



The lonely algorithm problem: the relationship between algorithmic personalization and social connectedness on TikTok

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Abstract

Many major social media companies have claimed that their social feed algorithms were designed to promote relational well-being and enhance social connection. This project tested part of these claims by investigating if algorithmic personalization predicted social connectedness on TikTok, where connecting with identity-relevant media content is prioritized over interpersonal interaction. Drawing from the algorithm responsiveness process, we identified perceived algorithm responsiveness (PAR) and perceived algorithm insensitivity (PAI) as perceptual mechanisms of how algorithmic personalization relates to social connectedness. In two preregistered studies, an online survey and a 2-week daily diary survey, results suggested that the TikTok For You algorithm curating frequent and positively valenced identity-relevant content was associated with higher PAR and less PAI. In turn, higher levels of PAR predicted more social connectedness, but PAI did not. These findings highlight the sociotechnical dynamics of algorithms, suggesting human-algorithm interaction predicted social connectedness not only an algorithm's code.

Lay Summary

Social media companies, such as TikTok, claim that their algorithms—the behind-the-scenes technology that recommends what posts/videos users see—are designed to facilitate social connection. But do these claims align with the experiences of social media users? To address this question, our project investigated whether and how algorithmically personalized videos on TikTok's For You feed makes individuals feel more or less socially connected. We conducted two studies to understand the relationship between algorithmic personalization and social connectedness on TikTok. Both studies suggested that viewing frequent and positive content related to one's identity promoted feeling socially connected to others by cultivating a perception that the TikTok For You algorithm understands and validates one's identity. In other words, individuals felt more connected to others when algorithmic personalization on TikTok reflected their sense of self, goals, interests, hobbies, etc. Feeling connected through algorithms appeared to be the byproduct of how users interact with and perceive the algorithm not just an algorithm's code.

Keywords: perceived algorithm responsiveness, social identity, social connectedness, daily diary method, TikTok.

Major social media companies state that algorithms are used on their social feeds—over reverse chronological order feeds—because algorithms make content on their platform more engaging by personalizing toward individual interests, networks, and identities, as well as performing content moderation of online harassment, misinformation, etc., at scale (Matias, 2023). Social media platforms, including TikTok (or ByteDance), also explicitly assert that their algorithmic recommendation systems are designed to improve relational well-being, such as reducing loneliness, increasing social connection, or encouraging meaningful interpersonal communication. For instance, when explaining the algorithm of the For You feed, TikTok states, “Each video is your chance to tell a story, express your creativity, and *connect with others who share your interests*” (TikTok, 2024, emphasis added). Instagram’s algorithmic personalization on their feed aims “to help you catch up with friends, family, and interests” (Mosseri, 2023), which aligns with Zuckerberg’s (2018) assertion that changes to Facebook’s Home feed algorithms were intended to shift focus from finding relevant information to fostering more meaningful social interactions.

Taylor and Choi (2024) argued these consistent and repeated promises from technology companies often go

unfulfilled, creating what they term “lonely algorithms” (p. 1254). This term captures the paradox that these algorithmic systems are allegedly designed to address loneliness and enhance other types of relational well-being, but the evidence and critiques of these claims cast doubts on algorithms as a loneliness antidote. Whereas research supports the connective potential of social media algorithms (e.g., Guess et al., 2023; Wang et al., 2023), each of the same algorithms are also associated with various forms of social isolation, ostracism, or disconnection (e.g., Bucher, 2017; Simpson & Semaan, 2021; Taylor & Choi, 2024). These unacknowledged negative externalities suggest that algorithms meant to bring people closer together will also likely drive people apart. The uncertainties about the veracity of these claims continue upon examining several of their assumptions and contexts. First, these claims prioritize technological deterministic narratives, suggesting that tweaking algorithms has the power to dial up or down relational functioning while minimizing how people construct and use algorithmic systems to meet their relational needs (Matias, 2023). Second, these claims fail to acknowledge (or address) the harms embedded in the classification and categorization of identity central to personalization algorithms (Karizat et al., 2021; Steen et al., 2023). Third, social

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media companies often use these claims as a cyclical strategy to deflect public criticisms, limiting accountability (e.g., Mosseri, 2018, 2021, 2023). Thus, we propose *the lonely algorithm problem* to systematically examine the interpersonal consequences of these algorithmic systems. Our proposed approach recognizes that, although algorithms might help forge and maintain social bonds, they also have conditions and assumptions that undermine their ability to promote social connectedness. Examining this problem will advance theory at the intersection of social media and personal relationships.

