements within recommendation systems may exploit children's developmental vulnerabilities, raising questions about manipulation and fairness (Albuquerque et al., 2021).

**Algorithm Literacy and Children's Understanding of Recommendation Systems**

Recent scholarship has emphasized the importance of algorithm literacy as a critical component for empowering children in algorithmic environments. Algorithm literacy refers to individuals' awareness and understanding of how algorithms function and influence their online experiences (Dogruel et al., 2022). This emerging field has particular relevance for children navigating recommendation systems like TikTok's "For You" algorithm.

Research by Schulz et al. (2024) has shown that children make sense of algorithmic recommendations in complex ways, considering their networked, affective-involving, and

economic-commercial character. This indicates that even young children develop an awareness of algorithmic influences, though their understanding may be incomplete or fragmented. Such research challenges the assumption that children are passive consumers of algorithmic content, suggesting instead that they actively interpret and navigate these systems based on their developing cognitive capacities.

Age significantly influences the development of algorithmic skills and problem-solving strategies (Adorni et al., 2024). Younger children typically possess more limited algorithm literacy and may struggle to identify when their digital experiences are being shaped by algorithmic processes. This developmental limitation underscores the importance of age-appropriate design for recommendation systems targeting children as well as educational approaches that foster algorithm literacy from an early age.

The development of algorithm literacy offers a promising complement to technical safeguards and regulatory approaches. By enhancing children's understanding of how recommendation algorithms function, algorithm literacy initiatives may help children become more critical and selective in their content consumption. Such initiatives align with broader digital literacy efforts but focus specifically on the unique challenges posed by algorithmic environments.

## Methodology

This research employs a multi-faceted methodological approach to comprehensively examine TikTok's recommendation system, its impact on children, and the relevant privacy protection and governance frameworks. The methodology integrates technical analysis, regulatory review, and case study components to develop a holistic understanding of the issues.

### Technical Analysis of TikTok's Recommendation System

To understand the technical functioning of TikTok's "For You" algorithm, this research combines analysis of public documentation, technical papers, and reverse engineering studies. The analysis focuses on data collection practices, algorithm components, optimization metrics, and content classification systems that comprise the recommendation ecosystem.

This technical assessment draws primarily on published research about TikTok's algorithm, including Zhou's (2024) analysis of its recommendation mechanisms, as well as TikTok's own public disclosures about its algorithm functioning. We also incorporate findings from University of Washington researchers who studied the platform's algorithm by analyzing data donated by 347 TikTok users, encompassing 9.2 million video recommendations (Roesner, 2024). This data donation methodology provides rare empirical insight into TikTok's algorithmic "black box."

Additionally, third-party research by organizations such as the Algorithmic Transparency Institute provides independent assessment of how the algorithm affects content delivery to younger users. These multiple sources of technical information allow for triangulation of findings about the algorithm's functioning and impact.

**Regulatory and Legal Analysis**

To establish the regulatory context, this study conducted a systematic analysis of key legislation, regulations, and enforcement actions related to TikTok's privacy practices and algorithm governance with respect to children, including:

1. **COPPA and Related FTC Actions**: Analysis of the 2019 settlement and 2024 lawsuit against TikTok for alleged COPPA violations, with particular attention to evidence of technical implementation failures and continued data collection practices in children's environments.
2. **GDPR and European Regulatory Approaches**: Review of European data protection requirements and their application to TikTok, including the introduction of the Digital Services Act as a more comprehensive regulatory framework for algorithm governance.
3. **TikTok's Privacy Policies and Terms**: Examination of the platform's stated policies regarding children, including its "Kids Mode" and age verification mechanisms, comparing official policy statements with actual practices as alleged in regulatory complaints.
4. **Regulatory Responses**: Assessment of how regulators have attempted to address the challenges posed by TikTok's recommendation system, including the evolution of enforcement strategies from monetary penalties to structural remedies.

This analysis draws on primary source documents including regulatory complaints, settlement agreements, policy documents, and official statements from both regulators and TikTok.

**Case Study Development**

The case study component focuses on developing a comprehensive understanding of TikTok's approach to children on its platform, including:

1. **Evolution of Privacy Measures**: Tracing the development of TikTok's privacy features for children over time, particularly in response to regulatory pressure and public concern.
2. **Technical Safeguards**: Evaluating specific technical measures implemented to protect children's privacy and enhance content safety, including age verification, private accounts, restricted mode, and content filtering systems.
3. **Regulatory Impact**: Assessing how enforcement actions have influenced

TikTok's approach to children's privacy and algorithm design, examining both formal compliance measures and their actual effectiveness.

4. **Algorithm Literacy Initiatives**: Analyzing educational approaches and platform transparency efforts aimed at enhancing children's understanding of and agency within recommendation systems.

The case study integrates data from multiple sources, including TikTok's official announcements, technical documentation, regulatory filings, and independent research reports to provide a multi-dimensional view of how the platform has addressed children's privacy in its recommendation system.

**Methodological Limitations and Future Research Directions**

This methodology faces several inherent limitations that reflect broader challenges in studying proprietary algorithmic systems affecting children. The most fundamental constraint stems from TikTok's algorithmic opacity—detailed information about the recommendation system remains proprietary, limiting analysis to company disclosures and external observations rather than direct algorithmic access. This "black box" problem, common across commercial platforms, constrains the depth of technical analysis possible and makes verification of platform claims difficult. Additionally, the rapidly evolving nature of both algorithmic systems and regulatory landscapes means findings may become outdated as platforms modify their algorithms and policymakers introduce new requirements.

Perhaps most significantly, direct empirical studies of algorithmic effects on actual children present substantial ethical challenges. Research must therefore rely on proxy measures such as simulated accounts, adult user studies, or post-hoc analysis of donated data—approaches that may not fully capture children's authentic interactions with recommendation systems. This limitation is particularly problematic given that children's cognitive and behavioral responses to algorithmic systems may differ substantially from adult patterns.

