CHAITok: A Proof-of-Concept System Supporting Children's Sense of Data Autonomy on Social Media

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ABSTRACT

Social media has become a primary source of entertainment and education for children globally. While much attention has been given to children's online well-being, a pressing concern often goes unnoticed: the pervasive data harvesting underlying social media and its manipulative impact on undermining children's autonomy. In this paper, we present *CHAITok*, an Android mobile application designed to enhance children's sense of autonomy over their data on social media. Through 27 user study sessions with 109 children aged 10–13, we offer insights into the current lack of data autonomy among children regarding their online information, and how we can foster children's sense of data autonomy through a socio-technical journey. Our findings inspire design recommendations to respect children's values, support children's evolving autonomy, and design for children's digital rights. We emphasize *data autonomy* as a fundamental right for children, call for further research, design innovation, and policy changes on this critical issue.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; **Interactive systems and tools**.

KEYWORDS

Children, Data Autonomy, Social Media

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1 INTRODUCTION

Social media platforms, including TikTok, YouTube, and others, have emerged as the primary sources of entertainment and even education for children around the world. Recent studies show that 38% of U.S. [67] and 42% of UK kids aged 5-13 [76] are using these platforms, despite the common age restriction of 13 set by social media companies for account registration. This triggers a wave of concerns on children's online wellbeing, from the dangers of online strangers [6, 118] and exposure to inappropriate content [77, 80], to worries over prolonged screen engagement [4, 35].

While there's been extensive discussion and research addressing children's online well-being, including issues like inappropriate content and addiction, the root cause driving these issues often receives less spotlight. Central to the impacts of social media is the vast amount of user data these platforms collect, granting them significant influence over their users. As individuals interact on social media, they produce vast data streams that platform owners harvest. This process, often referred to as "datafication", involves recording, tracking, aggregating, analyzing, and capitalising on user data. It empowers social media giants to predict and influence children's personal attributes, behaviors, and preferences, thereby shaping their online engagement and content choices [65, 68, 105, 111]. By exploiting user data, these platforms acquire the power to manipulate users' beliefs and interests. This enables micro-targeting and subtly influences opinions, leading to increased dependence on these platforms, potentially shaping how children view and engage with the world, who are in vital stages of cognitive and emotional development.

Traditionally, parents and guardians are seen as the first line of defense for children online [24, 93]. However, this approach is increasingly limited by new tech updates. By the time parents become familiar with platforms like Snapchat or YouTube, children may have already moved on to the next trend [77]. Meanwhile, the rising datafication on social media complicates parents' capabilities to monitor and guide their children effectively [65]. In response to this, recent work increasingly calls for a child-centered

approach [15, 107, 108], which shifts from just protecting or limiting children with parents and caretakers in charge, to actively guiding and empowering children to take a leading role. This perspective does not demand children to shoulder full responsibility or face the full consequences of their actions; instead, it emphasizes the importance of heeding their voices and nurturing self-development. Amidst this shift towards a child-centred approach, there's a growing consensus on the importance of fostering children's autonomy in the digital space, which includes developing their understanding, values, self-determination, and self-identity [15, 107, 108]. However, it is important to note that most prior studies in this area have primarily focused on children's self-regulation regarding digital well being, particularly in terms of managing screen time and identifying inappropriate content [9, 11, 34]. The pivotal role of *data* as a foundational element influencing social media's impact on these issues is frequently overlooked.

Given that data is the cornerstone of social media platforms' vast influence, this paper uniquely focuses on examining how to support children's sense of autonomy over their data on these platforms. We start by framing a working definition of *data autonomy* for children, which led to the design and development of *CHAITok*, an Android mobile application designed to support children's sense of data autonomy on social media. Through 27 user study sessions involving 109 children aged 10 to 13 across multiple schools, we seek to address three research questions:

RQ1: *How, if at all, do children currently experience and perceive the handling of their data on social media platforms?*
RQ2: *How does CHAITok influence children's user experience and sense of autonomy over their data?*
RQ3: *What are children's expectations towards having data autonomy on social media platforms?*

This paper highlights the unique role of data in shaping children's autonomy on social media. We emphasize *data autonomy* as a fundamental right for children and call for further research, design innovation, and policy changes focused on this critical issue. The contribution of this paper is as follows: (1) we investigate children's current experiences with social media and identify a lack of sense of autonomy concerning their data; (2) we design, develop, and assess a proof-of-concept system that demonstrates how popular social media platforms like TikTok can be integrated with autonomy-supportive features that promote children's sense of autonomy over their data; (3) we provide crucial insights into the expectations of children aged 10 to 13, a critical age range for transitioning into online social media interactions, regarding data autonomy online. Our research offers vital insights into how children presently perceive data autonomy online, and how we can empower children's sense of data autonomy through a socio-technical journey. Our findings inspire design recommendations to respect children's values, support children's evolving autonomy, and design for children's digital rights. We emphasize *data autonomy* as a fundamental right for children and call for further research, design innovation, and policy changes focused on this critical issue.

2 BACKGROUND AND MOTIVATION

2.1 Social Media as Platforms of Problematic Data Use

By definition, social media platforms encompass a subcategory of digital services that "enable the creation and sharing of digital content through virtual communities or networks" [48]. This includes, but is not limited to, video platforms such as TikTok and YouTube, communication platforms like WhatsApp and Snapchat, as well as content-sharing platforms such as Twitter and Instagram[1]. Despite the prevalent age restriction of 13 on most social media services [69, 70, 102], there is a substantial and growing trend of underage children using these platforms, as consistently documented in numerous global reports [25, 67, 76, 92]. Often, parents and guardians are even unaware of these age restrictions [75].

In addition to the well-recognized concerns surrounding children's digital well-being on various platforms—such as exposure to inappropriate content, online stranger danger, and excessive screen time [4, 6, 35]; recent research has highlighted growing concerns over problematic data use on these platforms. Data has always been the lifeblood of social media, serving as both a byproduct and a driver of user interactions [97]. As individuals communicate and engage on these platforms, they generate a wealth of information that is then collected and stored by platform operators. This leads to what is known as datafication, a process that involves capturing, analyzing, and exploiting vast amounts of information to create targeted profiles and predictive models [64, 68]. These models are subsequently used for personalized advertising and other commercial objectives, turning user data into a lucrative revenue stream. The implications of such datafication practices extend well beyond mere invasions of privacy. As Zuboff asserts, "surveillance capitalism feeds on every aspect of every human's experience" [121]. Research reveals that pervasive data practices on social media lead to both extrinsic and intrinsic losses of freedom. Externally, users face influences like content feeds that make disengagement challenging. Internally, they become more vulnerable to social pressures, such as those from the content they see, diminishing their capacity for independent choices [81].

On the other hand, in response to escalating concerns about these problematic data uses affects on children, legislators worldwide have been enacting specific regulations such as US's COPPA [2] and Europe's GDPR-K [3]. These laws set rules for handling minors' data, often requiring parental consent before collection for those under 13 in the US and under 16 in Europe. However, the effective enforcement of these laws is complex due to the sheer volume of apps and services that children use and the prevalence of non-compliance [78, 82]. For instance, in the congressional hearings on TikTok [39], attention was drawn to the concerning variety of harmful content targeting children on the platform, such as videos about drug use, self-harm, and eating disorders. Similarly, despite a minimum account age of 13 on many applications [47], studies show that children below this age still extensively use these

[1]Please note that by 'social media' here, we are specifically referencing the major centralized platforms that currently dominate the market. Emerging decentralized social media platforms like Mastodon, Blockstack, and Steemit are not included in the scope of this paper.

platforms [12, 67, 76]. Despite platforms like TikTok [102], Facebook [69], and Instagram [70] implementing strategies such as age verification, reporting mechanisms for harmful content, and parental controls, the problem persists as an industry-wide challenge. This underscores the complex legal and ethical landscape that tech companies must navigate as they strive to balance user engagement with legal compliance and moral responsibility.

2.2 Social Media and its Negative Impacts on Autonomy

The philosophical literature concerning autonomy is both vast and multifaceted [16, 29, 30, 49, 51, 57]. To make sense of this vast literature, it is helpful to note that theories of autonomy are generally classified into *procedural*, focused on the decision-making process itself [23], *substantive*, considering the alignment of decision content with personal values and identity [63], and *relational* perspectives, which recognize the influence of social interactions on our choices, emphasizing self-determination, self-governance, and self-authorisation [85]. Building on these classical dimensions, a significant body of scholars has further distilled these complex theories of autonomy into three more accessible forms tailored to adolescence [10, 28, 91, 96]: Cognitive Autonomy, an individual's ability to think independently, critically evaluating thoughts; Behavioral Autonomy, the capacity to act on personal judgment, making decisions independently; and Emotional Autonomy, an individual's ability to manage their emotions independently. These perspectives on autonomy, grounded in philosophical tradition, continue to evolve in modern contexts such as social media.