Previous research fitting underneath the umbrella of the lonely algorithm problem has examined the positive and negative consequences of algorithmic personalization in fostering personal relationships (e.g., Bucher, 2017; Wang et al., 2023). In addition, an experiment found Facebook's algorithmically-curated feed displayed more friends and family than reverse chronological feeds (Guess et al., 2023). However, previous research about the relationship between algorithmic personalization and social connection focuses on social media that prioritize interpersonal interaction, such as Instagram or Facebook. TikTok's For You feed, on the other hand, diverges from this model of social media, prioritizing content personalized to one's identity over social interaction (Bhandari & Bimo, 2022). This focus on algorithmically-personalized content on TikTok is notable compared to other social media because (1) the For You feed is the default page when logging on to TikTok, (2) the For You feed is where most people get their content on TikTok rather than from the "Following" page, and (3) many people primarily view and scroll through the TikTok For You feed without directly interacting with their existing networks. These divergences make TikTok a potent platform for understanding processes of algorithmic personalization and social connectedness, as it is more about connection via algorithmically-curated content and less about building or maintaining social networks. Previous research has suggested that TikTok's personalization can generate social connection by curating content that reflects the multifaceted aspects of the self (Lee et al., 2022). Yet, the precise ways self-focused algorithmic curation facilitates this sociality remain opaque. One research question within the scope of the lonely algorithm problem is explaining the relationship between algorithmic personalization and social connectedness when interpersonal interaction with friends and family is deemphasized.

This article aims to understand how algorithmic personalization on TikTok can promote social connectedness (i.e., a person's feeling of belongingness and connection to others). To accomplish this goal, we adopt a sociotechnical perspective via the algorithm responsiveness process (Taylor & Choi, 2022) to explicate the link between algorithmic personalization and social connectedness. We (1) advance *perceived algorithm responsiveness* (PAR) and *perceived algorithm insensitivity* (PAI) as potential mechanisms explaining the interpersonal consequences of algorithmic personalization on TikTok, (2) explicate identity representation in algorithmically-curated content, in terms of frequency and valence, as dimensions of algorithmic personalization on TikTok accounting for PAR and PAI, and (3) evaluate the longitudinal associations of algorithm personalization and social connectedness with a daily diary study. Our work addresses aspects of the lonely algorithm problem, highlighting how algorithm personalization and relationships become intertwined

through social media cognitions, even when interpersonal interaction is less salient.

The algorithm responsiveness process

The lonely algorithm problem questions if and how the personalization of algorithms can encourage social relations and reduce social isolation. At the junction of theories of interpersonal communication (Reis & Gable, 2015) and human-computer interaction research on algorithms (e.g., DeVito, 2021; Karizat et al., 2021), the algorithm responsiveness process offers one framework to theorize human-algorithm interplay, especially how algorithms infer and respond to a person's goals, motivations, and identity (Taylor & Choi, 2022). Within this framework, identity encompasses the multifaceted elements of a person's various roles, beliefs, values, social groups, and interests (Lee et al., 2022), and algorithms refer to adaptive computerized systems that collect input data, transform it into the output of curated media content, and update based on human responses to the output (Matias, 2023).

The algorithm responsiveness process (Taylor & Choi, 2022) theorizes an iterative four-stage model of human-algorithm interaction (see Figure 1). A person provides input data to algorithms through various sources, such as clicks, searches, likes, view time, cookies, etc. (Step 1: Eliciting Behavior and Data). The data used are rarely clear to the individual, but TikTok (2024) publicly reports tracking various data sources to feed its algorithmic recommendations, such as user interactions, video information, and account settings. Next, social media algorithms curate a personalized media feed in response to the data collected about that individual (Step 2: Enacted Algorithm Responsiveness). Algorithmic personalization is also shaped by numerous external factors related to the politics, norms, and design of platforms, such as economic incentives or programmer bias (Noble, 2018). The videos and content auto-populated on the TikTok For You feed represent this stage. Next, if the person is aware of social media algorithms, they perceive how well the algorithmic personalization responds to their goals, motivations, and identity (Step 3: Perceived Algorithm Responsiveness). Perceptions of algorithm responsiveness fall along two orthogonal dimensions: PAR and PAI. PAR refers to the extent to which algorithm recommendations are believed to support, validate, and care for a person's identity and goals. PAI addresses the extent to which algorithms are perceived to diminish, misinterpret, or actively work against their identity and goals. Finally, these algorithmic perceptions are, in turn, predicted to influence a range of outcomes of social media use, including attitudes (Oeldorf-Hirsch & Neubaum, 2023), communicative strategies (DeVito et al., 2018), and identity exploration (Lee et al., 2022) (Step 4: Human-Algorithm Outcomes). The process repeats as more data are collected about the person for new recommendations.

