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AI agency vs. human agency: understanding human–AI interactions on TikTok and their implications for user engagement

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Abstract

Artificial intelligence (AI) technology has vastly reshaped user experiences on social media. AI-powered social media use and its outcomes largely depend on how users collaborate with AI that exercises agency. Through in-depth interviews with TikTok users, this study investigates how users collaborate with AI when using AI-powered social media and how such dynamics shape user engagement. We found that TikTok users are receptive to personalized experiences enabled by machine agency. However, by influencing each other, user agency and machine agency also led to user–AI synergy. Users deliberately influence content curation algorithms to make them cater more precisely to their needs; AI also facilitates users' content creation and networking. Such AI–user collaboration on TikTok significantly influences medium engagement and social-interactive engagement. These findings advance our understanding of the dynamics between human agency and machine agency and, thus, how AI transforms user experiences on social media.

Lay Summary

Artificial intelligence (AI) technology has now been widely applied to social media. AI arranges posts based on user preferences and helps users easily create and share social media posts. AI-based algorithms underlying social media make decisions and initiate actions when interacting with human users, suggesting that machine agency and human agency coexist in human–machine interactions on AI-based social media. This study explores how TikTok users collaborate with AI, specifically focusing on the dynamics between human agency and machine agency, and how such dynamics shape user engagement. In-depth interviews with 25 TikTok users indicate that users are largely receptive to the personalized experiences offered by AI-enabled algorithms. Human users and AI-based algorithms also influence each other when the two interact, leading to human–AI synergy effects. Users try to train algorithms to provide a personalized feed that caters to their interests more precisely. AI also facilitates users' content creation and networking by reducing the efforts to exercise user agency. This study also finds that AI–user collaboration on TikTok influences user engagement with the platform and social-interactive engagement. These findings advance our understanding of how human agency driven by users and machine agency driven by AI collaboratively transform user engagement.

Keywords: TikTok, social media, human–machine communication, artificial intelligence, machine agency, user agency, user engagement

Introduction

The emergence of social media brought on a revolutionary change in technology-mediated communication, as it empowered users to control the communication process through facilitating user-initiated content creation, information navigation, and online networking. However, artificial intelligence (AI) technology further complicated the communication process on social media. Machine agency enabled by AI technology has now deeply and widely infiltrated current mainstream social media platforms, making machines active actors in communication processes on these platforms. AI-based algorithms running in the background of social media platforms autonomously learn users' preferences and interests by processing their behaviors and inputs on the platforms. The algorithms then curate personalized content for individual social media users based on the learned information. In addition, AI facilitates content creation by providing various AI-powered editing features, such as face-detecting filters and smart sound editing tools. AI-powered recommendations also help users create and expand their social networks. Hence, user agency and machine agency interact and co-create user experiences on AI-based social media platforms.

This study thus posits that investigating the dynamics between human and machine agency can be a foundational step that helps us grasp how machine agency shapes user interactions and experiences on AI-powered social media. The extant empirical research on AI-powered social media has mainly focused on user perceptions and experiences as outcomes, such as users' trust in algorithm-generated information (e.g., Zheng et al., 2018) or privacy issues associated with algorithm-based social media (e.g., Kang et al., 2021). However, because the various dependencies between human agency and machine agency largely determine human behaviors within a given human–machine network (Bucher, 2017; Pickering et al., 2017), a more theoretical understanding of the intermediating process through which AI affects users experiences on social media platforms is needed.

This study explicates how user actions afforded by AI-based features on social media lead to different modes of human–machine agency configuration. Sundar (2020)'s conceptual framework for investigating human–AI interactions has suggested that there are several possible ways that users and machines collaborate within an AI-powered medium. There can be agency trade-offs between human and AI: Some interactions can be guided by

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either user agency or machine agency; users may let the algorithms guide their experience; or they may dictate their interactions on the platform. In other interactions, machine and user agencies can influence each other, resulting in agency augmentation between human and AI. Drawing on the Sundar (2020)'s framework, as well as human–computer interaction (HCI) and media effects literature documenting the interplay between the locus of agency in human–technology interactions and user engagement (e.g., Kang et al., 2016; Sundar et al., 2012), this study further explores how human and machine agency interactions on AI-based social media shape user engagement.

This study focuses on human-AI dynamics on TikTok, one of the most popular social media platforms that has integrated AI-based algorithms into their key functionalities as a social media platform. Through in-depth interviews with TikTok users, this study explores how users collaborate with machine agency in the key aspects of social media use, namely, content consumption, content creation, and online networking. Specifically, this study explicates collaborations between human agency and AI agency through trade-offs between machine and human agency and/or via mutual augmentation, and how the human–AI dynamics contribute to user engagement.

Literature review

Algorithms, AI, and AI-based algorithms

Algorithms refer to "encoded procedures for transforming input data into the desired output, based on specified calculations" (Gillespie 2014, p. 1). Any given computerized system, including social media platforms, operates based on a set of complex algorithms. In other words, algorithms make things happen in online spaces and thus are central to formulating how communication, information, and relations are presented, located, curated, and/or even prevented (Wilson, 2017).

On the other hand, AI can be defined as "a system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation" (Kaplan & Haenlein, 2019, p. 17). As this definition denotes, a key characteristic of AI is its capability to modify and even create algorithms based on learned information of users rather than just relying on preprogrammed algorithms. Because of its ability to change, adapt, and grow based on autonomous learning, AI-powered technology is described as having intelligence, which used to be regarded as the preserve of humans. Moreover, Kaplan and Haenlein (2019) explained that AI is a broader concept than machine learning because AI encompasses the ability of a system to actively control and manipulate objects using learned information.

Therefore, in addition to intelligence, agentic capacity emerges as the core facet of AI. Integrating advanced AI technology, algorithms have evolved to gain agency by making highly sequential and contingent decisions involving users' social, political, and economic implications (e.g., Beer, 2017; Kitchin, 2017; Lundahl, 2020; Willson, 2017). One of the most common examples is that AI-powered algorithms have been taking up editorial roles in deciding what is important for users to view and to know (Gillespie, 2014), thus shaping their visions of the world (Lundahl, 2020). AI has also been actively integrated into social media algorithms by the industry in hopes of increasing the total amount of time that users spend on those platforms (Golino, 2021). As a result, the integration of AI into social media algorithms has fundamentally changed user experiences on social media platforms.