These constraints point toward promising future research directions that could advance understanding while addressing ethical concerns. Synthetic user testing protocols could enable systematic exploration of algorithmic behavior across different developmental stages without involving actual children, while collaborative partnerships between researchers and platforms—similar to Facebook's Social Science One initiative—could provide controlled access to algorithmic systems for academic study. The development of open-source recommendation algorithm simulations would allow controlled experimentation with different design choices, serving as testbeds for governance mechanisms before real-world implementation.

Longitudinal data donation studies, building on methodologies like those employed by the University of Washington, could track children's algorithmic experiences over time through appropriate consent mechanisms. Such approaches, combined with standardized protocols for assessing developmental impacts through interdisciplinary collaboration

between computer scientists and developmental psychologists, could significantly enhance understanding of how recommendation algorithms affect children's cognitive, social, and emotional development. Despite these limitations, the multi-method approach employed here provides valuable insights into TikTok's recommendation system and its implications for children's privacy and wellbeing.

## Technical Architecture of TikTok's "For You" Algorithm

### Data Collection and Processing

TikTok's content recommendation algorithm relies on extensive data collection to create personalized content streams for users, including children. The system collects three main categories of data: explicit information that users provide directly (such as account details and stated preferences), implicit information gathered through user behavior (such as viewing time, engagement patterns, and rewatching behaviors), and inferred data derived through analysis of user patterns (including predicted interests and demographic characteristics).

For children specifically, TikTok claims to implement different data collection practices depending on the user's age. According to TikTok's Children's Privacy Policy, the platform collects limited information from users under 13 in its "Kids Mode," including username, password, and birthday, along with technical information such as IP addresses and device identifiers (TikTok, 2024). However, the 2024 FTC lawsuit alleges that TikTok collected substantially more data from children than disclosed, including information enabling the targeting of advertising to them without parental consent (DOJ, 2024).

The platform's pervasive tracking extends to subtle engagement metrics that may not be apparent to children or parents. Research has shown that TikTok monitors metrics such as video completion rate, time spent viewing specific content types, rewatching behaviors, and even screen touches that don't result in explicit actions (Bhandari & Bimo, 2022). These granular signals allow the algorithm to rapidly develop detailed preference profiles, even for users who have not created accounts or provided explicit personal information.

Once collected, this data undergoes multiple processing stages. First, raw behavioral data is transformed into feature vectors representing user preferences and characteristics. Next, machine learning models analyze these features to predict engagement likelihood with different content types. Finally, these predictions are used to select and rank content for presentation to the user (Zhou, 2024). Throughout this pipeline, children's data may be combined with information from similar users through collaborative filtering techniques, raising additional privacy concerns about cross-user inference.

### Algorithm Design and Optimization Goals

TikTok's "For You" recommendation algorithm is distinguished by its sophisticated design and rapid adaptation to user behavior. The algorithm employs a hybrid approach

combining collaborative filtering with content-based filtering, enhanced by deep learning neural networks that identify patterns in user behavior that would be difficult to detect with simpler models (Zhou, 2024).

What sets TikTok's algorithm apart from many competitors is its emphasis on content over social connections. Unlike platforms that prioritize content from accounts users follow, TikTok's "For You" feed predominantly features content from creators users haven't encountered before, allowing for rapid discovery of new content that matches inferred preferences. The University of Washington study found that between one-third to half of the first 1,000 videos shown to new users are selected based on TikTok's predictions of what those users might like (Roesner, 2024).

The optimization goals of TikTok's algorithm primarily focus on maximizing user engagement. Engagement metrics—quantitative measures used to assess user interaction with content—include watch time, completion rate, sharing, commenting, and rewatching behaviors (Lee et al., 2022). These metrics collectively indicate the degree to which users actively interact with and respond to recommended content. This engagement-focused optimization can lead to problematic patterns for children, including what researchers have termed "rabbit hole" effects. For instance, the Center for Countering Digital Hate demonstrated that changing a user's name from "Sarah" to "Sarah Lose Weight" could result in TikTok's algorithm serving 12 times more self-harm content, as the algorithm recognizes vulnerability and exploits it to maximize time on the platform (Rawlinson, 2023).

TikTok has publicly claimed that its algorithm for younger users incorporates additional safety considerations, including content restrictions and reduced personalization in its "Kids Mode" (TikTok, 2023). However, independent research suggests that even with these modifications, the fundamental engagement-maximizing approach remains dominant, potentially prioritizing attention capture over children's wellbeing. This tension between stated safety goals and actual algorithmic behavior represents a central challenge in protecting children on the platform.

**Content Categorization and Filtering Mechanisms**

A critical component of TikTok's recommendation system is its content categorization and filtering mechanisms, which determine what content is considered appropriate for different user groups. TikTok employs a combination of automated classification and human review to categorize videos by subject matter, age-appropriateness, and potential safety concerns.

The platform's automated content classification uses computer vision, audio analysis, and natural language processing to identify potentially inappropriate elements in videos. These systems analyze visual content to detect inappropriate imagery or themes, evaluate audio content for concerning language, examine metadata including titles and hashtags, and consider how different age groups interact with the content. This multi-modal approach aims

to provide comprehensive content filtering, but its effectiveness remains questionable based on independent testing.

For content targeting children or likely to be viewed by children, TikTok claims to implement additional filtering mechanisms. According to the platform, its "Kids Mode" provides a more restricted viewing environment with curated content deemed appropriate for users under 13 (TikTok, 2023). TikTok has also announced partnerships with organizations such as Common Sense Networks to provide additional guidance on content appropriateness for younger users (TikTok, 2021).

However, the effectiveness of these classification and filtering systems has been questioned. Research by the Algorithmic Transparency Institute found that accounts simulating 13-year-old users were quickly exposed to potentially harmful content despite supposed protections (Amnesty International, 2023). The 2024 FTC lawsuit alleges that even in TikTok's "Kids Mode," the platform collected extensive personal information and built user profiles that were shared with third parties (DOJ, 2024).

The opacity of these filtering mechanisms makes it difficult for parents, researchers, or regulators to evaluate their effectiveness or hold the platform accountable for their outcomes. Unlike content moderation systems addressing clearly prohibited material (such as illegal content), age-appropriateness determinations involve greater subjectivity and context-dependence, creating additional challenges for automated classification systems.