A number of scholars have broadly categorised the impacts of social media on autonomy through its control over users' *data, attention*, and *behaviour* [32, 79, 89]. First, the aggressive data collection tactics of social media platforms have sparked ethical debates over user data exploitation, with critics questioning the fairness of data exchange, and the actual freedom users have to refuse data collection, even when they decide to leave these platforms [31, 55, 121]. Building on this foundation of data exploitation, researchers contend that social media platforms wield considerable power over users' *attention*. Algorithms can shape beliefs and interests, even affecting political discourse [72, 113]. This is especially concerning for young people. For instance, a UK study revealed that nearly 90% of adolescents aged 15–24 are targeted with alcohol marketing on Facebook [112]. Another study highlighted platforms micro-targeting vulnerable teens in moments of insecurity, such as enticing an insecure teenager with a new watch to superficially enhance self-esteem [99]. Lastly, research indicates a significant impact on users' *behavior*, including the risk of addiction that erodes autonomy [99]. For instance, studies indicate that 2 to 6 year-olds in China are changing media habits due to short-video apps [27]; 12.5% of UK 10-year-olds lose sleep weekly checking notifications [104]; and US adolescents spending over three hours daily on social media have doubled the risk of mental health issues [84].

2.3 HCI Research around Designing for Children's Autonomy Online

The long-established field of research into children's interactions with digital technology has traditionally positioned parents and caregivers as the primary safeguards [1]. However, the limitations of relying solely on parental guidance become increasingly evident with each technological advance. By the time parents catch up with current platforms, young users have often already transitioned to the next trend [77]. This has spurred recent research into 'child-centered AI' [15, 107, 108], focusing on supporting children's desire for autonomy and identity within the digital environment. This shift moves away from the traditional role of parents and caregivers solely protecting or limiting children and instead emphasizes actively guiding and empowering children to take a more proactive role in their online experiences.

Parallel to this, the HCI community has a rich history of child-focused design [106, 115–117]. Most previous studies in this area have predominantly focused on supporting children's self-regulation concerning digital well-being [40, 42, 43, 52], such as managing their own screen time [34, 42], navigating cyberbullying [66, 100] and inappropriate content [9, 33], as well as defending against malware attacks [41, 56]. Other research has also looked into children's understanding of online privacy and security, such as children's understanding of personal information collection and the varying sensitivities of different data types [118–120]. Particularly, research has focused on enhancing children's agency in online privacy and security, emphasizing the importance of cultivating privacy and security practices from a young age [53] and highlighting the critical necessity of involving children in the design process for privacy and security measures [54]. Meanwhile, a newer line of research has started to explore the 'datafication' of children's online information, going beyond traditional notions of privacy. This research scrutinizes how online services not only collect but also make algorithmic inferences about users, applying them for purposes like behavioral engineering and monetization. In these studies, children were found to have a somewhat fundamental understanding of datafication as 'making assumptions about them' [13, 109]. Other studies indicate that children actively seek more control over how their data is collected, processed, and exploited by online platforms [59, 111]. Despite some existing research on children's understanding of datafication and their desire for control, there remains a notable gap in understanding their actual sense of autonomy of their data on social media. This calls for further study on how to design systems that support children's sense of data autonomy and what that autonomy should involve.

3 DATA AUTONOMY: SCOPE AND DEFINITION

To establish the grounding of our design and development, we first aim to set up a working definition on *data autonomy* for children. In doing so, we reviewed existing literature to understand the prevailing interpretations of 'data' and 'autonomy'. Our goal of laying down such a working definition is by no means seeking for an all-encompassing framework or formal definition for data autonomy. Instead, at this stage, our goal is to tease out the key themes that are relevant to the concept of data autonomy. This understanding plays a crucial role in our design and development processes, which focuses on empowering children with greater autonomy over their own data on social media platforms.

3.1 Unpacking Data in Data Autonomy.

To refine the scope of "data" in our discussion of data autonomy, we reference Solove's privacy taxonomy [95] and conceptualisations around datafication [14, 68, 121]. Solove's taxonomy organizes data concerns into four categories: information collection (observation and recording of activities), information processing (storage, manipulation, and use of data), information dissemination (breaches of confidentiality, harmful disclosure), and information invasion (intrusions into physical, psychological, or digital spaces and decision-making). Meanwhile, scholars like Cukier and Zuboff have furthered the concept of datafication from social science and business perspectives [14, 68, 121]. The concept involves converting phenomena into quantifiable data for analysis, and is anchored in two key elements: first, the infrastructure that enables data collection, processing, and storage; and second, the value-generation mechanisms such as analysis, surveillance, and monetization, predominantly controlled by large corporations and states. Building on these frameworks, we distill three critical elements essential to "data", specifically in the context of online platforms:

- The first, *Data Collection*, defined by Solove as "the watching, listening to, or recording of an individual's activities" [95]. In the context of online platforms, this involves the gathering and storing of user information. A significant dimension within this element is data sharing – how platforms distribute the collected information to other entities, such as internal departments, partner companies, third-party vendors, or advertisers.
- The second element, *Data processing*, refers to the process in which digital platforms process, analyze and make use of collected user's data. In the context of social media and other online platforms, this involves using users' data to generate services and content, often supported by algorithms.
- The third element, *Data inference*, involves the further processing and analysis of user data by online platforms to evaluate or predict personal aspects, such as work performance, economic situation, or health. This aligns with Solove's categories of data dissemination and invasion, as well as the value-generation aspect of datafication. What sets *Data Inference* apart from *Data Processing* is its capacity to *learn* about individuals or groups about their personal aspects, going beyond simply processing data for services like video recommendations.

3.2 Unpacking Autonomy in Data Autonomy.

In line with our discussion on data autonomy, we aim to provide clarity on our interpretation of "autonomy" within the digital realm. As elaborated in Section 2.2, the philosophical discourse on autonomy is expansive and multifaceted. For this paper's purposes, we have honed in on the widely acknowledged classification of autonomy for adolescence [10, 28, 91, 96]. This classification encapsulates the myriad definitions and conceptualisations into three distinct forms:

- The first, *Cognitive Autonomy*, which refers to an individual's ability to think independently. It involves self-governance of the mental action or process of acquiring knowledge and understanding, to evaluate thought, to voice opinions, critically evaluate information, and to form personal beliefs.
- The second, *Behavioural Autonomy*, which refers to an individual's capacity to act independently, make their own decisions, and carry out actions based on their personal judgment and values. It involves the ability to self-regulate, take responsibility for one's actions, and behave according to one's own decisions and choices.
- The third, *Emotional Autonomy*, which refers to an individual's ability to identify, understand, and manage their own emotions independently. This involves the capacity to distinguish one's own feelings from those of others, handle emotional dependence, and maintain emotional stability without relying excessively on others.

3.3 Data Autonomy: A Working Definition

Building on the aforementioned concepts on "data" and "autonomy" across multiple disciplines. We now present an overview as a working definition of data autonomy in the digital realm:

> *Data Autonomy*, can be summarised as the empowerment and capability of individuals to comprehend, exercise control over, and reflect on the collection, processing, and inference of their data within the digital realm. This concept underscores the importance of informed understanding, active decision-making, and critical reflection in the way personal information is handled and utilized in online environments.

Please note that this definition is not intended as the definitive official interpretation. Rather, it is offered as an overview and a working understanding of what data autonomy may look like, guiding and informing the design and development of CHAITok.

4 SYSTEM DESIGN AND DEVELOPMENT

How can we design for children's data autonomy on their daily-used social media platforms? We selected TikTok as our primary platform for implementation due to its global popularity among children [67, 76]. In this section, we present the design and development of *CHAITok*, an Android mobile application that is constructed upon the foundation of TikTok and rooted in the data autonomy concept defined in Section 3. CHAITok is not intended to be a complete replacement for TikTok; instead, it functions as a *proof-of-concept* system built on TikTok's existing framework. Our aim is to explore how can we foster children's data autonomy within a social media environment that is already familiar to them.

4.1 Ideating

Our design objective is to introduce design elements that support children's development of different forms of autonomy, as defined in our working definition of *data autonomy* in Section 3. This support of autonomy is expected to occur as children engage with TikTok's datafication practices, including data collection, processing and inference. We initiate our design process by creating a separate design canvas for each of the three phases of datafication. Within each design canvas, co-authors suggested a set of design features aimed at supporting one of the three forms of autonomy. These

feature sets for each design canvas were then collectively evaluated by co-authors based on criteria like expected impact on users, novelty, and technical feasibility. The highest-scoring features for each design canvas were implemented.

4.2 CHAITok

In the CHAITok app, we implemented the three design canvases as sequential pop-up panels that appear after a finite series of video recommendations. Through our pilot study, we determined the ideal number to be 15 videos, which allows children to clearly see how their choices affect the recommendation patterns, without becoming overly engrossed in the videos. This means that while using CHAITok, rather than endless scrolling through videos, users will be shown a pop-up data panel after every 15 videos viewed. This staged approach guides users through the core aspects of datafication: from data collection, processing, to data inference. While users may experience diverse datafication practices on social media, we used the pop-up panels to direct their attention to specific sets of practices.