The rise of machine agency on social media

The initial advent of social media has significantly altered how we consume and communicate through communication technology, by letting users actively produce and share messages with others rather than behaving as passive audiences (e.g., Ellison & boyd, 2013). Thus, "active user" or "user agency" (e.g., Sundar, 2008) has become one of the key theoretical underpinnings of communication research for understanding user responses to social media and their underlying mechanisms. For example, following the uses and gratification approach, studies have shown that self-expression and self-presentation are the key motives of social media use (e.g., Seidman, 2013). Studies have also identified that agency-enhancing affordances on social media, such as customization, commenting, sharing, and liking enhance the persuasive effects of messages (e.g., Oh et al., 2021).

The integration of AI into the algorithms underlying social media platforms in recent years brought in revolutionary changes in terms of how users interact with, and communicate through, social media. AI-based algorithms of social media platforms underpin "the core functions of social media applications, namely search, aggregation, surveillance, predictions, filtering, recommenders, scorers, content generation, and resource allocation" (Lewis & Moorkens, 2020, p. 2). Shin and Park (2019) described algorithms as not directly facilitating users to achieve worthy goals on online or social networking sites; instead, algorithmic affordances enable users' interactions with the interfaces and their subsequent satisfaction.

Content consumption, content creation, and online networking are the key activities afforded by social media (e.g., Alhabash & Ma, 2017; Carr & Hayes, 2015; Ellison & boyd, 2013). Indeed, integrating AI-based algorithms into social media reshapes those core aspects of social media. In terms of content consumption, social media algorithms have evolved to provide individually personalized newsfeeds based on user preferences, and interests learned from user activities online. For example, Facebook algorithms learn about relationships between Facebook friends, and then place posts from close acquaintances at the top of individual users' Facebook timelines. Instagram also displays a list of short video clips (i.e., 'suggested reels') in the middle of users' Instagram feeds based on what the app has learned about each user's interests. Studies have shown that AI-based algorithms largely determine our everyday information consumption on social media platforms (e.g., Bucher, 2017; Swart, 2021).

AI also affords more convenient content creation on social media platforms. AI-based features, such as video and music editing tools and filters, let users create and share posts more easily. For instance, AI-powered filter stickers commonly available on current mainstream social media platforms detect users' facial features, which automatically synchronize the stickers with users' facial movements when they take selfies or short videos. Javornik et al. (2022) found that using face filters fulfils creative content creation and social interaction motives of social media users. Lastly, AI also enables easy networking among those who share similar interests. Personalized lists of "Who to follow" on Twitter and "People you may know" on Facebook are some of the examples of AI-

based features that facilitate online networking on social media. In the context of TikTok, Eriksson Krutrök (2021) analyzed postings using the hashtag #grief, and found that the ranking algorithms of TikTok that sort out content based on previous user engagement facilitate social connections via mourning.

Understanding human–AI interaction on social media

To understand how AI influences user experiences in AI-driven media, Sundar (2020) has proposed a framework for investigating the psychological process that shapes perceptual and behavioral outcomes of human–AI interaction. The Theory of Interactive Media Effects for the Study of Human–AI Interaction (HAII–TIME) suggests that AI's affordances can affect outcomes such as users' perceptions, engagement, trust, and experiences of AI via two different routes—cue and action routes (Sundar, 2020). Cueing AI as a source of user interactions can trigger certain heuristics based on mental shortcuts or stereotypes that exist in users' minds, thereby influencing their perceptions of and responses to an AI-based medium. However, drawing on the dual-process model, HAII-TIME explains that AI can produce long-lasting effects when users engage with AI's affordances through the action route. Given that engaging with AI affordances means interacting with machine agency in the "action" route, the user's experience of AI-powered social media is largely determined by the dynamics between machine and user agency that occur during the actual interactions. Focusing on the action route depicted by the HAII-TIME model, this study investigates how user actions afforded by AI features embedded in the core aspects of social media (i.e., content consumption, content creation, and online networking) lead to different types of human–AI collaboration, thus shaping user experiences on the platform.

The rise of machine agency in AI-driven media suggests the co-existence of machine agency and user agency in human–AI interactions. As a result, AI-based algorithms and platform users co-construct what users experience on the platform (Courtois & Timmermans, 2018). Prior studies have suggested that humans may have ambivalent attitudes toward machines exercising their agency. While users welcome the unprecedented efficiency and convenience AI offers, machine agency enabled by AI may also be perceived as a threat to user agency, creating agency tension (e.g., Jia et al., 2012; Kang & Kim, 2020). This is because humans are innately motivated to control their situations and environment, called effectance motivation (White, 1959). Bucher (2017) suggested that how we experience algorithms in everyday life introduces "force relations," which give users a "reason to react" (p. 41). In a similar vein, but from a critical point of view, Reviglio and Agosti (2020) suggested that assuring user agency can help decentralize the immense power of algorithmic curation of social media, contributing to a more sustainable social media landscape. Such agency tension potentially involved in HAII suggests that user experiences with AI-powered technology may significantly depend on how they collaborate with machine agency when using AI-powered mediums (Pickering et al., 2017; Sundar, 2020). The section below discusses the types of collaboration that may occur in HAII.

Agency negotiation: being guided by machine agency or exerting user agency

One possibility is that users choose to negotiate agency when interacting with AI, either by accepting AI's machine agency and letting it guide their experience, or by exerting control over it using customization or control features (Sundar, 2020). By providing tailored information and services that cater to individual users' preferences, AI-based algorithms guide individuals toward "particular dispositions, habits, and skills" (Lundahl, 2020; p. 9). This notion suggests that users may embrace AI agency for better convenience and functionality. For example, personalized content on an online portal site enhances users' intentions to engage with the site (Kalyanaraman & Sundar, 2006); personalized ads on social media increases brand engagement and attachment, as well as positive perceptions of brands advertised on social media (Shanahan et al., 2019).

However, users may prefer to control platforms by exerting user agency rather than being guided by the machine agency. Using the term "algorithmic sovereignty," Reviglio and Agosti (2020) suggested that the algorithm underlying the current mainstream social media keeps users from actively participating in the algorithm's decision-making process. Hence, self-determination can be an issue when it comes to using algorithm-based social media platforms because fulfilling people's need for autonomy is a powerful psychological mechanism underlying positive user experience with interactive technology. Supporting this notion, Bol et al. (2019) found that customization opportunities on mobile health apps enhanced intentions to engage in physical activity among users with a greater need for autonomy.