**Privacy-Preserving Features and Technical Safeguards**

In response to regulatory pressure and public concern about children's privacy, TikTok has implemented various technical safeguards and privacy-preserving features. These measures aim to enhance privacy protection while maintaining the platform's core functionality.

TikTok employs age verification at account creation, requiring users to enter their date of birth. Users identified as under 13 in the U.S. are directed to "Kids Mode" with enhanced restrictions (TikTok, 2023). However, the FTC lawsuit alleges that these mechanisms were easily circumvented and inconsistently enforced, with human reviewers spending an average of only 5-7 seconds reviewing accounts flagged as potentially belonging to children (DOJ, 2024).

The platform offers private account options that limit content visibility to approved followers, with accounts for users under 16 set to private by default since 2021 (TikTok, 2021). These settings restrict discovery of the account and its content by non-approved users. TikTok also provides a "Restricted Mode" setting that limits exposure to content that may not be suitable for all audiences, which parents can enable and lock with a passcode (TikTok, 2024).

Family Pairing, introduced in 2020, allows parents to link their TikTok account to their child's, enabling controls over screen time, direct messages, and content restrictions (TikTok,

2021). The platform also disabled direct messaging for users under 16 in 2020, eliminating a potential vector for inappropriate contact, and restricted downloading of videos created by users under 16, providing some protection against redistribution of children's content (TikTok, 2021).

TikTok has claimed that its "Kids Mode" implements additional technical safeguards beyond these general features, including a curated content library, disabled commenting and searching functions, and prohibition of content posting (TikTok, 2021). However, the 2024 FTC lawsuit challenges the adequacy of these protections, alleging that TikTok continued to collect extensive data from children in violation of COPPA requirements (DOJ, 2024).

While these features represent steps toward enhancing privacy, they have significant limitations. Age verification relies primarily on self-reported information, creating opportunities for circumvention. Privacy settings and parental controls depend on proper configuration, which many users may not implement. Most importantly, even with these safeguards, the core data collection and algorithmic personalization processes continue to operate, raising questions about their compatibility with strong privacy protection for children.

## Privacy Violations and Regulatory Actions: The TikTok COPPA Case Study

### The 2019 Musical.ly Settlement

TikTok's history of privacy compliance issues began with its predecessor application, Musical.ly. In February 2019, the FTC announced a settlement with Musical.ly (by then operating as TikTok following ByteDance's acquisition) for $5.7 million—at that time the largest civil penalty ever obtained in a children's privacy case (FTC, 2019). The settlement addressed alleged violations of COPPA related to the collection of children's personal information without parental consent.

The FTC's complaint alleged several significant violations. Musical.ly collected personal information (including email addresses, phone numbers, usernames, first and last names, and profile pictures) from all users, including those under 13, without seeking parental consent. The registration process failed to include neutral age gates or make reasonable efforts to notify parents about information practices. The platform allowed obviously underage users to create accounts despite receiving thousands of complaints from parents about children's accounts. Users' profiles and videos were public by default, and the platform included features that enabled adults to contact children directly.

As part of the settlement, TikTok agreed to pay $5.7 million in civil penalties, delete all personal information for users identified as under 13, comply with COPPA's requirements going forward, and create a separate, limited experience for users under 13 that would protect their privacy. This settlement represented a significant regulatory intervention but relied primarily on TikTok's compliance with its terms to protect children going forward.

**Continued Violations and the 2024 Lawsuit**

Despite the 2019 settlement, concerns about TikTok's practices regarding children's privacy persisted. In August 2024, the Department of Justice, acting on behalf of the FTC, filed a new lawsuit against TikTok, ByteDance, and their affiliates, alleging "flagrant violations" of both COPPA and the 2019 consent order (DOJ, 2024). This unprecedented second action against the platform highlighted the challenges of enforcing privacy protections in complex technical environments and the limitations of settlement-based approaches.

The 2024 complaint contained several significant allegations regarding TikTok's continued privacy violations. TikTok's human reviewers allegedly spent an average of only 5-7 seconds reviewing each account flagged as potentially belonging to a child, resulting in many underage users remaining on the main platform rather than being directed to the children's version (FTC, 2024). The platform allegedly built "back doors" into its age verification measures that allowed children to bypass age verification, such as permitting account creation through third-party credentials without age verification (DOJ, 2024).

According to the complaint, TikTok failed to honor parents' requests to delete their children's accounts and personal information as required by COPPA and the 2019 order (FTC, 2024). The lawsuit also claimed that TikTok classified millions of accounts as "age unknown" but continued to collect and use personal information from these accounts without determining whether they belonged to children (DOJ, 2024).

Most concerning, the complaint alleged that even in TikTok's "Kids Mode"—specifically designed to comply with COPPA—the platform collected "far more data" than needed, including information about users' in-app activities and identifiers that TikTok used to build profiles and shared with third parties to increase engagement among less active users (DOJ, 2024). The lawsuit seeks civil penalties of up to $51,744 per violation per day, which could amount to billions given the scale of the alleged violations (DOJ, 2024).

**Technical Implementation Failures**

The TikTok case highlights several specific technical implementation failures that contributed to privacy violations despite the platform's public commitments to protecting children. TikTok's age verification relied primarily on self-reported birth dates, an approach easily circumvented by children. When additional verification was employed, such as human review of potentially underage accounts, the process was insufficient, with reviewers spending only seconds per account (FTC, 2024).

The platform's policies regarding children apparently contained significant loopholes. According to the 2024 complaint, as of 2020, TikTok maintained accounts of children it knew were under 13 unless they made an "explicit admission of age" and other rigid conditions were met (DOJ, 2024). The complaint alleged that TikTok allowed children to create accounts without providing age information by using third-party credentials, then

classified these as "age unknown" accounts—a classification that grew to millions of accounts but did not receive COPPA protections (FTC, 2024).