Upon launching CHAITok, users first see the data collection panel. Users could configure the panel by setting what personal data they allow CHAITok to use for creating video recommendations. They can then click 'Show me my videos' and receive a set of 15 recommended videos. Our video recommendation page in CHAITok resembles TikTok's 'For You' page, where users can swipe up to view videos, as well as like and comment, mirroring typical TikTok behaviors. All user interactions are recorded. As users swiped through these 15 videos, the data processing panel is triggered, where users can adjust a new set of configurations, which can influence the next set of 15 video recommendations. Similarly, after swiping through the second set of 15 videos, the data inference panel appears. Figure 1 shows a visual overview of the user flow in CHAITok and we introduce the detailed features of each panel in the sections below.

4.2.1 Data Collection Panel (Figure 2). This panel appears upon launching the CHAITok application, and is designed to support children's autonomy on the collection and sharing of their data. To support children's ***cognitive autonomy*** we include the following features: a **"Seek Help"** button that displays a demo video on navigating CHAITok; an **"Examples"** button that presents real-world examples and news related to datafication on social media; and a **"WHAT IS"** explanatory message which offers a brief explanation of what data collection entails on social media platforms.

In the section dedicated to children's ***behavioral autonomy***, users are first nudged to review and manage the various data types they wish to share with CHAITok through the **"THINK & ACT"** message. After reading through these messages, users can then use the **toggle buttons** in the **"Control Panel"** to indicate their preferences in two key areas: 1) personal details to be used by CHAITok for video recommendations, including age, language, areas, as well as user-selected video interest categories (e.g., Pets & Animals, Gaming); and 2) sharing or withholding online activity data from platforms like Google (e.g., "your browsing history on Google"), or Amazon (e.g., "your purchase history on Amazon") with CHAITok. The selection of data types stems from our analysis of TikTok's privacy policies [101]. We do not claim this offers the most comprehensive representation of data that might be collected by TikTok, but serves to stimulate children's reflection and consideration of the data collection process. For each study, we pre-filled some personal details based on the year groups we visited, including age (e.g., "12 years old"), area (e.g., [school's location]), and second language (e.g., "French" if teachers informed us they were studying it). While not aiming for perfect accuracy, these steps were taken to help children more contextually make their decisions.

Finally, to support children's development of ***emotional autonomy***, they are encouraged to reflect on their sense of autonomy by the **"HOW YOU FEEL"** message in the panel. Once completing all the configurations, users can click **"Show me my videos"** to see 15 recommended videos on their video recommendation page. For instance, if users activate the "Second Language: French" or "Area: [City X]" toggles, they will receive recommendations for French-language or locale-specific videos, respectively.

4.2.2 Data Processing Panel. After users have scrolled through the 15 videos, the *Data Processing Panel* pops up (see Figure 4 in Appendix), designed to support children's autonomy on the processing of their data. The features around ***cognitive autonomy*** and ***emotional autonomy*** stayed the same. The **Control Panel**, which aims to support children's ***behavioural autonomy***, enables users to adjust two key features: 1) using **toggle buttons** to modify how their data is processed. For example, the app analyzes tags from videos they engaged with and presents the top three interests, such as Gaming or Beauty & Fashion. Users can either accept these summaries or make adjustments; 2) using **slide bars** to customize CHAITok's recommendation algorithm by adjusting the importance of different data points, including personal information, declared interests, and video interactions. These slide bars enable users to set the weight of each data point in the algorithm to low, medium, or high. After configuring the settings, users can click **"Show me my videos"** to receive 15 new video recommendations according to their customisation. For instance, if they set a high weight for interaction data, the algorithm will focus more on their likes, comments, and watch time, suggesting videos similar to those that they engaged with. If they prioritised personal info, the algorithm will recommend more videos based on their personal info, like kid-friendly content or those relevant to their locale.

4.2.3 Data Inference Panel. After scrolling through another set of 15 videos, a *Data Inference Panel* appears (see Figure 5 in Appendix), designed to strengthen children's control over data-driven assumptions made about them. The features around ***cognitive autonomy*** and ***emotional autonomy*** stayed the same. The ***behavioral autonomy*** features include a **Control Panel** that allows users to review and control assumptions derived from their interactions with the last 30 recommended videos. For instance, if a user often likes, comments on, or stays longer on pet-related videos, we might assume, "You have pets at home because you've been quite into Pets & Animals videos". CHAITok computes these assumptions based on methods outlined in previous articles published by Google on ad personalization [37]. We do not claim these assumptions to be fully accurate or exactly representative of social media platforms' actions. Our goal is to provide simplified examples to children, helping them understand how assumptions could be made about them using their

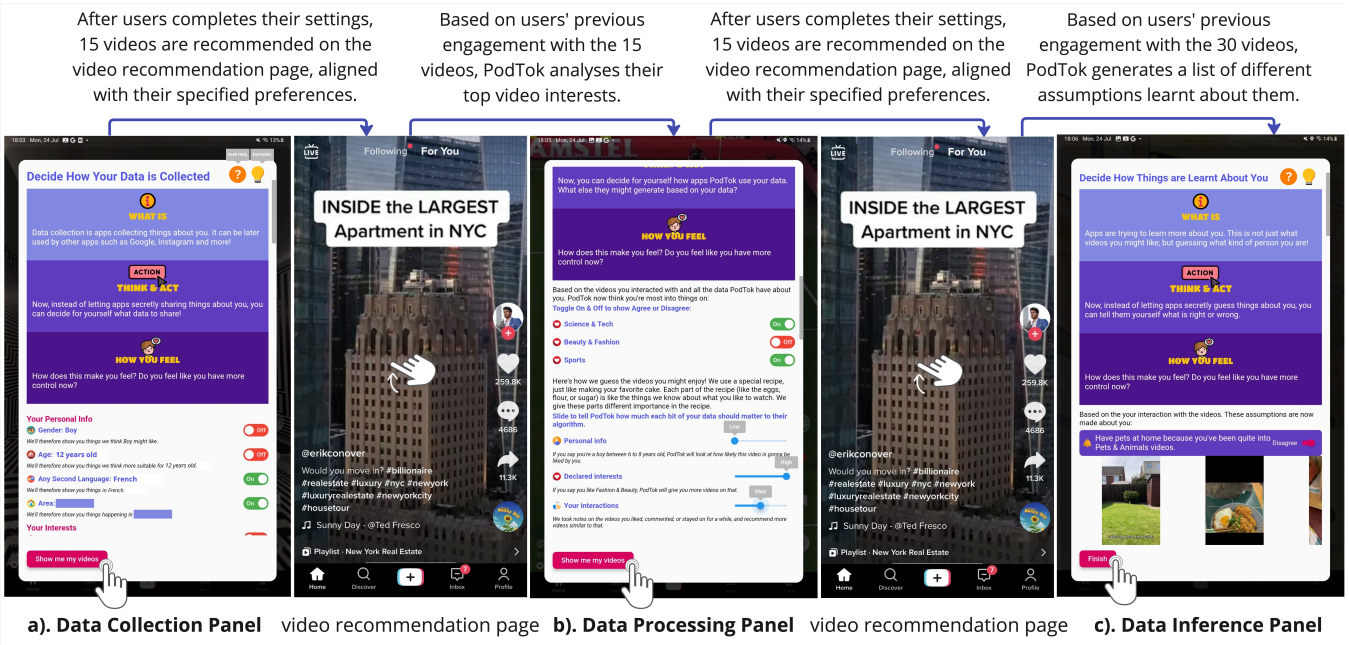


Figure 1: A visual representation of the user interaction flow in the CHAITok application from panel to panel.

data. Users can use **toggle buttons** to agree or disagree with each assumption. Finally, users can click **"Finish"**, which marks the end of their activities on the app.

4.3 Implementation & Piloting

We did not use TikTok's API for our project; instead, we built the app from scratch using Android Studio for Android 13 and integrated with Google Firebase. Our goal was to mimic the TikTok user experience while maintaining full control over content safety and recommendation algorithms. Our videos are from our hand-curated database hosted on Cloud Firestore, ensuring all content was appropriate. Interaction data was also stored in this database to improve the recommendation algorithms. We also set up pre-registered anonymous accounts for children to use during the studies to safeguard their identities. Our research team initially piloted the CHAITok app on our Android devices, conducting multiple rounds of configuration checks on the three panels and reviewing the recommended results. This process helped us identify several usability challenges, from font size issues to delays in updating recommendations, which were subsequently resolved. We then piloted our app with three active TikTok users, aged 10, 11 and 13, who helped us identify further usability issues, including trouble locating configuration buttons and subtle changes in recommendation that were hard to notice. We addressed all these concerns to further refine the app's usability and functionality. We have also found that having 15 videos between popups strikes the right balance: it sufficiently engages children and allows them to identify noticeable changes in their recommendations, without becoming so absorbed in the video content that they lose focus on the study itself.