Synergy effect through mutual augmentation

In addition to the trade-offs between machine agency and human agency, human–AI agency synergy can be derived from human–AI interactions (Sundar, 2020). The highly intelligent and agentic capacity of AI offers the potential for it to build human-like relationships with its users (e.g., Kang & Kim, 2020; Wilson, 2017). Thus, as users delegate their agency to AI-based algorithms, their everyday needs and actions will be decided based on "a synergistic melding of human and machine" (Wilson, 2017, p. 143), resulting in user-AI interdependence.

Bucher (2017) discovered that Facebook users are aware of algorithms underlying the Facebook platform, which influence individuals' emotions and sense of self in various situations. She then suggested a concept called "algorithmic imaginary," explaining that Facebook users consistently try to make sense of and imagine what social media algorithms are and how they function. The study found that some Facebook users intentionally made their needs and interests recognizable to the algorithms based on their algorithmic imaginary. For example, by hiding posts out of their interests, users attempted to train the algorithm to curate content suited to their interests on the feeds. Moreover, studies have shown that when users are provided with more opportunities to adjust how an algorithm works, AI can better cater to users' specific needs (Sundar, 2020) and decrease aversive responses to the algorithm (Dietvorst et al., 2018). In addition, customization features providing algorithm-recommended options can help users make decisions more efficiently. For instance, when a Spotify user customizes the list of artists in her library,

Spotify prioritizes the artists in the customization tool using the user's listening history. To sum up, user agency and machine agency can mutually influence each other, heightening each other's agentic capacity.

TikTok: AI-based algorithmic social networking site

In this study, we explicate the dynamics between the user agency and the AI agency on TikTok, a video-sharing social networking mobile app owned by Chinese company ByteDance. TikTok is inarguably one of the most popular social media platforms today; with 850 million downloads, 689 million monthly active users worldwide, and over one billion video views per day, TikTok was the most downloaded app in 2020 (Omnicore, 2021). TikTok's user-centric algorithm plays a larger role than other social media platforms' peer-network driven recommendation strategies, making it an optimal venue for examining the interplay between the algorithmic power of AI and user agency and related implications (Rach & Peter, 2021).

On TikTok, AI-based features are integrated into the key aspects of social media, including information and content consumption, content creation, and networking. TikTok offers a "For You" feed algorithmically curated and personalized for each user, based on their past engagement activities and preferences for presented videos, including viewing time, liking, commenting, sharing, and following (Bandy & Diakopoulos, 2020). To select and recommend videos for users, TikTok applies natural language processing to identify textual and audio elements (e.g., sounds) of the videos that users enjoyed, computer vision to classify the videos' visual components, and analysis of the hashtags and captions connected to such videos. TikTok's algorithm is so powerful and aggressive that it can learn the vulnerabilities and interests of a user in less than 40 minutes (Lovejoy, 2021). TikTok also helps content creators create viral videos based on trending sounds, hashtags, filters, and posting times (Davis, 2019). Ma and Hu (2021) describe the AI-based algorithm as TikTok's core technology and explain that the algorithm relies on computer vision to infer users' interests and engagement patterns, enabling it to curate personalized and personal user experiences. Schellewald (2022) suggested that the TikTok algorithm can be configured and domesticated in "everyday processes of meaning making" (p. 1). Collectively, we see the power relation between users and the AI-based algorithm on TikTok being flexible, interactive, and co-determined. Thus, the explication of human–AI interactions on TikTok will provide valuable implications for theorizing the human–AI agency dynamics on social media and their outcomes.

In light of the potential types of collaboration in the HAII action route (Sundar, 2020), this study investigates user–AI interaction on TikTok in the activities afforded by social media. Therefore, we ask:

> **RQ1:** How do users and AI collaborate on TikTok, through agency negotiation and/or mutual augmentation in content consumption, content creation, and networking?

Influences of HAII on user engagement

The study also investigates how HAII on social media influences user engagement in terms of engagement with the medium and social-interactive engagement. Although a number of different definitions of engagement exist, engagement can be broadly defined as a status of being deeply involved in a given task (O'Brien et al., 2018), mediated content (Busselle & Bilandzic, 2009), or a specific subject (e.g., communities, brands, or organizations; Brodie et al., 2013). Because of the user-empowering nature of social media, prior studies have mainly focused on exploring how user agency afforded by social media enhance user engagement (e.g., Kang et al., 2016; Sundar et al., 2012). However, as AI technology is increasingly integrated into social media platforms, it is imperative to update our understanding of social media user engagement by exploring how machine agency and user agency collaboratively shape user engagement.

In the human–computer interaction (HCI) context, Oh et al. (2018) argue that user engagement is a multidimensional construct encompassing psychological and behavioral experiences, including the extent to which users are cognitively involved in interactions (e.g., Busselle & Bilandzic, 2009) and how often users interact with a given technology or interface (e.g., Hutchins et al., 1986). The multi-dimensional perspective of engagement also aligns with how some marketing scholars defined engagement. For example, Hollebeek (2011) conceptualized customer engagement as a multidimensional concept comprised of cognitive, emotional, and behavioral aspects. Oh et al. (2018) suggested that the psychological aspect of user engagement includes psychological absorption in a task (e.g., losing track of time), positive feelings, and interface assessment. The physical dimensions of user engagement include frequency and duration of interactions with the technology (i.e., physical interactions) and sharing experiences with others (i.e., outreach).

In addition, from the computer-mediated communication (CMC) perspective, social-interactive engagement is highly relevant to user experiences on social media (e.g., Habibi et al., 2014; Voorveld et al., 2018) and websites (Calder et al., 2009). Calder et al. (2009) identified that, in addition to personal engagement that includes stimulation, temporal, and social facilitation factors, social-interactive engagement is a significant dimension that comprises online engagement. They found that social-interactive engagement, encompassing genuine interest in others and input from others on the site (i.e., community) and engaging in conversations and socializations on the site (i.e., participation and socialization), significantly influences the effectiveness of ads on the site. For brands and organizations, achieving a greater share of user attention and engagement by creating and managing online communities is the major aim of using social media (Habibi et al., 2014). Therefore, many scholars focused on individuals' positive dispositions towards social media communities when exploring social media engagement (e.g., Dessart, 2017). Given the social-interactive functions that social media perform, this study also investigates how human agency and machine agency collaboratively influence social-interactive engagement, encompassing feelings of social connectedness and social interactions (Calder et al., 2009). Taken together, this study examines how HAII formulates user engagement with the medium and social interactions on social media. Therefore, we propose the second research question as follows:

> **RQ2:** How do the dynamics between AI agency and human agency on TikTok shape user engagement in terms of a) engagement with the medium and b) social-interactive engagement?