Despite COPPA's requirement that platforms delete children's personal information upon parental request, the complaint alleged that TikTok failed to honor many such requests or made the process unnecessarily difficult for parents (DOJ, 2024). Perhaps most troubling, even TikTok's supposedly COPPA-compliant "Kids Mode" allegedly continued collecting and using children's personal information in ways that violated the law, suggesting fundamental conflicts between the platform's data-driven business model and children's privacy requirements (FTC, 2024).

These implementation failures illustrate broader challenges in protecting children's privacy in algorithmic systems. Technical safeguards that appear robust on paper may fail in practice due to poor implementation, deliberate circumvention, or prioritization of competing business objectives. As the TikTok case demonstrates, even a platform under specific regulatory oversight may struggle to align its technical systems with privacy protection requirements, particularly when those requirements conflict with engagement-maximizing algorithms.

**Implications for Recommendation Systems**

The TikTok COPPA case has significant implications for recommendation algorithms targeting children. First, it demonstrates that traditional privacy compliance frameworks focused on notice and consent may be insufficient in algorithmic environments where data collection and processing occur continuously and often invisibly to users. Second, it highlights tensions between the business models driving recommendation systems (maximizing engagement and time spent) and children's privacy rights. Third, it suggests that technical measures alone may be insufficient without aligned business incentives and robust external verification.

The case also raises questions about the viability of "child-specific" versions of platforms built on recommendation algorithms. TikTok's "Kids Mode" was specifically designed to comply with COPPA, yet the allegations suggest that even this environment continued problematic data practices (DOJ, 2024). This points to deeper challenges in adapting algorithmic recommendation systems originally designed for adults to serve children appropriately.

Most importantly, the TikTok case illustrates how recommendation algorithms can blur traditional definitions of personal information. While COPPA focuses on the collection of explicitly personal information (names, contact details, etc.), recommendation algorithms derive detailed profiles from seemingly innocuous behavioral data. This creates a fundamental challenge: recommendation effectiveness depends on extensive data collection and profiling, yet these very processes may inherently conflict with children's privacy rights regardless of whether traditionally defined "personal information" is directly collected.

## Ethical Considerations and Developmental Impacts

### Child Development and Algorithm Exposure

The impact of TikTok's recommendation algorithm on child development raises significant ethical concerns that extend beyond traditional privacy considerations. Research suggests several developmental domains may be affected by algorithmic content curation.

Children and adolescents are still developing the cognitive skills needed to critically evaluate content and understand how algorithmic systems may be influencing their experiences. The rapid-fire, algorithmically optimized content stream on TikTok may impact children's attention spans and cognitive processing. Research by PsyPost found a negative relationship between short video usage and elementary school students' academic performance, mediated by reduced attention spans (PsyPost, 2025). The platform's design elements—including infinite scrolling, autoplay features, and brief content duration—may train young minds toward frequent task-switching and reward immediate gratification.

During critical developmental periods when children and adolescents are forming their identities, algorithmic recommendations may exert outsized influence. TikTok's algorithm quickly identifies and amplifies content related to emerging interests, potentially narrowing rather than expanding children's exposure to diverse ideas and role models. Research suggests that algorithmically reinforced identity exploration may intensify social comparison and contribute to self-concept disturbances in some adolescents (Simpson & Semaan, 2021).

The recommendation algorithm's emphasis on engagement metrics may prioritize emotionally provocative content, potentially exposing children to extremes of both positive and negative emotion without adequate context or support. Studies have identified associations between algorithm-driven content consumption and impacts on children's emotional regulation, empathy development, and social comparison tendencies (Livingstone & Stoilova, 2021).

Traditional media consumption allowed children to actively choose content, developing critical thinking skills and preference formation. In contrast, algorithmic recommendations may reduce active choice, potentially limiting opportunities for children to develop media literacy and independent judgment (Kidron et al., 2018). This shift from active selection to passive consumption raises questions about children's developing sense of agency in digital environments.

### Algorithmic Manipulation and Children's Vulnerability

Children's developmental vulnerabilities make them particularly susceptible to algorithmic manipulation through recommendation systems. Several factors contribute to this heightened vulnerability.

Children are still developing the cognitive skills needed to critically evaluate content and understand how algorithmic systems may be influencing their experiences. They may not recognize when recommendation systems are designed to maximize engagement rather than serve their best interests (Livingstone & Stoilova, 2021). Children and adolescents place greater emphasis on peer approval and social acceptance than adults, making them more responsive to recommendation algorithms that leverage social validation metrics like likes, shares, and follower counts (Bhandari & Bimo, 2022).

Children's still-developing executive function limits their ability to resist the powerful engagement mechanics embedded in TikTok's algorithm, such as infinite scrolling, autoplay features, and intermittent variable rewards that trigger dopamine releases (Taylor & Choi, 2022). Research suggests that children often place heightened trust in technological systems, assuming they are neutral or beneficial rather than designed with commercial incentives. This "algorithmic trust" may make children less questioning of recommendation patterns (DeVito, 2022).

Children typically have minimal understanding of how their data is collected and used to shape future recommendations, creating information asymmetry that limits informed decision-making (Livingstone et al., 2019). Recent research on algorithm literacy has found that while children do make sense of algorithmic recommendations in quite complex ways, considering their networked, affective-involving, and economic-commercial character, this understanding is still developing and incomplete (Schulz et al., 2024).

These vulnerabilities raise ethical concerns about the design of TikTok's algorithm when applied to children. The system's sophisticated engagement mechanisms—including personalization based on subtle behavioral signals, content timing optimization, and emotional response tracking—may constitute a form of manipulation when deployed against users with limited capacity to recognize or resist these influences.

Research by the Center for Countering Digital Hate highlighted how quickly TikTok's algorithm can exploit vulnerability in children, as demonstrated when changing a user's name from "Sarah" to "Sarah Lose Weight" resulted in 12 times more self-harm content (Rawlinson, 2023). For children with existing vulnerabilities, such as those struggling with body image, mental health challenges, or identity issues, the algorithm may rapidly amplify content related to these struggles without adequate safeguards or context.