If algorithmic personalization alters social connectedness, then the algorithm responsiveness process theorizes that PAR and PAI are the reasons why. As in other models of artificial intelligence or machine agency (Sundar, 2020), focusing on perceptual mechanisms for algorithmic effects is warranted given (1) the limited transparency of algorithmic systems makes them unknowable to users and even their programmers (Schulz, 2023), (2) people operate with individualized understandings of algorithms (Eslami et al., 2016), and (3) repeated interpersonal studies find perceived responsiveness, more than enacted responsiveness, determine interaction outcomes (e.g., Choi & Toma, 2022). Furthermore, mounting evidence shows

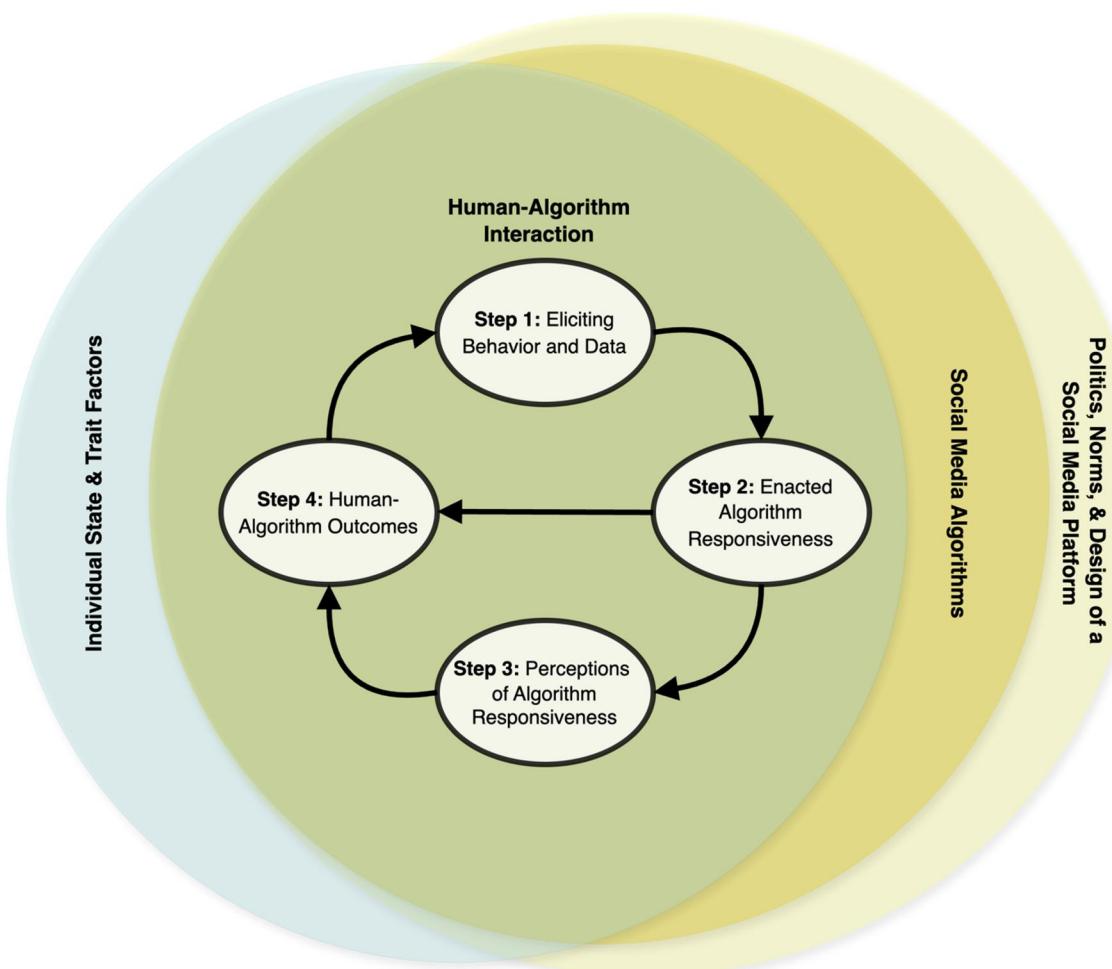


Figure 1. The algorithm responsiveness process.