Method

Participants and procedure

We conducted in-depth one-on-one interviews with 25 TikTok users in Singapore to answer our research questions. Enrollment stopped when we reached a state of theoretical saturation, describing when researchers "have enough data to build a comprehensive and convincing theory" (Morse, 1995, p. 148) or have sufficient findings to ensure conceptual rigor. According to Low (2019), it is problematic to claim data saturation when no new information/theme emerges from data analysis, as there will always be new insights if data collection continues. Thus, it is more practical and cogent to apply the theoretical saturation principle to cease data collection when the obtained findings address "the core explanatory questions of how and why, not merely descriptive accounts of what question" (Low, 2019, p. 137).

We recruited active users of TikTok between ages 21 and 26, who fall into the demographic profile of the majority users on TikTok. They were recruited through personal networks of the interviewers and snowball sampling. Each interviewee was given monetary compensation approximately equivalent to USD $15. We interviewed 15 females and 10 males with an average age of 22.64 (SD =1.64) (see demographics in Appendix A). Among the 25 interviewees, 14 are users who often browse content but don't create or share, and 11 are both browsers and content creators. Most of them are Chinese (60%, $n = 15$), with 20% being Malay ($n = 5$), and 12% being Indian ($n = 3$). All interviews were conducted in English over Zoom. Each interview was audio-recorded for verbatim transcription.

Two trained research assistants conducted the interviews independently. They followed an interview question list to understand TikTok users' usage patterns and related behaviors and probed for further information when necessary (Appendix B). The interviews lasted around 40–60 minutes. After the interviews, the same two research assistants manually transcribed the interviews verbatim for subsequent coding.

Data analysis

Following a three-step protocol, two interviewers coded all transcripts independently (Tracy, 2013). First, in the open-coding stage, the two coders independently read all the transcripts line by line and assigned initial codes to the original conversations (e.g., codes like "browsing habit" and "addictive use"). They adopted the constant comparative method, which is a qualitative analysis approach in grounded theory (Glaser & Strauss, 1968). Second, two researchers who have theoretical knowledge engaged in the axial/hierarchical-coding stage where they discussed the codes that were generated from their individual analysis and identified the overlapping or prevailing codes. They grouped their initial codes into second-level interpretive themes (e.g., "usage pattern," "user agency," and "machine agency"). The extant literature on affordances, user/machine agency, and user engagement guided their grouping and categorization of the initial codes. These second-level codes/themes are to "explain, theorize, and synthesize" the interviews (Tracy, 2013, p. 194). Lastly, the two researchers discussed each of the second-level themes and decided how they should be theorized or categorized to answer each research question. They merged overlapping themes and excluded rarely mentioned themes. The two researchers also referred to the related theoretical framework to further theorize new findings to answer the research questions.

Results

Human–AI agency collaboration through negotiation and mutual augmentation (RQ1)

First, we investigated how user agency and machine agency collaborate on the major user activities on social media, namely content consumption, content creation, and online networking (RQ1). We found that user activities were facilitated by relevant AI features, implying that user agency and machine agency jointly influence user experiences on social media. Through probing interviewees' experience with AI-based affordances of TikTok, we found that various types of dynamics exist between human agency and AI agency.

Relying on AI-based algorithmic curation for content consumption

All interviewees responded that they heavily rely on Tiktok's For You Page (FYP), which mainly relies on AI-based algorithms for content curation, when browsing content. For example, Kyle (22 years old, male) stated, "...on the For You Page, I stick to there and just keep scrolling." Carol (26 years old, female) also shared that she browses videos mostly on the FYP. She mentioned:

> The content (of Instagram) is purely things that I want to see, and I know that I will see, but as for TikTok, I don't actually follow people per se, I don't follow a selected group of people, I just browse through stuff randomly and whatever that appears.

Personalization and convenience were two main reasons they chose to be guided by AI agency rather than exercising user agency. Machine agency allows for personalized and convenient experiences, echoing prior studies that documented positive user responses to personalized online experiences (e.g., Shanahan et al., 2019).

Linda (21 years old, female) described that TikTok allows her to experience personal and private moments, describing TikTok as "a private little space, even more private than other forms of social media." She explained, "TikTok is full of creators and once it really gets going, it's quite customized to you, so like it never feels strange, or foreign, or boring." Karen (23 years old, female) also echoed, "For You Page gets tailored to things you would actually watch very quickly." Similarly, Carol (26 years old, female) added "I like the algorithm and now all the videos that I watch are really closely tailored to what I like". Robert (22 years old, male) stated that he likes to scroll through FYP because it requires less cognitive effort, stating "it's more intuitive to just, you know, keep scrolling and watch this video, watch the next video."

Limited exercise of user agency for creation and sharing

The video editing tools of TikTok powered by AI technology also provide varied user control and customization features. However, having too many features allowing user control in the video editing tools yield a psychological barrier to creating content among users. Joyce (22 years old, female) explained:

> (Having many customization features) makes it quite difficult for me to create, the barrier to entry is quite high. You have to think about where to find a soundtrack, how you do your transitions, the (special) effects that you want to put (in).

While customization empowers users by making them controllers of the communication process, customization requires cognitive efforts from the users (Kang & Sundar, 2013; Sundar & Marathe, 2010). Thus, customization involves a learning curve for some users, especially those who lack the ability or interest in adopting new technological features (Sundar & Marathe, 2010). This notion has been echoed by some interviewees. Kyle (22 years old, Male) shared that "although the video editing feature of TikTok has a lot of different things... some my friends were saying that it's so hard to create content on TikTok."

Liking and commenting are common features on social media that allow users to become communication sources who actively share and express their opinions on social media platforms (Oh et al., 2021; Sundar, 2008). However, most of our interviewees responded that they rarely like or comment on others' postings. This might be because most videos they see are often posted by strangers, since they rely on recommendation algorithms for content consumption on TikTok. Thus, they do not feel much obligation to people whom they do not know or follow, as David (23 years old, male) indicated, "I feel like following them (creators) seems like a lot of commitment." Interviewees responded that they rarely comment on others' videos, but they like videos quite often for future references, similar to bookmarking. Jessica (21 years old, female) stated, "I will like the videos that I want to keep for later, so they are not necessarily videos that I love, unless it's damn funny," suggesting that liking in TikTok is not necessarily expressing one's views pertaining to the videos.