The manipulation concern extends beyond individual recommendations to questions about algorithmic influence on children's worldviews, preferences, and behaviors over time. When recommendation systems are optimized for commercial objectives rather than children's wellbeing, they may systematically prioritize content that triggers strong emotions, reinforces existing beliefs, or promotes consumption behaviors, potentially shaping children's development in ways that prioritize platform interests over healthy development.

**Privacy Rights in the Context of Recommendation Systems**

The TikTok case highlights how recommendation algorithms challenge traditional conceptions of privacy rights for children. Beyond questions of data collection and consent, several privacy dimensions emerge as particularly relevant.

Privacy encompasses not only protection from unwanted data collection but also the developing capacity for informational self-determination—the ability to control information about oneself and understand its use. TikTok's algorithm creates detailed behavioral profiles that children cannot meaningfully access, understand, or control, potentially undermining this core privacy right (Barassi, 2020).

The concept of intellectual privacy—the freedom to explore ideas and develop one's thoughts without surveillance—takes on particular importance for children's development. TikTok's continuous tracking of viewing patterns, interest development, and engagement behaviors may compromise this intellectual privacy, particularly when the resulting data is used to shape future content exposure (Cohen, 2013).

TikTok's collaborative filtering approaches mean that children's experiences are shaped not only by their own data but by patterns derived from other users. This raises questions about collective privacy rights and the ethics of allowing some children's data to influence content recommendations for others, particularly when vulnerable communities may be disproportionately affected (Taylor, 2017).

While platforms may obtain consent (often through parents) for explicit data collection, recommendation algorithms frequently make inferences about children's characteristics or preferences without specific consent for these inferences. These may include sensitive attributes such as emotional states, developmental issues, social dynamics, or family circumstances (Zuboff, 2019). The ethics of such inference-making remain largely unaddressed in current governance frameworks.

For children, the long-term implications of digital profiles created through recommendation systems raise particular concerns. Data collected during childhood may persist and influence algorithmic decisions throughout their lives, creating a "permanent digital record" with unpredictable future impacts (Barassi, 2020).

These expanded privacy considerations highlight the insufficiency of traditional privacy frameworks focused primarily on data collection and consent. Protecting children's privacy rights in the context of recommendation algorithms requires addressing questions of algorithmic transparency, inference limitations, profile access and deletion rights, and fundamental questions about the ethics of behavioral prediction and influence.

**Algorithm Literacy and Children's Agency**

As recommendation algorithms increasingly shape children's digital experiences, the concept of algorithm literacy has emerged as a critical factor in empowering children to navigate these environments. Algorithm literacy encompasses understanding how algorithms

function, awareness of their influence, and the ability to make informed decisions when interacting with algorithmic systems (Dogruel et al., 2022).

Research indicates that algorithm literacy develops progressively with age. A study by Adorni et al. (2024) found that age significantly influences the development of algorithmic skills and problem-solving strategies. Younger children typically demonstrate more limited understanding of algorithmic processes, while adolescents begin to develop more sophisticated mental models of how recommendation algorithms function. This developmental trajectory suggests the need for age-appropriate approaches to fostering algorithm literacy.

Children's algorithm literacy can be enhanced through both formal education and platform transparency initiatives. Educational programs that incorporate age-appropriate explanations of algorithmic concepts can help children understand how recommendation systems work and the factors that influence their content exposure. Simultaneously, platforms like TikTok could provide child-friendly explanations of their recommendation processes, giving children greater insight into why they see particular content.

TikTok has taken some steps toward algorithmic transparency through its Transparency and Accountability Centers, where invited guests can examine how TikTok moderates and recommends content (TikTok, 2023). However, these initiatives have limited reach and accessibility, particularly for children themselves. More comprehensive efforts to enhance algorithm literacy might include in-app explanations, algorithm literacy games, or interactive tools that help children understand and influence their recommendation feeds.

Enhanced algorithm literacy offers several potential benefits for children using recommendation systems. First, it may help children maintain a sense of agency in their content consumption, recognizing when and how algorithmic systems are shaping their experiences. Second, it could support critical evaluation of recommended content, allowing children to consider why particular videos are being promoted. Third, it might enable more intentional interaction with recommendation systems, as children learn how their behavior influences future recommendations.

The development of algorithm literacy represents an important complement to technical safeguards and regulatory approaches. Rather than simply protecting children from algorithmic systems, algorithm literacy initiatives aim to empower children to engage with these systems more knowledgeably and critically. This approach aligns with the broader goal of balancing protection with agency in children's digital experiences.

**Balancing Personalization Benefits and Protection**

While this analysis has focused on concerns related to TikTok's recommendation algorithm, it is important to acknowledge that personalization also offers potential benefits for children. Finding the appropriate balance between these benefits and necessary protections represents a core ethical challenge.

Recommendation algorithms can help children discover educational content, diverse perspectives, and creative inspiration that they might not encounter through traditional media channels or social connections. For children with niche interests or limited local resources, algorithmic discovery may provide valuable connections to relevant content and communities (DeVito, 2022).

Personalized recommendations have the potential to adapt to children's developmental needs, interests, and learning styles. When designed with children's wellbeing as a primary objective, recommendation systems could potentially support educational goals and healthy development through carefully curated content suggestions (UNICEF, 2019).

The engaging nature of TikTok's personalized recommendations provides genuine entertainment value that children enjoy. Complete rejection of algorithmic personalization would eliminate these benefits and may push children toward platforms with even fewer protections (Simpson & Semaan, 2021).

Engaging with recommendation systems, when accompanied by age-appropriate education and parental guidance, may help children develop critical digital literacy skills needed to navigate increasingly algorithmic environments throughout their lives (Livingstone et al., 2019).

Balancing these potential benefits with necessary protections requires nuanced approaches rather than binary choices between unrestricted personalization and complete algorithmic limitation. Potential balancing strategies include implementing different levels of algorithmic personalization based on developmental stages, redesigning recommendation algorithms to optimize for metrics related to child wellbeing rather than engagement, developing age-appropriate algorithm literacy initiatives, and creating child-friendly interfaces that allow children to understand and adjust how their recommendations are personalized.