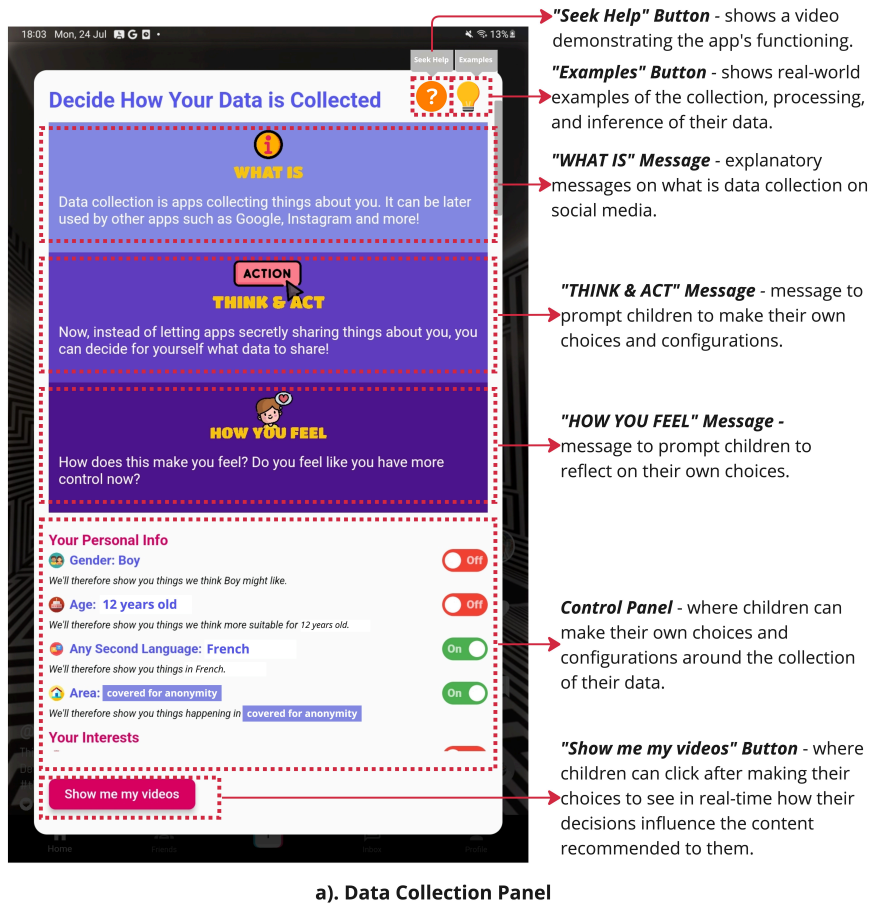
5 USER STUDY

5.1 Participants

For our user study, we recruited 109 children aged between 10 to 13 through school recruitment. The participants were required to be active TikTok users (using the app for more than five hours weekly). We selected this age group for several reasons. Firstly, reports have highlighted that this is a critical period during which children move from parent-supervised online activities to active social media participation [74–76]. Additionally, this age bracket is usually the period when many children across the globe progress from elementary to middle schools, a shift often leading to an increase in their online social interactions [26, 114]. It is thus essential to assess the experiences of children at this stage regarding social media datafication, as it often marks their entry into the digital world. Among the 109 participants (M = 11.8, SD = 0.95): 27 participants were 10, 27 were 11, 27 were 12, and 28 were 13 years old. 53 were girls and 56 were boys. We visited a diverse array of 8 schools: two state schools, two grammar schools, one private school, one Catholic-faith school, and one Muslim-faith school.

5.2 Procedure

We carried out 27 user study sessions involving 109 children between April and July 2023, post-IRB approval. Each study involved 3-5 children and was led by 2 researchers in school classrooms, using Android tablets with the CHAITok app pre-installed. The children in each session were usually classmates, fostering a more dynamic interaction and mitigating the cold start effect. Every study spanned a duration of 90 minutes and consisted of three sessions:



a). Data Collection Panel

Figure 2: Screenshot of Data Collection Panel. All three panels follow the same interface design, and contain a "Seek Help" button (shows a demonstration video on how to navigate CHAITok) , an "Examples" button (shows real-world examples of the collection, processing, and inference of their data). A "WHAT IS" message (explanatory message on data collection/processing/inference). A "THINK AND ACT" message (prompting children to make their own choices). A "HOW YOU FEEL" message (prompting children to reflect on choices). A control panel (where children can make their own choices on the collection/processing/inference of data). A "Show me my videos" button (children can click to instantly see how their choices affect the recommended content).

5.2.1 Warm up (10-min). We kicked off the study with an ice-breaker game. Children tossed a ball and the catcher named their favorite social media platform, followed by a brief thought on how that platform might handle their data. We asked children to elaborate on their responses without judging their answers as right or wrong. The questions aimed to provide initial insights into their understanding of their data on social media platforms.

5.2.2 Session 1: Tasks with CHAITok (40-min). In this session, participants were introduced to CHAITok via a 2-minute video that summarized its key features and instructions. This video is also accessible in-app under the "Seek Help" button. They were then given 5 minutes to freely explore the app and ask any questions to the researchers. Next, children were presented with three activity sheets, each containing the tasks associated with each of the three panels (see Figure 3) that correspond to the datafication process. Though they were encouraged to record their thoughts and actions on these sheets, it wasn't mandatory. The task sheets were introduced to provide children with a structured framework to consolidate their thoughts [5, 94], and children were reminded to verbalise their thought process for the audio recording. During tasks, children were encouraged to collaborate as a group. Researchers observed and noted points for discussion in the follow-up interview, intervening only when technical support is needed. Upon completion, children were provided with a 10-minute break during which they could hydrate and enjoy some snacks, which were conveniently arranged for us by the schools.

5.2.3 Session 2: Semi-structured Interview (30-min). In this session, we carried out a semi-structured focus group interview. We began by prompting the children to share their most surprising findings from the session and identify the most exciting features. Next, we encouraged them to reflect on and articulate the concept of *data autonomy*. We directed the children to focus on three main questions:

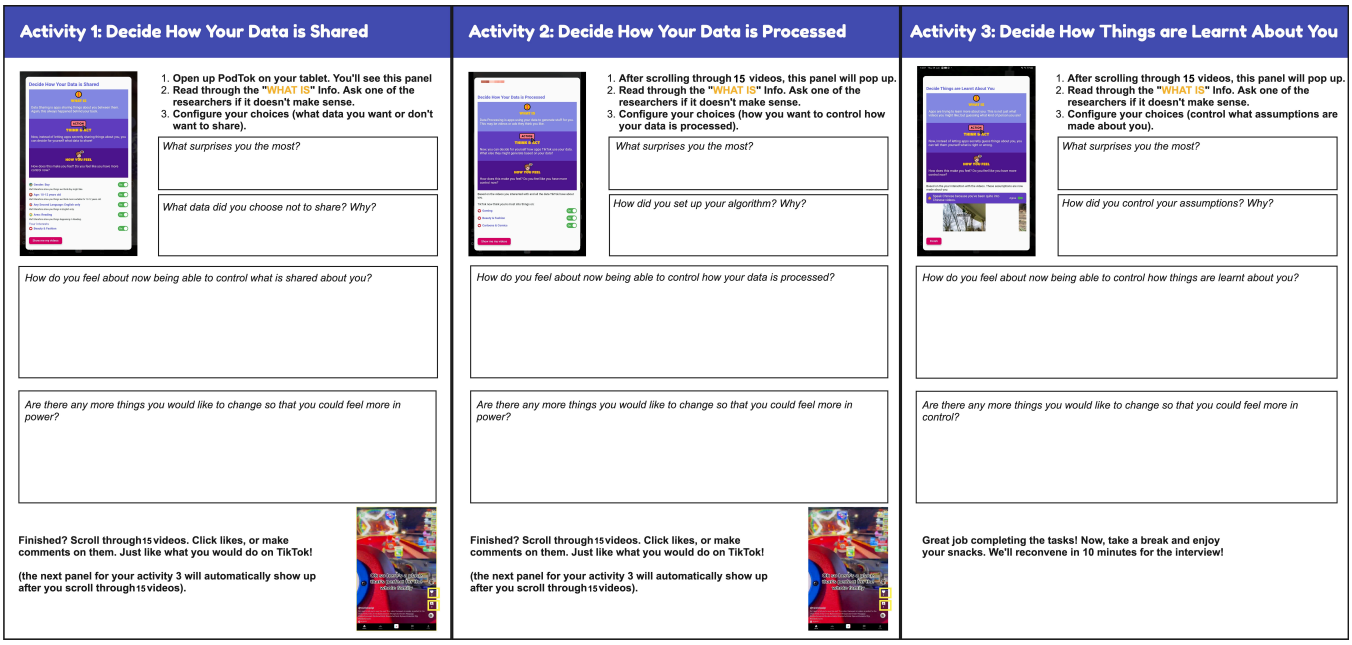


Figure 3: Activity sheets used for guiding children through the tasks on each panel.