Note. For more details, see [Taylor and Choi \(2022\)](#).

individuals perceive both algorithm responsiveness and insensitivity. For instance, qualitative interviews reveal that members of marginalized groups find identity support from algorithms while also experiencing further marginalization (DeVito, 2022; Karizat et al., 2021; Simpson & Semaan, 2021). These results are consistent with survey research, which finds that PAR and PAI, although correlated, are empirically distinct with different predictors and outcomes (Taylor & Choi, 2022, 2024).

PAR and PAI are also consistent with the positive and negative perceptions found in the psychology of algorithms: algorithm appreciation and algorithm aversion. Algorithm appreciation refers to the tendency of people to rely on advice from algorithms over humans when making decisions (Logg et al. 2019). PAR may reflect the appreciation people experience from understanding that algorithms curate billions of TikTok videos into a single personalized feed, a laborious and arduous task for a human. Although social media algorithms are designed to tap into a person's identities, goals, and interests (Karizat et al., 2021; Taylor & Choi, 2022), algorithms are far from perfect categorizers or predictors of the complexities of identity. As a result, algorithmic personalization will make incorrect predictions about what content a person will find engaging, such as showing irrelevant or misleading content in the For You feed (Lee et al., 2022). Experiencing these errors can generate psychological

resistance called algorithm aversion, or the tendency to favor inferior human predictions over algorithm predictions after witnessing erroneous algorithm decisions (Dietvorst et al., 2015). PAI may represent some of the aversion to algorithms experienced after the For You feed algorithm (inevitability) makes personalization errors.

Whereas PAR and PAI represent a promising direction for understanding how human-algorithm behavior can influence social connection to other people, there is ambiguity about these mechanisms. First, factors of algorithmic personalization that predict PAR and PAI remain unspecified in the framework. Second, it is unclear if PAR and PAI explain the association between algorithmically-curated content and social connectedness on a social media platform that downplays interpersonal interaction. Third, there is limited understanding of how the cyclical process of human-algorithm behavior unfolds over time. Each ambiguity is theorized and empirically investigated below.

Identity-relevant content and perceptions of algorithm responsiveness

One area to build theory of human-algorithm behavior relates to identifying what factors of algorithm personalization predict PAR and PAI. Initial investigations focused on channel comparisons, finding PAR was greater on TikTok

than other social media (Taylor & Choi, 2022). Previous studies have also emphasized individual differences, particularly algorithm awareness, or a media literacy related to knowing what an algorithm does and its effects on media content (Oeldorf-Hirsch & Neubaum, 2023; Zarouali et al., 2021). More algorithm awareness was associated with more PAR and less PAI on TikTok, Instagram, Facebook, and Twitter (Taylor & Choi, 2022). This finding is consistent with research on many algorithmically-curated media platforms, which finds algorithm awareness predicts algorithm attitudes and satisfaction (Espinosa-Rojas et al., 2022; Gran et al., 2021; Oeldorf-Hirsch & Neubaum, 2023). Individual differences in psychosocial dynamics matter too. For example, a longitudinal survey found that loneliness predicted reports of PAR on Instagram two weeks later (Taylor & Choi, 2024). Whereas channel comparisons and individual differences research clarifies who experiences different levels of PAR and PAI and where, it overlooks what personalized content in the feed (i.e., enacted algorithm responsiveness) predicts PAR or PAI.

Research on TikTok use has recognized identity representations recommended by algorithms as a key aspect of algorithm personalization. With the centrality of human-algorithm interaction on TikTok, each new video prompts the user to consider the question, “Does this represent me?” because the content is supposedly personalized to their identity (Bhandari & Bimo, 2022). There is a long history of media psychology and social identity research, suggesting (1) individuals seek out media consistent with their social identity (Knobloch-Westerwick, 2015) and (2) visibility of one’s social identity in media can promote well-being by making ingroup membership salient (see Trepte & Loy, 2017). Given that TikTok focuses on connecting users with identity-related content rather than facilitating interpersonal interaction or self-presentation, such well-being media effects should apply. However, algorithms influence how frequently certain identities appear, making the frequency of identity representation a critical variable for understanding what predicts PAR and PAI.