Finding this balance requires multidisciplinary collaboration among platform developers, child development experts, privacy advocates, parents, and children themselves. It also necessitates moving beyond compliance-focused approaches toward ethical frameworks that center children's rights and wellbeing in recommendation system design.

## Toward a Comprehensive Governance Framework

### Limitations of Current Regulatory Approaches

The TikTok COPPA case highlights several limitations in current regulatory approaches to protecting children's privacy in algorithmic environments.

COPPA and similar frameworks focus primarily on data collection practices rather than algorithmic decision-making processes. This emphasis fails to address how recommendation

systems use collected data to influence children's experiences, even when data collection formally complies with requirements (Livingstone et al., 2019).

Current regulations typically employ binary age classifications (under/over 13 in COPPA's case) that fail to reflect the developmental continuum of childhood and adolescence. This approach creates artificial boundaries that platforms can exploit while neglecting to address the evolving capacities and vulnerabilities of children at different developmental stages (Milkaite & Lievens, 2020).

Regulatory frameworks heavily emphasize parental consent mechanisms that place significant implementation burdens on platforms while often failing to provide meaningful privacy protection in practice. Many parents lack the technical knowledge to make informed decisions about algorithmic systems, and consent mechanisms are easily circumvented by children (Livingstone et al., 2019).

The TikTok case demonstrates significant challenges in enforcing existing regulations. Despite facing one of the largest COPPA penalties in history in 2019, TikTok allegedly continued violating children's privacy requirements, suggesting that monetary penalties alone may be insufficient to change platform behavior when violations are aligned with business incentives (DOJ, 2024).

Current regulations focus primarily on the collection of explicitly personal information rather than addressing how recommendation algorithms derive detailed profiles from seemingly innocuous behavioral data. This creates a fundamental challenge when recommendation effectiveness depends on extensive behavioral profiling that may inherently conflict with children's privacy rights (Zuboff, 2019).

Regulatory bodies often lack the technical expertise and resources necessary to effectively monitor compliance with complex AI systems. The opacity of recommendation algorithms makes evaluation difficult without specialized knowledge and access that regulators may not possess (Pasquale, 2015).

The global nature of platforms like TikTok creates jurisdictional challenges for regulators. Different privacy standards across regions lead to uneven protection for children and compliance challenges for platforms operating internationally (European Commission, 2022).

These limitations suggest the need for updated regulatory approaches that specifically address the unique challenges of recommendation algorithms targeting children. The European Digital Services Act represents a step in this direction by incorporating specific provisions for algorithm governance and transparency requirements (European Commission, 2023). Moving beyond traditional privacy frameworks toward more comprehensive governance models that address algorithmic decision-making, design requirements, and outcome-based regulation may provide more effective protection.

**Principles for AI-Driven Recommendation Systems for Children**

Building on existing ethical frameworks and the specific challenges identified in the TikTok case, this research proposes five core principles that should guide the governance of AI-driven recommendation systems targeting children:

1. **Child-Centered Design**: Recommendation systems must prioritize children's rights and best interests in their design, operation, and governance. This principle recognizes children as rights-holders with evolving capacities rather than merely objects of protection. For TikTok's algorithm, this would require fundamental redesign of optimization goals to prioritize wellbeing over engagement and explicit consideration of developmental impacts in algorithm design.
2. **Proportionate Protection**: Safeguards should be proportionate to risks, with more stringent requirements for systems targeting younger children or processing sensitive information. This allows for age-appropriate approaches that balance protection with supporting children's autonomy. For TikTok, this might involve graduated recommendation settings based on developmental stages rather than binary age classifications.
3. **Transparency and Accountability**: Mechanisms must exist for meaningful oversight of recommendation systems by relevant stakeholders, including parents, regulators, and researchers. This requires appropriate levels of transparency about system operation and impact. TikTok's current opacity about its algorithm functioning, particularly for younger users, fails to meet this principle.
4. **Prevention and Precaution**: Governance should emphasize preventing harms before they occur rather than remedying them afterward, with precautionary approaches to uncertain risks. For recommendation systems like TikTok's, this implies rigorous pre-deployment testing for potential harms to children and ongoing monitoring of algorithmic impacts.
5. **Multi-Stakeholder Responsibility**: Effective governance requires coordinated action across multiple stakeholders, including platforms, regulators, parents, educators, and children themselves. No single actor can ensure adequate protection without collaboration from others in the ecosystem.

These principles provide a foundation for specific governance mechanisms addressing both the technical implementation and regulatory oversight of recommendation systems targeting children.

**Technical Safeguards and Design Requirements**

Effective governance requires specific technical safeguards and design requirements for recommendation systems targeting children. Based on the TikTok case analysis, several key measures emerge:

Recommendation systems should employ privacy-preserving design patterns that maintain personalization benefits while minimizing privacy risks. Options include on-device processing where personalization occurs locally rather than on centralized servers, differential privacy techniques that add calibrated noise to datasets to prevent individual

identification, and federated learning approaches that train algorithms across distributed devices without centralizing user data (Wang et al., 2021).

Platforms should implement privacy-protective default settings calibrated to children's developmental stages. For TikTok, this might include progressively expanding recommendation options as children develop greater algorithmic literacy and critical thinking skills, with the most restrictive defaults for younger children.

Children and parents should have access to clear, age-appropriate explanations of how recommendation algorithms work and meaningful controls to modify these systems. TikTok could implement child-friendly visualizations of what factors influence their recommendations and simple controls to adjust these factors.

Recommendation algorithms should incorporate diversity mechanisms that prevent filter bubbles and ensure exposure to varied content types. TikTok's algorithm could be modified to deliberately introduce diverse content into recommendations rather than narrowing based on engagement signals.

Platforms should develop and implement wellbeing-focused metrics to complement or replace pure engagement metrics in algorithm optimization. For TikTok, this might include measuring educational value, creativity stimulation, or positive emotional impact rather than primarily watch time or completion rates.

Regular independent auditing of recommendation systems should be required to assess compliance with child protection requirements. TikTok could implement standardized testing protocols to evaluate how its algorithm responds to different user profiles and identify potential harms.