1) After participating in the session, did they feel a greater sense of autonomy over their data on social media platforms compared to their prior experiences? 2) What additional features or support would make them feel greater sense of autonomy with their data? 3) How would they define 'data autonomy' in the context of social media, and did they feel they currently had this autonomy on existing platforms?

We tried to use the exact term *data autonomy* in our interview questions as much as possible to accurately capture children's expectation of this concept. While some children shared their thoughts insightfully, others found it abstract or confusing. To mitigate this, we used alternative phrasings like "in control", "empowered", or "have a say". These phrases have also been used in previous HCI studies on understanding users' sense of autonomy and agency, which were found to be more understandable and capable of capturing study participants' judgments [8, 61, 71]. This also served as a great starting point for children in our study to elaborate on their thoughts about data autonomy. Any additional points noted in the observational notes from Session 1 were also addressed.

5.3 Data Analysis

All user studies were audio-recorded, yielding 2673 minutes of data that were transcribed for analysis. We employed thematic analysis [50], and cross-referenced transcripts with observational notes and children's written responses on the worksheets to complement our analysis process. The first two authors initially coded 20% of the data independently to create a preliminary codebook. This was followed by a group discussion involving all authors to explore individual codes, resolve disagreements and finalise into a final codebook (interrater reliability exceeded 90%) which is used by the first author to code the rest of the data.

6 RESULTS

To address our research questions, we first outline children's general experiences and perceptions about data handling on social media platforms **(RQ1)**. Next, we discuss their user experience with the CHAITok app and how it influenced their sense of autonomy over data **(RQ2)**. Lastly, we explore their visions for gaining more autonomy over their data, including desired design features and expectations towards *data autonomy* **(RQ3)**. While our study is organized into three sessions, findings aren't confined to specific parts. For example, children might discuss their current social media experiences or interactions with CHAITok at any point. The study is best viewed as an integrated process where themes can emerge and be explored at any stage. Participant quotes are presented with their ID and age for context.

6.1 Children's Current Experience and Perception on How Social Media Platforms Handle Their Data

All 109 children reported using various social media platforms, with TikTok, YouTube, Snapchat, and WhatsApp being the most popular. Nearly all knew they technically shouldn't be using these platforms due to age restrictions, but explained they still did, *"My mom set it up to stay connected."* (P2, age 10), or *"Everyone in class is using it."* (P38, age 12).

Although our primary focus wasn't on digital literacy, our findings do indicate that children between 10 and 13 have considerable understanding of how social media platforms use their data; and we did not find a significant difference in the understanding across this age bracket. The majority of the participants were aware that platforms **collected** their data, including personal details, such as

mobile numbers and email addresses, and online behaviors, such as engaging with videos on TikTok, sharing content on Instagram, and connecting with friends on Snapchat. While many children had a vague idea that their data would be **shared** across platforms, only a few could clearly describe this process. Some referred to it as *"selling my data"* (P12, age 10), while others more insightfully called it their "digital footprint", explaining that *"Whatever you do online, it leaves a trace and it follows you."* (P37, age 13). We also discovered that most children in our study were well aware that social media platforms would **process** their data, such as TikTok using it to curate better videos for them. There were some knowledge gaps among some children regarding the potential real-world consequences that could be **inferred** from their data. Initially, about two-thirds of the children thought data was only used to improve their video experience or to target advertisements. However, interacting with CHAITok – by reading the "WHAT IS" information, viewing examples, and reflecting on their choices – led them to consider more nuanced implications of their data, such as external influence, nudging, and behavioral engineering, *"Your identity, your likes and dislikes, and everything in your life is being learned by them."* (P15, age 10).

While many children referred to social media platforms as "their favourites" and would spend *"anytime off school on them"* (P42, age 11); almost all expressed concerns with the ways their data is being handled. They shared experiences where they felt a lack of autonomy, or in their own words – *"don't have autonomy at all"* (P37, age 13) over their data.

6.1.1 A Passive and Disrespectful Experience. To start with, many children (around one in three) described their experience with data on social media platforms as quite a passive experience, *"I don't think we have autonomy. Once you enter your data, you can't change or delete it; it's already out there."* (P100, age 12). This perception extends beyond basic data collection to how algorithms shape their experience, essentially turning them into "zombies" by making all the decisions for them, *"The TikTok algorithm is deciding for you what you can like, and the more your data is collected, the more you just become a zombie."* (P40, age 13). Many children were concerned about being manipulated by the processing and interpretation of their data, *"If they just steal your information, it doesn't matter that much. There's way to stop it. But it's annoying if they use your data to put ideas into your head."* (P89, age 11). Some proposed that the handling of their data should be a 'two-way' thing, and otherwise "disrespectful": *"They've made us agree to their policies, but it's should be a two-way system. We have our conditions too, and neglecting that is disrespectful."* (P87, age 11).

As a result, children have shown great distrust in these social media platforms, describing practices as 'being tricked" and "behind your back". Interestingly, many children believed that platforms were intentionally undermining their autonomy by normalizing certain behaviors, *"[P103, age 13] The reason people are normalized to this is that companies are intentionally doing it. [P104, age 13] Yeah, like by pushing more and more 'allow all cookies' and using the exact same wordings and format on everything."* Due to this distrust, some children have developed various folk theories, ranging from believing their data might be sold to foreign governments or the dark web, to suspicions that their devices are always listening: *"[P42, age 11] Doesn't TikTok and Instagram do that, listen to you? [P43, age 11] Yes, my mom mentioned my sister's ballet classes and then we saw ballet shoes in her size on Instagram."*

6.1.2 A Detrimental and Helpless Experience. Many children also expressed concerns about their data-related well being on social media. About a third found it hard to disengage from these platforms, and some even reported sleep issues when using phones before bedtime. Many children connected these experiences to how social media processes their data, saying platforms only aim to capture attention: *"They don't care what's good for you. Like gaming? Let's send you more and who cares it keeps you up all night!"* (P18, age 10). Some children complained that their data is used to push content without regard for their feelings. *"If you search for Covid-19, they flood you with more news. Twitter aims to grab our attention, even with disturbing images. Do people really want to see that?"* (P93, age 12).

At the same time, children felt helpless against these practices. Many considered apps like WhatsApp and Snapchat essential for communicating with parents and friends. They also lacked confidence in "competing against big companies", noting *"all your data will end with a few big companies, like Google; they can piece together everything about you, and there's no undoing that"* (P63, age 11). Some children insightfully commented on the lack of 'good practice' in the industry, *"If even one company tries to do good, it would set a good example for others to follow."* (P73, age 13). Meanwhile, many felt they had been normalized to current datafication tactics, *"Honestly, I haven't given much thought to it since I was born into this system, it was there before me. If you were older and saw the increase in these things, you might have more to say."* (P31, age 12). Children recognised the problems but felt powerless, some even blamed themselves for lack of resilience, *"It feels like it's my fault for not reading their terms. Who am I to complain about options?"* (P23, age 10).

6.2 The CHAITok User Experience

To glean a comprehensive understanding of their experiences with CHAITok, we amalgamated data from diverse sources, including audio recordings of group activities, interviews, and observational notes, thereby facilitating a multifaceted insight into the participants' experiences.

6.2.1 Sense of Security. Initially, many children described their CHAITok experience as 'safe and secure,' a term noted by nearly one-third of them. Typically, they begin by reading the 'WHAT IS' section, which often triggers group discussions, and then scroll to view data might get collected, including activity and interests. This triggers various reactions, from surprise to concern, with a 10-year-old participant (P11) using the term *"reveal the reality"*. Most children were surprised by the amount of data collected about them and questioned why platforms like TikTok needed such information, leading to immediate discussions about the potential harms of extensive data collection.

Many children experimented with various data types, and some chose to turn off their online activity data, expressing fears of future misuse, *"I hadn't realized how freely they could use that data until I saw this myself. They would pretty much know every single*

thing we're doing when we get older." (P16, age 10). We observed that children's inspired thinking often led them to promptly take protective actions, for instance, most children quickly deactivated personal information like name, age, gender, and location in the data collection panel, *"dangerous to give these out."* (P51, age 11). Similarly, many children chose to minimize personal information when setting up their algorithms, only keeping their declared interests, *"The only thing that should matter to the algorithm is our video interests, not who we are."* (P93, age 12).

When later asked about their feelings regarding their choices and decisions, nearly all children expressed feeling "safe", "secure", and "more self-assured". Some elaborated that they now have an "ease of mind" and are more willing to trust and use the app, *"With this app, I feel reassured that we're fine and protected. The fact that I can protect myself ease my mind a lot and definitely made me trust the app a lot more."* (P72, age 11).