Ambivalent feelings towards machine agency

While the interviewees heavily relied on algorithm-based recommendations for content consumption, they had ambivalent feelings towards being guided by machine agency. Our findings suggest that the role of agency in AI-based social media is complex and fluid. Interviewees expressed that while they enjoy personalized content and services on TikTok and generally exercise limited user agency, they still aspire to secure user agency. They responded that securing user controllability is important, not only in terms of how TikTok uses their personal data but also in terms of general interactions on the platform.

In terms of their ability to exercise control on the platform, Linda (21 years old, female) cited this as a crucial condition for continued use. She explained that although TikTok provides targeted ads based on her data, she found them manageable: "In general, I think when it comes to spending money because of a targeted ad, it is genuinely (motivated) because I would spend that money because I liked the product anyway." She also added, "In general, unless I can really see how TikTok is controlling me, I will just continue to use it." However, Joan (22 years old, female) expressed a different opinion on the influence of Tiktok's machine agency on her behaviors:

> If they can control what we see on TikTok because it's what we like, they can also control what we see in terms of blocking the things that they don't like. It's kind of scary how it might influence someone's political views also, so there are a lot of big question marks about that.

The above responses indicate that whether or not they feel that they have enough control over the TikTok algorithms and their influences on them, users think securing their agency is an essential condition for continued use of TikTok.

In addition, the loss of privacy is an inevitable downside of an agentic technology that autonomously provides individually tailored content and facilitates experiences (e.g., Agguire et al., 2016; Sundar & Marathe, 2010; Hermann, 2022). This is because personalization algorithms cannot function without accessing and controlling user data. Many interviewees shared their thoughts on privacy issues associated with sharing their experiences with AI-based algorithms of TikTok. We found that sharing personal data with TikTok did not seem to be a critical factor that can overturn TikTok users' affinity for personalized content or interface features. They considered data sharing as the price being paid for using personalized services and believed that there was no other way to live in this digital era without compromising their privacy. For instance, Jessica (21 years old, female) commented, "I don't really care because I think everyone is stealing our data on all the platforms." However, privacy became an issue when they felt like they lost their control over the personal information shared on TikTok. Joan (22 years old, female) stated:

> I wish they (TikTok) would be more transparent with how our data is being collected, and where they're collecting the data from. Are they collecting data from other apps on our phone or just our behavior on the app? So it's a bit questionable, a big question mark about how my data is being used?

Mutual agency augmentation: Human–AI synergy

User agency facilitated by AI for creation and networking.

Although humans strive to exercise user control, exercising agency involves voluntary actions that require mental and physical efforts (e.g., Vohs et al., 2008). For example, customizing interfaces may deplete users' mental resources as they require users to deliberate on customization options and making choices subsequently (Kang & Sundar, 2013). Our results indicated that AI features augment user agency by reducing users' effort required for users to exercise agency, especially when creating content and managing networks. Lisa (21 years old, female), who often creates and shares content on TikTok, mentioned that creating videos on TikTok was a lot easier than she thought due to its auto-sync function: "(To create a video) you just have to select a few different clips from your photo album, and then you choose a song, and then they have an auto sync function. You can create a short video within 20 minutes."

AI-based algorithms also influence the way in which TikTok users form and articulate social networks. Interviewees responded that TikTok's algorithms allow them to discover creators who share content of their interests on FYP. Robert (22 years old, male) responded, "It's way easier to find people or things that interest me or content that interests me on TikTok... I think it is because the main area where people get their content is the For You Page, which is very algorithm-based." When they see interesting content curated by AI-based algorithms, they start to follow the content creators.

This suggests that AI facilitates the creation of online communities of users who share similar interests.

Algorithmic content curation trained by users.

A common criticism about AI-powered social media is that how social media algorithms work largely remains in the black box (e.g., Reviglio & Agosti, 2020), making it difficult for users to adapt the algorithmic information flow created for individual users (Gillespie, 2014). Nevertheless, users persist in trying to understand the formula underlying algorithms based on their daily interactions with them (Bucher, 2017). We found that TikTok users try to figure how the algorithms work to assure that they exercise control over their experiences on TikTok. Joyce (22 years old, female) mentioned that she had to create three accounts to have an account with a properly "trained" algorithm. She described that she failed to create an FYP that was interesting and relevant to her in the first two trials, and finally managed to create the one she liked on the third.

Several interviewees shared that they try to make sense of how the algorithm functions in order to control their influences on them. Kevin (21 years old, male) explained, "The longer I stay for those dance challenges, the algorithm thinks that all these trends fit me a lot." Joyce (22 years old, female) also mentioned, "(When a video on FYP is not interesting or funny), I'd just faster swipe up, because I want TikTok to know that I don't like this kind of content." Choosing who to follow is another strategy that the interviewees use to influence the algorithm: Joan (21 years old, female) recognized her active role in influencing how the algorithm of the FYP works for her by intentionally following the right people and thus informing the algorithm of her preferences. Sandra (21 years old, female) even tried to boost the reach of her videos by figuring out how the algorithms select videos on FYP pages:

> One thing I notice about TikTok is that if you're using trending sounds, this particular video might be able to get more reach as compared to other videos. So, I figured out certain ways to getting the video up more on other people's FYP.

User engagement influenced by human–AI interactions (RQ2)

User engagement with the platform

Through our interviews, we also attempted to probe how human–AI agency dynamics influence user engagement, in terms of engagement with the platform and social-interactive engagement (RQ2). Many interviewees described their experiences on TikTok as engaging and even addictive because of the endless content feed tailored to their interests. Interviewees described the attention-absorbing nature of TikTok, which leads to more frequent and prolonged use. Sarah (25 years old, female) explained, "You'd just keep scrolling, and you don't know how much time has passed." Interviewees explained that the addictive nature of TikTok stems from the fact that users themselves do not choose the content displayed on FYP, but the machine that understands their interests. Users cannot predict what will be shown next, but at the same time, they expect that the subsequently recommended video would somehow match their interests. The 'pleasantly surprising' effect promoted by algorithm-based content feeding systems positively enhances user engagement with the platform. Joyce (22 years old, female) described her experiences as "baiting a carrot in front of me." In a similar vein, Carol (26 years old, female) also explained: "I see myself constantly wanting to scroll through and see new stuff. It's quite hard to get bored if you constantly just see things you don't anticipate. So, it's easy to just get carried away for hours."