Recommendation systems should include automatic intervention mechanisms that activate when problematic patterns are detected, such as rapid narrowing of content types or excessive usage. TikTok could implement "circuit breakers" that introduce content diversity when the algorithm detects a child entering a potential content rabbit hole.

These technical requirements should be embedded in both product development processes and regulatory frameworks to ensure that recommendation algorithms are designed from the ground up with children's privacy and wellbeing as core considerations rather than afterthoughts.

**Regulatory Framework Components**

Building on the identified limitations in current approaches, a more effective regulatory framework for recommendation systems targeting children should include:

1. **Algorithm Impact Assessments**: Platforms operating recommendation systems that target or are likely to be accessed by children should be required to conduct and document Children's Algorithmic Impact Assessments (CAIAs) prior to deployment and at regular intervals thereafter. These assessments would evaluate privacy impacts, safety

risks, developmental considerations, and fairness implications, with independent verification of methodologies and results.

2. **Outcome-Based Obligations**: Beyond data protection requirements, regulations should establish outcome-based obligations for recommendation systems, such as prohibiting algorithms from recommending harmful content to children or requiring diversity in recommendations to prevent filter bubbles. These obligations focus on algorithmic impacts rather than merely data collection practices.
3. **Graduated Regulatory Approach**: Rather than binary age classifications, regulatory frameworks should establish graduated requirements based on children's developmental stages, with different standards for early childhood, middle childhood, and adolescence. This approach would better reflect the evolving capacities and vulnerabilities of children at different ages.
4. **Mandatory Transparency Requirements**: Platforms should be required to provide appropriate transparency about their recommendation algorithms to different stakeholders: child-friendly explanations for users, more detailed documentation for parents, and technical information for regulators and qualified researchers. Current opacity about algorithm functioning impedes effective oversight.
5. **Independent Oversight Mechanisms**: Regulatory frameworks should establish independent oversight bodies with technical expertise to evaluate recommendation systems and investigate potential harms. These bodies would need appropriate access to algorithmic systems and data to perform meaningful assessment.
6. **Algorithm Literacy Initiatives**: Regulations should promote the development of age-appropriate algorithm literacy programs that help children understand and critically engage with recommendation systems. These initiatives should be integrated into digital literacy education and supported by both platforms and educational institutions.
7. **International Coordination**: Given the global nature of platforms like TikTok, mechanisms for cross-border regulatory cooperation should be established, potentially through a multilateral framework on children's rights in digital environments. This would reduce jurisdictional gaps and compliance challenges for international platforms.

These regulatory components would complement technical safeguards to create a comprehensive governance framework addressing both the development and deployment of recommendation systems targeting children.

## Conclusion

This analysis of TikTok's recommendation algorithm and its impact on children's privacy reveals both specific concerns about current practices and broader challenges in protecting children in algorithmic environments. The TikTok case illustrates how recommendation systems raise novel privacy questions that go beyond traditional data collection concerns to fundamental issues of algorithmic influence, developmental impacts, and children's autonomy in digital spaces.

Several key insights emerge from this examination. Current regulatory frameworks focused primarily on data collection and parental consent prove insufficient in addressing the unique challenges of recommendation algorithms. The TikTok COPPA case demonstrates how platforms may formally comply with data collection requirements while still operating recommendation systems that potentially compromise children's privacy and wellbeing through continuous behavioral tracking and influence. Moving beyond collection-focused regulation toward governance of algorithmic systems themselves represents a necessary evolution.

The technical architecture of TikTok's "For You" algorithm creates specific privacy and developmental concerns for children. The system's emphasis on rapid adaptation to user signals, engagement maximization, and continuous profile refinement may exploit children's developmental vulnerabilities while limiting their opportunities for autonomous exploration and diverse content exposure. Technical safeguards that merely filter inappropriate content without addressing the fundamental design of recommendation systems may prove insufficient.

Algorithm literacy represents an important complement to technical and regulatory approaches. Recent research suggests that children develop complex but incomplete understandings of algorithmic recommendations. Enhancing children's algorithm literacy through age-appropriate education and platform transparency could help them navigate recommendation systems more critically and intentionally, maintaining agency in increasingly algorithmic environments.

Effective protection requires a multi-faceted approach integrating technical safeguards, regulatory requirements, algorithm literacy initiatives, and stakeholder responsibilities. Neither technical solutions alone nor regulatory interventions in isolation can adequately address the complex challenges of algorithmic environments. A comprehensive governance framework must incorporate child-centered design principles, privacy-preserving algorithm approaches, outcome-based regulation, and support for parents and educators.

Balancing personalization benefits with protection needs remains a central challenge. While this analysis has highlighted concerns with current recommendation approaches, algorithmic personalization does offer potential benefits for children's education, entertainment, and development. Finding appropriate balances that preserve benefits while mitigating risks requires nuanced, age-appropriate approaches rather than binary choices between personalization and protection.

The rapidly evolving nature of recommendation algorithms necessitates adaptive governance approaches. Static regulatory frameworks may quickly become outdated as technology advances. Governance systems must be able to evolve alongside technological developments while maintaining core principles centered on children's rights and wellbeing.

As recommendation algorithms increasingly shape children's digital experiences, the importance of addressing these challenges grows. The TikTok case provides valuable insights

into both the specific privacy concerns posed by current recommendation systems and potential pathways toward more effective protection. By learning from this case and implementing comprehensive governance approaches, we can work toward algorithmic environments that respect children's privacy while supporting their development and engagement in the digital world.

## Acknowledgments

This research received no external funding.

## Conflict Statement

The author declares no conflict of interest.

## References

Adorni, G., et al. (2024). Development of algorithmic thinking skills in K-12 education: A comparative study of unplugged and digital assessment instruments. ScienceDirect.

Albuquerque, J., Bernardo, M., Gonzalez, C., & Prada, R. (2021). Persuasive technology and children: A systematic literature review. International Journal of Human-Computer Studies, 153, 102673.

Amnesty International. (2023). Driven into the darkness: How TikTok encourages self-harm and suicidal ideation. Amnesty International.