6.2.2 Sense of Empowerment. Another significant theme reported by children was an increased feeling of empowerment and interest because they could choose what information to consume, which was believed to be a direct consequence of having control over their own data. Aside from immediate worries such as data leaks or password exposure, a large proportion of the children (about 80%) were also concerned about indirect harms such as data being used to subtly influence them. Children were surprised to see their data choices (e.g., toggling off data types) directly led to immediate changes in video recommendations. This sparked discussions on how different users could encounter completely unique content on the same platform; and due to the ubiquity of these platforms, companies could effortlessly manipulate global content: *"Maybe because platforms like TikTok are controlled by China, the Chinese government might try to push ideas that Americans might not find very good, but that the Chinese might think are acceptable."* (P76, age 12).

As a result, we noted that many children made choices based on subtle concerns about how their data might affect them. For instance, some didn't want their gender information collected, noting that it could lead to stereotypical content: *"Even if it knows that we're girls, it's kind of sexist because it's going to give us videos based on what a girl likes. But girls like all kinds of stuff."* (P57, age 11). Language-based concerns were also raised, *"Like what's happening between Russia and Ukraine. They might show you different things if you choose different language."* (P73, age 13). Moreover, certain kids deliberately opted out of categories like Cartoons to avoid time-consuming content, *"Typically, on TikTok, for cartoons, they would give you one from a whole series. And then it becomes addictive."* (P23, age 10).

We observed increased engagement when children could adjust settings and see real-time changes to their content feed. Even initially indifferent participants became more vocal in discussions after interacting with controls. Many reported feeling empowered, *"Now, I'm actively making choices, rather than just whatever is thrown at me."* (P97, age 13). Some children expressed feeling more prepared and comfortable with online content, *"To be honest, seeing all the beautiful girls on Instagram sometimes makes me feel bad. But now I realize the whole world isn't like that, and I can adjust my filters on this app (CHAITok) to see things differently."* (P35, age 11).

6.2.3 Sense of Respect. Another significant theme reported by children regarding their CHAITok user experience was a feeling of respect and equal treatment. For instance, while reviewing the assumptions inferred about them based on their past interactions, they quickly opposed many of them and engaged in critical discussions about the real-world implications, *"All this made me question if I'm just part of a data cycle. I give the data, they sell and use it, and then its consequences loop back to me. You think you're the customer online? Actually, you're the product."* (P46, age 12)

Children strongly wanted to be seen as equal individuals by social media platforms and to have a voice in their data experience. Their choices were often guided less by specific concerns like harm or influence, and more by a desire for control over their online presence. For example, some disabled data categories they felt they couldn't control such as demographic info, arguing for platforms to collect only modifiable data like activity. Almost all were proactive in accepting or rejecting assumptions about them, indicating a strong wish to shape their online image. We also saw many instances of children experimenting with settings to observe real-time effects and then reflecting on those choices, *"We tried reducing personal info and denying all interests. It's cool that it actually listens to us!"* (P51, age 11).

When reflecting on their choices, many children said they felt more respected and "special", *"It makes me feel special. It's asking my opinion, focusing on what I want and don't want."* (P75, age 12). An 11-year-old (P61) added *"I'm liking this app way more; it's not like YouTube or TikTok at all. It's designed with us in mind. Because it feels like I'm not being looked down in a way. Unlike the apps get to decide who I am and how they see me."*.

6.2.4 What Hinders Children and Why. While most children had positive experience with CHAITok, we did notice instances where the children were stuck. We carefully analyzed these situations to identify obstacles they faced:

Lack of supporting context. As elaborated in section 6.1, most children had a decent grasp of datafication. But for those with less background knowledge, like not knowing that activity data would be collected, they were often more hesitant to engage in discussions. For children who had a foundational understanding of various datafication aspects, the challenge often laid in bridging the gap between theoretical knowledge and real-world applications. For instance, while many recalled learning about algorithms in their ICT or computing classes, some struggled to relate this knowledge to how platforms like TikTok curate content, causing occasional pauses in initial conversations. A related obstacle was the absence of context to make sense of information presented in CHAITok. Even when children had the essential knowledge, they sometimes described the information as *"overwhelming"* (P58, age 13) or had trouble discerning *"what was important"* (P29, age 10), indicating a need for additional guidance to connect the dots.

Disinterest and lack of confidence. We noticed instances where some children showed disinterest in managing their data, which led to a lack of confidence in their capacity to make informed decisions. Although a small group (8 out of 109 participants) expressed this lack of interest, citing they *"don't see the point"* (P4, age 13), this disinterest often stemmed from a previously mentioned lack of context. For example, children who assumed their data was

only used to improve services were generally indifferent to adjust their settings, *"It's good to have all these on? So that they can have all the information to give me the best videos and trends."* (P69, age 11). Among those who were somewhat aware, comments like *"I don't see any direct danger anyway."* (P7, age 13) revealed a level of disinterest. Some even felt resigned to datafication as inevitable, *"That's just how it is. There's nothing we can do."* (P35, age 11); *"The more data they gather, the more money they make. Everything is about money these days."* (P73, age 13). Similarly, doubts about the efficacy of change were expressed, compounded by a lack of trust in all online platforms: *"This idea is great. But I doubt even if you asked them to implement CHAITok, there are still various ways they can get away."* (P99, age 12).

6.3 Children's Conceptualisation on What *Data Autonomy* Means for Them

Towards finishing of activities, children began discussing potential design improvements for greater autonomy. In follow-up interviews, we probed this topic further, asking what additional designs could increase their sense of autonomy over their data, and what *data autonomy* meant to them. In this section, we first outlined the children's practical suggestions for enhancing data autonomy, then their conceptual understanding and expectations of the term.

6.3.1 Children's Proposed Autonomy-Supportive Design Features. Children in our study proposed a range of suggestions to enhance their sense of autonomy regarding their data, which can be grouped into three main categories:

Designs enhancing data safety and security. Among children's suggestions for enhancing their sense of autonomy over data, a recurring theme focused on *enhancing data safety and security*. Ideas ranged from encrypting personal details to real-time alerts for suspicious activities on their social media accounts. Some children also considered the safety of data in transit, like a proposal for a "private web structure" aimed at *"restricting users' data from easily getting around across platforms and apps"* (P100, age 12).

Designs supporting self-reflection of their data. About one in four children suggested features to *support self-reflection of their data*, from basic screen-time tracking, to more innovative ideas like an adapted version of "screen data" that would quantify the amount of data they have shared. Some expressed a desire for tools that promote healthier social media habits, saying, *"Since they have so much of your data, they could use it to guide you into healthier behaviors. Support your autonomy rather than restricting it."* (P72, age 11). Some also proposed features for societal benefit, *"For posts with crucial information, like those about vaccines, make sure they prompt users to pause and reflect."* (P105, age 13).

Designs enabling users to create and control their own recommendation algorithms. Many children looked beyond just interface design to consider what they saw as more autonomy-supportive algorithmic design. They imagined systems where users could *create and control their own recommendation algorithms* rather than rely on a one-size-fits-all platform algorithm. For instance, some suggested letting users input their own hashtags or keywords to influence content tagging (P71, age 11). Some suggested a community-driven approach, enabling people to form groups and collaboratively design their content recommendation algorithms, *'You and your friends could create algorithms just for your group, cause you know what each other likes better. Not just a wide thing that's the same for everyone."* (P45, age 12).

6.3.2 Children's Conceptualisation and Expectation towards Data Autonomy. How do children conceptualise the concept of *Data Autonomy*, and what are their expectations then? In our exploration, we identified three major themes:

Data Autonomy as deciding for your own data. Most children conceptualize the term through the lens of control and awareness. Some children described that having an awareness is the first step, *"Be aware of what's happening with your data? You can't have autonomy if you don't even know these things could happen."* (P90, age 12). Other children further contemplated the aspect of control, *"Data autonomy means having the power to control what's happening with your data, and what are the consequences."* (P26, age 10). Some focused on the more practical aspects of how their data is used, *"It means having control over the content I see, so I can get what I actually want. I may watch a lot of gaming content, but that doesn't mean I really WANT it – it's just addictive."* (P56, age 11). Some children extended the concept of data autonomy to include a "mindset", *"It's not just about control but also feeling secure and safe in your choices."* (P57, age 11).

Data Autonomy as resilience over own data. Another major theme of data autonomy is resilience – the capacity to resist external control arising from the use of their own data, *"having free will and making your own decisions without being nudged into things using your own data."* (P56, age 11). Some extended it to the concept of "identity", *"It means having your own identity online. You are in control of your own landscape."* (P109, age 13). Some children also focused on data autonomy as a collective thing, *"Your autonomy is impacted by what your friends share or recommend, so it's not just a personal matter."* (P95, age 12). Alongside this concept of collective influence, several children emphasized the importance of self-reflection and personal responsibility, *"Data autonomy also involves you taking responsibility for your choices and understanding where that can take you."* (P23, age 10).