In addition, many interviewees responded that they often shared video links with their close friends through other platforms (e.g., WhatsApp, Telegram) when they encountered interesting or funny videos on TikTok. For example, Jessica (21 years old, female) mentioned, "I send TikTok (videos) to my friends, who don't have TikTok, I would copy the link and send it on Telegram." Daniel (21 years old, male) also commented, "Because when I see something cool or something fun, I tend to share it with my friends. I'll send it to a group, and they will just start discussing it." This might be because AI-powered algorithms curate the content that users see on TikTok, and the online network they create is mainly derived from the algorithm, not from their existing network (as we discovered from RQ1). Therefore, TikTok algorithms make every feed unique to each user, encouraging users to share interesting content with others outside the platform.

Social-interactive engagement

From the interview responses, we found that HAII on TikTok fosters social-interactive engagement by enabling niche and fluid communities. These findings are somewhat contradictory to our finding reported earlier that TikTok users are less likely to engage with others through liking and commenting, indicating limited behavioral social engagement.

First, because the algorithm recommends content catering to users' interests, users can easily discover creators who have similar interests. Naturally, social networks are created based on their genuine interests. Daniel (21 years old, male) described TikTok as "a basis for me to form a closer community with like-minded friends." Similarly, Joyce (22 years old, female) explained that TikTok is "more non-conventional. I do see a lot of LGBTQ, fandom, and, K-Pop content on TikTok." Moreover, AI-based creation and editing tools encourage ordinary users to share their videos more easily, nurturing niche communities on TikTok. Lisa (21 years old, female) explained: "Because if you were to do that without TikTok, you would actually need an actual green screen and you need to spend more time on the editing. But TikTok has that filter function ready for you."

In addition, we found that niche communities could flourish on TikTok because users are assured that their content will find its way to like-minded users through the algorithms. Lisa (21 years old, female) explained:

> I feel that when people go onto TikTok, they find a sense of belonging from the variety of personality available. If I am into slime, there are a huge community of slime goers who are already posting videos on slime content and it will probably make me feel that there is a community.

Therefore, users can share their genuine interests more openly on TikTok, like Lisa (21 years old, female), who commented: "What you can do on TikTok is be yourself. This sounds really corny, but I feel like it's a bit more accepting of people who just make videos from their bedroom."

Second, because of the powerful algorithms of TikTok, trends on TikTok are formed and transformed in a very rapid manner. Karen (23 years old, female) explained, "TikTok

algorithm works in a pretty magical way in the sense that they are able to pick up very quickly what you enjoy and what you don't enjoy." This powerful capability to detect and respond to user interests in real-time could therefore position TikTok as a "trendsetter" of youth culture (Kennedy, 2020). For example, Tony (22 years old, male) also explained that TikTok is a place where he can get memes. He also talked about the fast trends of TikTok, "If there's something funny that they (his friends) will be like (on TikTok) 'you see this video already?' and most probably your friends will be like 'yeah' because it's trending (on TikTok)"

Discussion

Our study extends the theoretical understanding of human–AI interactions, primarily focusing on the dynamics between human agency and machine agency that co-exist on AI-based social media and their outcomes. Figure 1 summarizes the processes through which AI-based affordances influence user engagement.

Theoretical implications

We found that machine agency largely guides and influences content consumption, creation, and network buildings on AI-powered social media platforms. Corroborating with prior research on the psychological appeals of personalization (e.g., Shanahan et al., 2019), our interviewees revealed that they enjoy using AI-based affordances on TikTok because they provide personally relevant content while requiring little effort from them. At the same time, users did not actively engage with user agency affordances on TikTok. We found that most users tended not to interact by liking or commenting, preferring to passively consume others' posts. Some interviewees even mentioned that the wide range of video editing features that allow detailed customization pose psychological barriers to using the app.

These results somewhat contradict one of the core notions of self-determination theory (Ryan & Deci, 2000), such that people strive to feel in control of their behaviors. Studies of user responses to algorithms have also documented algorithm aversion (e.g., Dietvorst et al., 2015), demonstrating that humans tend to be averse to and harshly evaluate algorithm-based decisions and prefer humans' forecasts to AI-based ones. One explanation for our findings is that some of the major motives for using social media are escapism and relaxation (e.g., Smock et al., 2011), and thus, users can act as cognitive misers. Therefore, user agency affordances such as customization may not always be welcome, as active control of behaviors can significantly drain users' cognitive energy (Kang & Sundar, 2013).

However, users' acceptance of machine agency when using TikTok did not mean that they did not experience psychological tensions in response to machine agency (e.g., Sundar, 2020), suggesting that configurations of human–machine agency in AI-powered social media are fluid, and therefore complex. The interviewees indicated that loss of privacy is an inevitable cost they must bear in order to enjoy a personalized social media experience. At the same time, however, they cared deeply about their autonomy when their information is shared with TikTok. In other words, realizing the significant loss of autonomy associated with using an AI-powered platform could be a critical point that led them to avoid machine agency and break the human–AI relationship. We also discovered that users consistently attempted to understand how the algorithm works behind the scenes so that they can influence it strategically. This finding aligns with Bucher (2017)'s notion of "algorithmic imaginary," suggesting that users keep trying to make sense of how algorithms work through their experiences. Moreover, this also implies that users understand that they are not powerless; they can exercise their agency within the boundary of a given platform because algorithms run on user data, the essential resources for algorithms (Courtois & Timmermans, 2018).

By extension, the results of this study imply that users of AI-based social media seek to exercise their agency by delegating tasks to AI, thereby exercising proxy agency (Bandura, 2000). Bandura has suggested that individuals gain heightened personal agency when they can influence others who have the resources and capabilities to conduct a given task, calling this *proxy agency*. This finding corroborates with prior research findings indicating the importance of providing balanced intelligibility and user control to mitigate the loss of user autonomy. For example, when using an online dating app, users prefer to have both personalized recommendations and customizable options that help them find potential dating partners (Cho & Sundar, 2022). Also, when users are allowed to make even slight modifications, their aversive responses to AI-based algorithms decline significantly (Dietvorst et al., 2018).