Barassi, V. (2020). Child data citizen: How tech companies are profiling us from before birth. MIT Press.

Bhandari, A., & Bimo, S. (2022). AI agency vs. human agency: Understanding human--AI interactions on TikTok and their implications for user engagement. Journal of Computer-Mediated Communication, 27(5), zmac014.

Cohen, J. E. (2013). What privacy is for. Harvard Law Review, 126(7), 1904-1933.

Department of Justice (DOJ). (2024). Justice Department sues TikTok and parent company ByteDance for widespread violations of children's privacy laws. Press Release, August 2, 2024.

DeVito, M. A. (2022). Understanding the impact of TikTok's recommendation algorithm on user engagement. Media and Communication Research, 11(2), 23-41.

Dogruel, L., Masur, P., & Joeckel, S. (2022). Development and validation of an Algorithm Literacy Scale for Internet users. Communication Methods and Measures, 16(2), 115-133.

European Commission. (2022). Data protection and online privacy for children. European Data Protection Board Guidance.

European Commission. (2023). Digital Services Act implementation report. European Commission.

Federal Trade Commission (FTC). (2019). Video social networking app Musical.ly agrees to settle FTC allegations that it violated children's privacy law. Press Release, February 27, 2019.

Federal Trade Commission (FTC). (2020). Children's Online Privacy Protection Rule: A six-step compliance plan for your business. FTC Guidance Document.

Federal Trade Commission (FTC). (2024). FTC investigation leads to lawsuit against TikTok and ByteDance for flagrantly violating children's privacy law. Press Release, August 2, 2024.

IEEE. (2019). Ethically aligned design: A vision for prioritizing human well-being with autonomous and intelligent systems. The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems.

Jobin, A., Ienca, M., & Vayena, E. (2019). The global landscape of AI ethics guidelines. Nature Machine Intelligence, 1(9), 389-399.

Kidron, B., Evans, A., & Afia, J. (2018). Disrupted childhood: The cost of persuasive design. 5Rights Foundation.

Lee, Y., Park, J., & Choi, J. (2022). Experiencing algorithms: How young people understand, feel about, and engage with algorithmic news selection on social media. Digital Journalism, 10(5), 737-756.

Livingstone, S., & Stoilova, M. (2021). The 4Cs: Classifying online risk to children. CO:RE Short Report Series on Key Topics.

Livingstone, S., Stoilova, M., & Nandagiri, R. (2019). Children's data and privacy online: Growing up in a digital age. London School of Economics and Political Science.

Milkaite, I., & Lievens, E. (2020). Child-friendly transparency of data processing in the EU: From legal requirements to platform policies. Journal of Children and Media, 14(1), 5-21.

Montgomery, K. C., & Chester, J. (2015). Data protection for youth in the digital age: Developing a rights-based global framework. European Data Protection Law Review, 1(4), 277-291.

Office of the Privacy Commissioner of Canada. (2021). Growing up with AI: What are the privacy risks for children? Real Results, Vol. 4.

Pasquale, F. (2015). The black box society: The secret algorithms that control money and information. Harvard University Press.

PsyPost. (2025). New TikTok research: Short video use linked to lower academic performance in children. PsyPost, January 20, 2025.

Rawlinson, K. (2023). TikTok's algorithm "exploits the vulnerability" of children. Humanium.

Reyes, I., Wijesekera, P., Reardon, J., Elazari Bar On, A., Razaghpanah, A., Vallina-Rodriguez, N., & Egelman, S. (2018). "Won't somebody think of the children?" Examining COPPA compliance at scale. Proceedings on Privacy Enhancing Technologies, 2018(3), 63-83.

Roesner, F. (2024). Q&A: How TikTok's 'black box' algorithm and design shape user behavior. University of Washington News.

Sch, J., Herrmann, V., Hollitzer, P., & Kümpel, A. (2022). An empirical investigation of personalization factors on TikTok. arXiv.

Schulz, B., Schweiz, E., Klus, A., & Häner, N. (2024). Understanding algorithmic recommendations: A qualitative study on children's algorithm literacy in Switzerland. Tandfonline.

Simpson, E., & Semaan, B. (2021). For you, or for "you"?: Everyday LGBTQ+ encounters with TikTok. Proceedings of the ACM on Human-Computer Interaction, 4(CSCW3), 1-34.

Taylor, L. (2017). What is data justice? The case for connecting digital rights and freedoms globally. Big Data & Society, 4(2), 1-14.

Taylor, S. H., & Choi, D. (2022). AI agency vs. human agency: Understanding human--AI interactions on TikTok and their implications for user engagement. Journal of Computer-Mediated Communication, 27(5), 1-19.

TikTok. (2020). TikTok introduces family pairing. TikTok Newsroom, April 16, 2020.

TikTok. (2021). Strengthening privacy and safety for youth on TikTok. TikTok Newsroom, January 13, 2021.

TikTok. (2023). How TikTok recommends videos #ForYou. TikTok Newsroom, June 29, 2023.

TikTok. (2024). Privacy policy for younger users. TikTok Legal.

UNICEF. (2019). AI for children. Office of Innovation.

Vogels, E. A., Gelles-Watnick, R., & Massarat, N. (2022). Teens, social media and technology 2022. Pew Research Center.

Wang, C., Yang, H., & Bao, F. (2021). Privacy-preserving recommendation systems: A comprehensive survey. ACM Computing Surveys, 54(4), 1-36.

Zhou, L. (2024). Understanding the impact of TikTok's recommendation algorithm on user engagement. ResearchGate.

Zuboff, S. (2019). The age of surveillance capitalism: The fight for a human future at the new frontier of power. Profile Books.

## Author Biography

Zhao Hongqiang is the Director and Party Branch Secretary of Henan Modu Law Firm. He is a leading expert in corporate law, mining rights law, and administrative law. Additionally, he serves as the senior legal advisor to several large enterprises in the county and is a member of the Municipal Party Committee's legal expert database. The second author, Cao Zhen, and the third author, Li Xincheng, both hold Master of Law degrees from the University of Malaya.