Data Autonomy as developmental competencies to be learnt. Children often express the view that the concept of data autonomy should be age-dependent and gradually acquired, *"It should be based on one's age and experience. Cause you don't want to give a 3-year-old too much autonomy."* (P87, age 11). Others describe expectations for how data autonomy should be taught, rather than simply handed over: *"I think data autonomy should be taught on how to approach things, not just given as 'here's your freedom, off you go.'"* (P22, age 10). This reflects a broader sentiment among children that data autonomy is not an inherent trait but rather a skill or competency that needs to be cultivated. A 13-year-old (P108) commented, *"It isn't something you just have; it's a skill you learn, like Maths or Physics. You don't just know it at 13. So perhaps starting with simple things that you can make own decisions, not just become normalized."*.

7 DISCUSSION

7.1 Impact on Children's Sense of Autonomy Over Their Data

Before diving deeper, it's important to clarify our choice of terminology. We specifically used "autonomy" when describing working

definitions and design goals, and carefully switched to "sense of autonomy" when discussing methods and findings as it often contains self-reported data. It's worth noting that using self-reported data from children may pose challenge as self-reported autonomy may be different from actual autonomy, potentially influenced by a false sense of autonomy [22, 49]. However, in this study, we contend that "sense of autonomy" and actual "autonomy" can largely align due to various mitigating factors: Firstly, in addition to self-reporting data, our observations of children's discussions offer objective evidence regarding children's development of data autonomy, particularly in terms of their enhanced critical thinking and informed decision-making. Furthermore, we took care to ensure that children were not misled into a sense of autonomy when they had little actual control, for instance, the app allows their control to directly affect recommendation outcomes. We propose that by beginning with a "sense of autonomy" perspective, and then integrating the self-reports with direct observations of children's actual thoughts and actions, we can construct a more nuanced and robust indicator of children's perception and development of data autonomy.

Overall, our findings show that children often feel their autonomy is compromised on social media platforms. While CHAITok is not a complete solution, it has notably improved children's self-reported sense of data autonomy. Children felt safer, more empowered, and more respected – *"For the very first time, what I think actually matters on these apps."* (P31, age 12). In addition to these self-reported feelings of greater autonomy, we also observed grounded improvements, aligning with ***cognitive, behavioral***, and ***emotional*** forms of autonomy outlined earlier. For example, we observed that children demonstrated increased awareness of data-related issues, and further spontaneously engaged in critical thinking about the potential uses of their data, beyond just service enhancement, demonstrating signs of improved ***cognitive*** understanding. This shift seemed to arise from a blend of features: scrutinizing the "WHAT IS" information and examples given by CHAITok, while exercising configurations of their settings, coupled with engaging in group discussions. Building on this heightened awareness and critical understanding, we observed that children were increasingly looking for opportunities to exercise control, and exhibited informed decision-making, reflecting enhanced sense of ***behavioral*** autonomy. For instance, they critically considered how social media might produce biased content based on certain data types and modified their choices to align with their values, such as opposing gender-specific recommendations or not wanting to see game-related content. Lastly, grounded in cognitive and behavioral autonomy, children demonstrated greater confidence. This newfound confidence made them feel more at ease for online challenges. For example, when faced with addictive content or content concerning body image, the children felt better prepared. They understood why such content is generated and knew they could exert some control over it by managing their own data – an indicator of ***emotional*** autonomy. Interestingly, this emotional autonomy seemed to reinforce and boost children's cognitive and behavioral autonomy in return. When feeling more confident, children became more proactive in critical thinking and feel more comfortable with making decisions for themselves.

Awareness is undoubtedly the foundational step in the journey toward autonomy. It plants the seeds for deeper critical reflection and the subsequent application of control. However, it's crucial to understand that the development of children's autonomy is not strictly linear but rather a dynamic interplay of various elements that reinforce each other. For example, an initial awareness of data risks prompts children to engage in critical thinking and exercise control, leading to experimentation that enhances both their understanding and emotional autonomy, such as confidence, which then further fuel a cycle of critical engagement and proactive control. Particularly, this research contributes to the existing literature by underscoring the importance of children's emotional autonomy, a dimension often eclipsed in previous studies [17, 21, 110]. Our findings highlight the need to cultivate a mindset in children about their data. Instead of merely approaching data literacy as a skill-based development (like navigating to privacy settings), it's crucial to frame it as a *socio-technical* journey – by encouraging children to grasp its wider societal repercussions, evaluate the consequences of their choices, and consequentially make well-informed, balanced decisions.

7.2 Design Implications

As an initial proof-of-concept focused on enhancing children's data autonomy, our system has shown promising results based on children's responses. These outcomes offer key insights for future design considerations, suggesting how support for children's data autonomy can be integrated in ways that align with their values and behaviors.

Respect children's values: Our findings indicated that children place greater value on the alignment of data-driven outcomes with their personal values than on mere just control over data. They stress that algorithmic content should extend beyond relevance, and also reflect their ethical and social values, such as promoting vaccine awareness or encouraging healthier behaviors. This fresh perspective of respecting children's values should prompt immediate considerations in design practices. In today's social media, algorithms frequently equate relentless user engagement with success, and prioritize engagement over users' well-being. Our efforts to increase transparency and offer customisable settings are a good starting point. Social media platforms could integrate our algorithm control panel, perhaps as pop-ups, during children's interaction phases, empowering children to shape the content recommendations based on their personal values. Furthermore, future designers could build upon our insights to create designs that prioritize children's well-being over engagement metrics, such as implementing adaptive feedback tools that ask simple questions like, "How does this content make you feel" to consistently align with children's evolving values and preferences.

Support children's evolving autonomy: In our study, children demonstrated a need for an adaptive approach to data autonomy, aligning with their evolving literacy and agency. Prior research highlights how autonomy needs to differ by life stage: younger children seek independence from caregivers [86], whereas teenagers aim for independent life choices [7]. Legislation like the UK ICO Age Appropriate Design Code [45] and the IEEE Standard for an Age Appropriate Digital Services Framework [46] also emphasize accounting for children's age and developmental stage in designing of digital services. Designers and innovators must recognise

this complex transition from childhood to adulthood, and put deliberate considerations into children's individual characteristics, vulnerabilities and circumstances. In particular, by focusing on 10- to 13-year-olds, a crucial age for social media engagement [76] and school transition [103], our study found that this age group are especially concerned about external information impact, frequently emphasizing "resilience", which appears different from the traditional notion about autonomy that emphasizes on "agency" and "control" [61, 98] . Our research has also shown that an improved emotional autonomy in this age group is often associated with an improved behavioural autonomy. Echoing the findings from earlier research conducted with adults [61, 62], we also advise that future design efforts for children should emphasize features that foster intentional self-reflection, rather than just aiding in impulse control. Our designs, such as those supporting children to review their interests/personal traits inferences, are good examples. Future designs could also incorporate features such as displaying shared data volume for self-reflection, along with other reflection points on their choices and content encountered.

Design for children's digital rights: In line with prior research [108, 109], our study highlights the importance of children's digital and algorithmic literacy in fostering data autonomy. However, we underscore an urgent need to reevaluate the current focus of designs, which predominantly concentrate on developing children's digital skills rather than providing comprehensive support aligned with their digital rights. Our designs, which allow children to make their own decisions about their digital experiences, specifically those that allow them to control their data collection and manage their own recommendation algorithms, have shown to be effective initial steps in educating and empowering them about their digital rights. Meanwhile, we have observed that current curriculum for children aged 10 to 13 typically cover basic topics related to data collection and algorithms, but predominantly focus on the technical aspects. Existing efforts also typically focus on skill-based knowledge in a defensive manner, like mastering how to turn off personalised adverts [36, 38]. Our findings show that these are inadequate to help children bridge the gap between their skills and practical challenges in real-world scenarios when it comes to exercising their data autonomy. This underscores the profound need to broaden current design approaches, aligning them more closely with children's fundamental rights and well-being. The Children's Rights by Design [58] is an exemplar initiative, based on the UNCRC [73], it offers 11 Childs Rights by Design principles for innovators and designers. The initiative prioritizes placing children at the heart of the design process, urging reflection on digital product impacts while emphasizing children's voices, consultation, and upholding their best interests and agency. We underscore this important direction of future design approaches for supporting children's digital experiences online, focusing not only on providing guidance for children on how to control their data or opt out of data practices on platforms like YouTube, but also on providing mechanisms for them to exercise and develop their rights to their data online.