Another notable contribution of the study is that it illuminates the role of machine agency in user engagement. Prior research on social media user engagement has primarily focused on the effects of user agency afforded by customization or self-expressive features (e.g., Oh et al., 2021; Zhang & Jung, 2019). However, this study expands our understanding of user engagement with AI-based social media platforms that exercise agentic capacity, and thus potentially limit user agency. The results demonstrated that receiving content and services contingent on prior interactions and real-time activities afforded by AI-based algorithms positively influences user engagement with the platform. Moreover, because the AI-driven recommendations are not completely predictable, the personalized content feeds also yield surprising effects. As a result, experiencing the machine agency on social media can positive implications for all aspects of user engagement with the medium: frequency of usage, absorption, and content sharing with others (Oh et al., 2018).

The study also reveals how AI influences social-interactive engagement on AI-powered social media. Interestingly, the AI-based algorithm functioned as a catalyst for the niche and fluid nature of TikTok's networks. Because of the unique algorithmic environment that the platform provides, videos created by TikTok users effectively reaches users who are interested in them, thereby fostering niche and fluid communities created not based on existing social connections but on individuals' genuine interests. As a result, TikTok can nurture niche and fast-trending cultures thanks to its algorithm that facilitates a bottom-up approach (Schellewald, 2021) to building social networks and interactions among users.

Our findings on user engagement also demonstrate the complexity of user engagement on AI-powered social media. We discovered that TikTok users do not actively engage in social interactions through actions, such as liking and commenting, even with a heightened sense of community they expressed. This might be because of the passive mode of user activities triggered by AI agency, which keeps users from

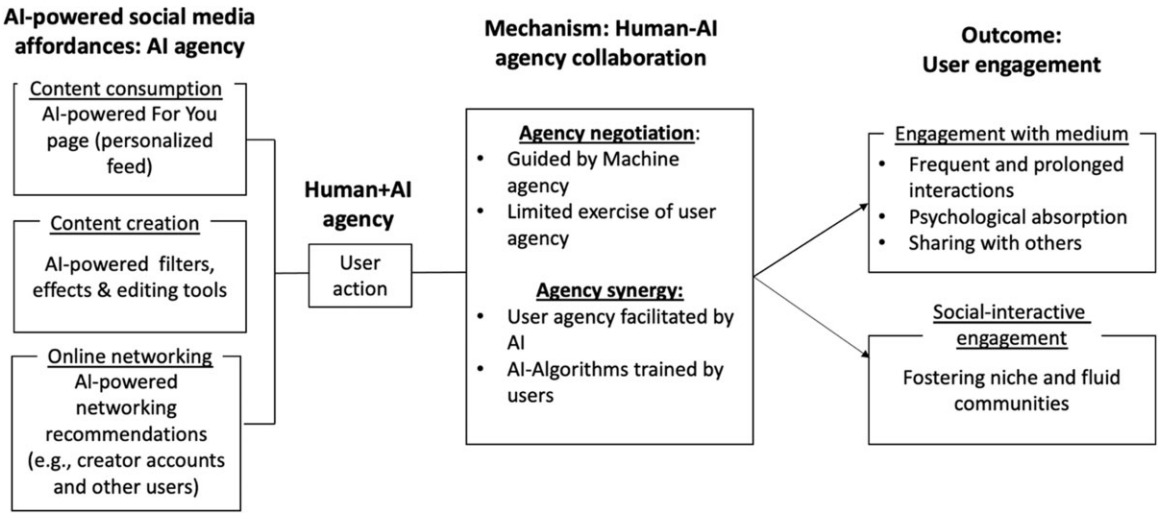

Figure 1 *A Conceptual Flow Explicating AI+User Agency and its Influences on User Engagement on TikTok.*

expressing their engagement through actions. Such complexity potentially underlying user engagement calls for more careful conceptualization and operationalization of user engagement, especially in the AI-powered social media context.

Recent user engagement literature has emphasized the multidimensional nature of user engagement (e.g., Oh et al., 2018). Still, user engagement on social media has often been operationalized, focusing mainly on the behavioral aspect. For example, Kahn (2017) viewed YouTube engagement as comprising click-based participation (e.g., liking) as well as simple content consumption (e.g., browsing). Similarly, in comparing the effectiveness of Instagram versus TikTok as science communication platforms, Habibi and Salim (2021) assessed user engagement by analyzing the numbers of likes, comments, shares, saves, and views. However, as our study demonstrates, user engagement might not necessarily be symbolically manifested through visible actions, such as liking, commenting, and sharing. This result supports Ellison et al. (2020) that non-clicking on social media may also be resulting from thoughtful engagement. User engagement should also entail passive or non-quantifiable indicators like browsing, interests (or lack of interests) in certain contents, or skipping behaviors. Hence, it is important to consider the multi-faceted nature of user engagement for a better understanding of user engagement in AI-powered social media.

Practical implications

The findings of this study offer practical implications for users, content generators, and regulatory bodies. While TikTok users accept machine agency and exercise limited user agency, they still strive to ensure controllability. This result suggests that AI-based social media platforms should not entirely rely on automated AI-based algorithms that do not allow user input or modification.

Additionally, due to TikTok's bottom-up recommendation approach, content generators are more empowered to transmit their content to a potentially large audience compared to non-AI based social media platforms. In other words, content generators can expect to be found and appreciated by other users if they produce quality content, regardless of their number of followers. Content generators can leverage the algorithmic advantage of AI-powered social media to share high-quality content that can potentially reach a large audience based on its topic, hashtags, sounds, and captions.

TikTok is largely an entertainment platform that constantly curates content for individual users. The current findings also boast promising implications for similar algorithm-powered entertainment platforms like Spotify or Netflix. We expect users on these platforms tend to appreciate and enjoy algorithmic curations, the same way in which TikTok users interact with the FYP. AI-based entertainment platforms may want to refine their algorithms to offer highly personalized content and services. At the same time, they should be mindful of preserving users' perceived controllability by providing easy customization options and transparently sharing how they handle user data.

Lastly, our results also provide an important implication for users. The limited exercise of user agency may contribute to overwhelming machine agency on TikTok. Users may be drawn to the content constantly recommended by the platform, resulting in an imbalanced power relation between machines and humans. We advise users to actively engage with the platform and materialize their will when viewing content, which could contribute to a healthier human–machine power relation in technology-mediated communications. In view of TikTok's almighty algorithm that can get users hooked for long periods of time, policymakers should pay close attention to what can be shared and restrict the spread of inappropriate content (e.g., pornographic content and fraudulent ads, Davis, 2019).