TikTok’s algorithms are perceived as sensitive when videos appearing on the For You feed reflect a multifaceted sense of self, rather than constraining recommendations into a few reductive, stagnate categories (Lee et al., 2022). These facets combine trait (e.g., race) and state (e.g., current hobbies) aspects of identity. Initial algorithmic content on TikTok often does not reflect a person’s sense of self, leading individuals to spend time training the algorithm to recommend their identity categories over other irrelevant ones more frequently (Siles et al., 2022). Members of marginalized groups report less frequent representation in their For You feed, suggesting TikTok’s algorithms may de-prioritize or censor relevant content from minorities (Karizat et al., 2021). Transgender content creators on TikTok, for example, state their content is less frequently populated in the For You feed because algorithms may identify them as potential targets of harassment (DeVito, 2022). One strategy for avoiding this algorithmic erasure is using alternative or coded language (i.e., auti\$ム for autism, Steen et al., 2023). Others noted that people formed positive algorithm perceptions when content personalization frequently reflected their goals, interests, or identity (Bucher, 2017). Thus, frequent representations of identities within algorithmically-curated content likely predicts PAR and PAI.

H1: Frequency of identity representation on TikTok is (a) positively associated with PAR and (b) negatively associated with PAI.

Although algorithms may frequently recommend identity-related content, this algorithmic personalization can highlight positive or negative aspects of these identities. Social identity and media effects research suggests individuals favor positive media portrayals of their identity (see Trepte & Loy, 2017), and experimental evidence indicates that one’s perception of the identity depends on the valence of media content consumed (Trepte et al., 2018). However, algorithms complicate seeking identity-relevant content with positive distinctiveness—or the tendency to seek favorable aspects of their ingroup to differentiate their group positively from outgroups. The bias, blind spots, and decontextualization of algorithms means it is often unclear if the content is affirming, trivializing, or attacking one’s identity (Karizat et al., 2021; Steen et al., 2023). Often, negativity in algorithmic personalization includes reinforcing harmful, inaccurate stereotypes of marginalized groups. For instance, some body positivity social media content (e.g., #BoPo) promotes appreciation of all bodies, while others endorse self-objectification and traditional beauty standards, creating opportunities for disparaging algorithmic curation (Vandenbosch et al., 2022). Noble (2018) documented this problem on Google search, finding their algorithms promoted overt sexualization of Black women. LGBTQ+ TikTok users report algorithmic recommended content both validates their queer experiences as well as perpetuates problematic social hierarchies (Simpson & Semaan, 2021). Others have noted this experience of algorithm personalization, whether supportive, patronizing, or destructive, can extend across a broad range of identity affiliations, including fandoms or political affiliations (Lee et al., 2022).

PAR and PAI were conceptualized as perceptions that capture the experience of these algorithmic identity failures and oversimplification (Taylor & Choi, 2022). Extending established work on social identity and media use, the valence of identity representation, or the extent to which algorithms curate perceived positive distinctiveness of an identity category, represents a second dimension of enacted algorithm responsiveness. Receiving positively valenced content about one’s identity likely promotes the belief that the algorithm understands and validates one’s goals and sense of self. Conversely, algorithmic recommendations that correctly classify and categorize aspects of identity but erroneously recommend negatively valenced content, likely from promoting superficial, inaccurate stereotypes, should predict the belief that algorithms are working to undermine or misinterpret one’s social identity.

H2: Positive valence of identity representation on TikTok is (a) positively associated with PAR and (b) negatively associated with PAI.

Perceived algorithm responsiveness and insensitivity as mechanisms

TikTok is demarcated among social media by prioritizing human-algorithm interaction over interpersonal interaction (Bhandari & Bimo, 2022). This difference challenges previous research addressing lonely algorithms, which theorized