7.3 Towards Future Data Autonomy as Rights for Children

Our findings shed light on children's views about *data autonomy*, a term not yet well-understood, offering an empirical, HCI-centric look into children's desire for greater autonomy over their data on social media platforms. Interestingly though, many of children's expectations align well with existing philosophical theories. For instance, children seeing *data autonomy as deciding for their own data* aligns with the philosophical idea of *authorship and self-congruence* [83, 88], asserting that individuals act in tune with their core values and needs [87, 90]. Children's perspective on *data autonomy as resilience over data* reflects discussions on *susceptibility to control* [18], emphasizing resistance to internal and external pressures. Lastly, their idea of *data autonomy as a learned developmental competency* aligns with the philosophy of autonomy as *interest-taking* [44, 60], focusing on continuous self-reflection and evolving understanding [19, 88].

Why focus on *data* autonomy then? It's widely recognized that children can face harm on social media. Yet, most discussions have centered around topics related to children's "online safety", like inappropriate content; and "self-regulation", like excessive screen time. While these issues are crucial, the notion of data takes on a unique dimension. We observed that **among the various concerns children have expressed about their lack of autonomy on social media, data always emerges as the central issue.** Even seemingly surface-level aspects like click baits, and what might appear to be content-based issues like addictiveness, are fundamentally tied to the use of data. Children view their data experience on social media as "passive", "disrespectful", "harmful", and "helpless". In extreme instances, some children even blamed themselves for datafication consequences. **Children are struggling, and their rights are being neglected.** In 2021, the UNCRC [73] outlined children's digital rights with four principles: i) the *right to non-discrimination*, ensuring all children have meaningful access to the digital world; ii) *the best interests of the child*, prioritizing their welfare in decisions; iii) the *right to life and development*, addressing online harms and highlighting tech education; and iv) *respect for the views of the child*, stressing their involvement in policy-making and freedom of thought. Regrettably, our findings indicate that none of these four essential digital rights for children are being fulfilled in the current datafication landscape: children are overwhelmed by algorithms, facing limited digital access, having their well-being sidelined in data decisions, and finding their voices suppressed on platforms regarding their data.

These findings indicate that it is critical to **reconsider the role of data autonomy as a fundamental digital right for children**. Data is at the core of the business models of many large online platforms. Examining children's online experiences with the lens of data autonomy reveals new pathways for research, policy, and intervention. Our research has highlighted that, in addition to the existing emphasis on supporting children's self-regulation and digital literacy development, the promotion of their "data" autonomy has received less attention despite being a crucial aspect of children's digital rights. Even the latest guidance on Child Rights by Design [58] has primarily focused on children's autonomy in

terms of behavior and agency, rather than specially on the development of children's autonomy over their data. The main factor behind the extensive datafication affecting children and society is the dominance of a few platform companies with centralized data monopolies [20, 121]. This, combined with the pervasive nature of surveillance capitalism, has diminished the autonomy of children. Our study reflects these concerns, revealing how children feel about their restricted autonomy when dealing with current dominant companies. It serves as a foundation for exploring new design directions aimed at genuinely helping children gain autonomy over their data on these platforms. It also underscores the need to recognize the complex relationship between technology, social context, and children's specific rights and needs, which is fundamental for fostering strategies that can more effectively empower children in the online realm. For instance, while our study focused on children's self-autonomy and did not directly involve parents, guardians, or teachers, their role could also be beneficial. Our study establishes a foundational basis for subsequent research, which could further explore a collaborative effort in enhancing children's data autonomy. In doing so, we pave the way for the development of future platforms designed to prioritize and amplify children's voices, uphold their values, and enhance their capacity for self-determination.

8 LIMITATIONS AND FUTURE WORK

Despite striving for diversity by including free, private, grammar, and religious schools, our participating schools might inherently be more cautious about children's online data. While we did not gather extensive demographic details like family income or racial background, our observations indicated that demographic factors, including the schools the participants attended, did not markedly influence their perceptions. This could be because datafication is a more advanced topic not yet extensively covered in school curriculums, unlike more traditional subjects like online safety. Meanwhile, we acknowledge that real-world platform data practices are far more complex and a lot less implicit than in our study. Nevertheless, we believe that the examples and design strategies we utilized successfully served to stimulate children's reflections and considerations, thus providing valuable insights for future initiatives aimed at supporting data autonomy for children. It's also important to highlight that data autonomy covers a broad range of issues. Our study focused on aspects directly related to children's social media experiences, especially short video platforms like TikTok. Exploring gaming or educational systems may offer different insights.

Future work will explore designing methods based on children's understanding of data autonomy and ways to help them realize their autonomy expectations. It would also be valuable to gather behavioral data from children through field tests or longitudinal studies. Such data could offer valuable insights into the evolution of students' autonomy journeys, identifying which specific designs promote sustained autonomy over an extended period. Meanwhile, inspired by the diverse design ideas and values expressed by children in our study, future research could focus on comparing these insights and values of children with the values of online platform practitioners, and further exploring strategies to motivate developers and practitioners to more effectively enhance children's data autonomy in their work.

9 CONCLUSION

In this paper, we present *CHAITok*, an Android mobile application designed to support children's sense of autonomy over their data on social media. Our research offers vital insights into how children presently perceive data autonomy online, and how we can empower children's sense of data autonomy through a socio-technical journey. Our findings inspire design recommendations to respect children's values, support children's evolving autonomy, as well as designing for children's digital rights. We emphasize *data autonomy* as a fundamental right for children and call for further research, design innovation, and policy changes focused on this critical issue.

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"Seek Help", "Examples" Buttons. "WHAT IS", "THINK & ACT", "HOW YOU FEEL" Messages.
**These features exist on all three panels.*

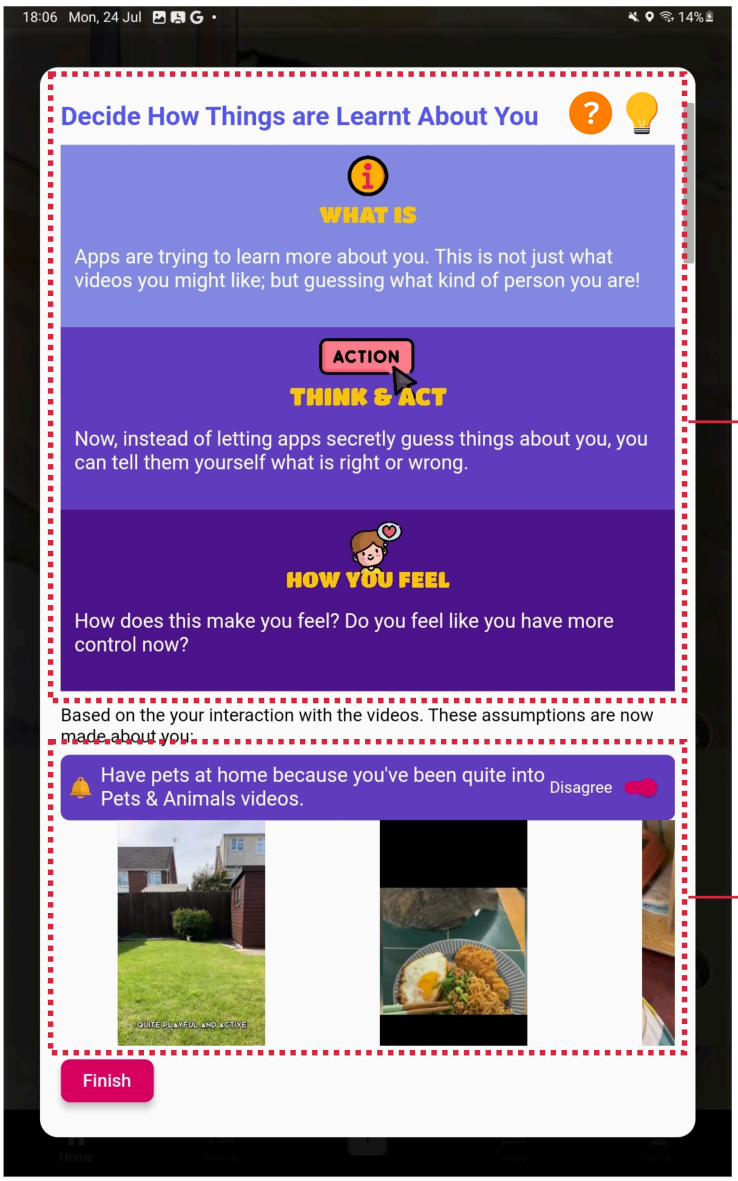
Control Panel - where children can make their own choices and configurations around processing of their data, for instance, control what categories of videos might get recommended.

Control Panel - where children can make their own choices and configurations around processing of their data, for instance, tailor their own algorithm.

"Show me my videos" Button - where children can click after making their choices to see in real-time how their decisions influence the content recommended to them.

b). Data Processing Panel

Figure 4: An example screenshot of Data Processing Panel.



"Seek Help", "Examples" Buttons. "WHAT IS", "THINK & ACT", "HOW YOU FEEL" Messages.
**These features exist on all three panels.*

Control Panel - where children can make their own choices and configurations around inference of their data, for instance, agree or not agree with assumptions made about their personal aspects.

c). Data Inference Panel

Figure 5: An example screenshot of Data Inference Panel.