Limitations and future directions

This study has some limitations that point to directions for future research. First, this study did not test the effects of specific AI feature(s) applying a variable-centered approach. Nass and Mason (1990) advocated the variable-centered approaches "that describe technologies as a 'box' and those that describe the tasks that technologies perform; that is, the static and dynamic aspects of a technology, respectively" (p. 51). This approach suggests that media effect research should theorize, hypothesize, and test variables, rather than whole media technologies. Hence, when investigating the effects of a specific affordance, it is important to control other factors that operate with the affordance. However, this study aimed to capture a comprehensive picture of how AI-based social

media affordances shape user experiences focusing on the underlying human–AI agency dynamics. Toward that end, we chose a qualitative method, which compromises the establishment of causal relationships between specific variables for a more comprehensive and deeper understanding of given phenomena. However, instead of taking a holistic approach and treating TikTok as a unit of observation and analysis, our investigation focused on the human–AI interactions in content consumption, creation, and networking, the key affordances that define social media. Thus, our results can provide valuable implications for understanding user experiences on various social media platforms that apply AI-based algorithms, not only TikTok. Guided by our results, future research can test the effects of specific AI-powered social media features on user engagement for a more granular understanding of the roles that AI-powered social media features play in user experiences. For example, an experimental study can be designed to test the effects of different types of AI features for content curation (e.g., AI-powered hashtags vs. content filters) on user-AI collaboration and user engagement.

In addition, in explicating the collaboration between machine agency and human agency, we focused on how users make decisions on the level of agency that they exercise and how to interact with machine agency only from the perspectives of users. Thus, our analysis did not consider the level of agency that algorithms decide to exercise or how they are evolved in relation to user agency. Future studies can explore what types and levels of machine agency are exercised in different social media affordances, and how machine agency is adjusted in accordance with its interactions with user agency.

It should be also noted that our study results are limited to user interactions on one social media platform, TikTok. We made this decision to allow interviews to be more focused and data analysis to be more consistent and comparable. Also, we chose TikTok as the study context because it is (a) a widely adopted AI-based social media platform and (b) uses highly advanced AI technology for the key aspects of social media. However, we should note that every result and implication of our study may not be applicable to understanding user interactions on all types of AI-powered social media, although our study has focused on user–AI interactions in the common aspects of social media. Another limitation is that we interviewed mostly younger users of TikTok (aged 21–26) in Singapore. It is also possible that TikTok users may share some unique characteristics, such as the low need for self-determination. Hence, replicating this study in different contexts and populations can help us have more generalizable insights.

Finally, this research mainly focuses on perspectives of browsers, rather than those of active content generators, also called social media influencers. The dynamics between machine and human agency may differ depending on the role (user vs. content-generator) involved when individuals engage with the platform. Future research may delve deeper into the perspective of content generators on TikTok.

Data Availability Statements

The data underlying this article cannot be shared publicly due to the privacy of individuals that participated in the study. The data will be shared on reasonable request to the corresponding author.

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Appendix A. *Demographics of Participants*

ID	Pseudonym	Age	Gender	Ethnicity	Occupation	Browser/creator
1	Kyle	22	M	Chinese	Student	Creator & Browser
2	Joyce	22	F	Chinese	Student	Browser
3	Linda	21	F	Chinese	Student	Creator & Browser
4	Robert	22	M	Malay	Student	Creator & Browser
5	Joan	21	F	Japanese	Student	Browser
6	Jessica	21	F	Chinese	Student	Browser
7	Sarah	25	F	Chinese	Videographer	Browser
8	David	23	M	Filipino	Student	Creator & Browser
9	Karen	23	F	Chinese	Student	Browser
10	John	21	M	Chinese	Student	Browser
11	Nancy	21	F	Chinese	Student	Creator & Browser
12	Lisa	21	F	Chinese	Student	Creator & Browser
13	Daniel	21	M	Chinese	Student	Browser
14	Tony	22	M	Malay	Unemployed	Creator & Browser
15	Mark	24	M	Chinese	Operation Coordinator	Browser
16	Sandra	21	F	Malay	Student	Creator & Browser
17	Kevin	21	M	Chinese	Student	Creator & Browser
18	Emily	23	F	Malay	Student	Creator & Browser
19	Kimberly	24	F	Indian	Student	Browser
20	Carol	26	F	Indian	Business Intelligence Analyst	Browser
21	Amanda	26	F	Indian	Servicing Executive	Creator & Browser
22	Paul	22	M	Chinese	National Serviceman	Browser
23	Amy	23	F	Chinese	Student	Browser
24	Nichole	23	F	Malay	Student	Browser
25	Benjamin	25	M	Chinese	Public servant	Browser

Appendix B. *List of Exemplary Questions*

To understand general usage of social media and TikTok.

- Which social media platforms do you use?
- On average, how long do you spend on social media per day?
- When and how did you start using TikTok?
- What motivates you to use TikTok and other social media platforms?
- Can you walk me through your interactions on or use of TikTok on an average day?
- Which features of TikTok do you use often? What are the features that you like or dislike? Why?

To understand how users collaborate with AI when using TikTok (RQ1)

- How do you browse information or content on TikTok?
- Do you follow any particular person on TikTok? How have you started to follow those creators?
- Do you like that the contents (on TikTok) are varied, or do you prefer to see content from your friends?
- Do you consciously think of the algorithm when you do your browsing on TikTok
- How do the algorithms influence your interactions on TikTok?
- Do you upload your own videos on TikTok? Why or why not?
- Do you have any concerns about using TikTok?

To understand user engagement influenced by the dynamics between AI agency and human agency (RQ2)

- Can you bring me through your user journey of using the TikTok app? How do you navigate TikTok?
- Can you share your thoughts about algorithms on social media? What about those on TikTok?
- Do you find this algorithm makes TikTok addictive to you? Why or why not?
- Do you see yourself using TikTok more often than other social media platforms? Why or why not?
- How does TikTok influence your interactions with others?
- How do you connect with others on TikTok?

* In many cases, the responses to the questions designed to answer a specific RQ generated insights for another RQ.

* During the interviews, probing and follow-up questions were asked when needed.