how algorithm responsiveness facilitates relationship formation and maintenance (Wang et al., 2023). Yet, repeated studies have documented that human–algorithm interaction on TikTok can facilitate social connectedness (e.g., Lee et al., 2022; Simpson & Semaan, 2021). From an algorithm responsiveness perspective, these alterations in social connectedness are attributable to the sociotechnical process that forms PAR and PAI. This prediction derives from interpersonal interaction research, which widely finds that feeling understood, validated, and cared for by an interaction partner generates intimacy and well-being (see Reis & Gable, 2015). The importance of perceived responsiveness expands beyond interpersonal interaction, fostering well-being in human–robot interaction as well (Rains et al., 2020). Most importantly, initial evidence suggests that responsiveness judgments made about algorithmic recommendations influence social well-being, even without interpersonal interaction. After controlling for interpersonal interaction on the medium, an investigation into Instagram found that PAI, but not PAR, was longitudinally associated with more perceived social isolation (Taylor & Choi, 2024). Qualitative inquiries of human-algorithm behavior on TikTok have specifically identified the extent to which algorithm recommendations are sensitive to one's self-concept as important for creating feelings connectedness to others on TikTok (Lee et al., 2022). Part of the tendency to seek responsiveness and avoid insensitivity from algorithms likely comes from the larger psychological need to belong, feel understood, and supported by others (Taylor & Choi, 2022).

This theorizing on the well-being effects of feeling validated in mediated environments can also be traced to media effects research on media representations. Savvy media users often actively select positive depictions of their identities for self-validation (Knobloch-Westerwick, 2015). Research finds these positive depictions bring social benefits by increasing the perceived visibility of one's social identity, which is often associated with enhanced self-esteem (e.g., Bond & Miller, 2017; McKinley et al., 2014). This sense of feeling “seen” through media representations enhances individuals' sense of belongingness, contributing to overall well-being. This differs from how interpersonal interaction facilitates belongingness, often resulting from processes like social support or self-disclosure. Within today's media ecosystem, algorithmic recommendation systems play an increasingly significant role in finding positive portrayals of one's identity, which, when positive distinctiveness is curated, may bear similar benefits of selective exposure. Furthermore, because of the human–algorithm interaction on social media, feeling seen requires communicating with algorithms about one's goals and identity. Thus, there is theoretical and empirical evidence to posit PAR and PAI are related to social connectedness.

H3: PAR is positively associated with social connectedness.

H4: PAI is negatively associated with social connectedness.

Bringing together the algorithm responsiveness process (see Figure 2) to understand one aspect of the lonely algorithm problem indicates that algorithmically-personalized media content (i.e., Step 2: Enacted Algorithm Responsiveness) predicts social connection (i.e., Step 4: Human-Algorith-

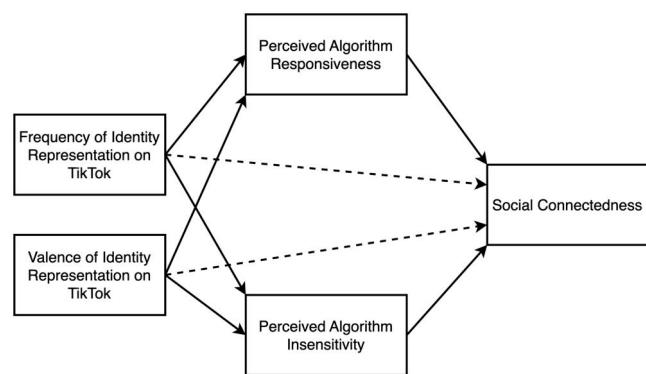


Figure 2. Model of identity representation on TikTok to social connectedness via PAR and PAI.

Outcomes) via the parallel mechanisms of PAR and PAI (i.e., Step 3: Perceptions of Algorithm Responsiveness). We anticipate frequent, positive identity representations filtering into a single social stream will predict a greater sense of social connectedness because this type of algorithmic personalization demonstrates validation and support for the multiple facets of the self. Conversely, infrequent or negative portrayals of one's sense of self likely reduced social connectedness on TikTok because an individual's sense of self feels misunderstood or potentially harmed through human-algorithm interaction.

H5: There is a positive indirect effect between (a) frequency of identity representation and (b) valence of identity representation and social connectedness via PAR.

H6: There is a negative indirect effect between (a) frequency of identity representation and (b) valence of identity representation and social connectedness via PAI.

Study 1

Method

Sample and procedure

Six hundred participants were recruited via the online recruitment service Prolific. Prolific prescreened participants as being 18–50 years old and using TikTok at least monthly. After data cleaning (i.e., did not meet sample requirements, bot checks, failed attention checks, no algorithm awareness,¹ incomplete responses, outliers, etc.), our final sample consisted of 551 participants. This sample size was sufficient, as our *a priori* power analysis suggested 569 participants to estimate a small effect size of .10 with 95% statistical power. The average age was 30.67 years ($SD = 8.83$), and the gender was 48.46% female, 47.91% male, and 3.45% non-binary or genderqueer. Full demographic information is available in Supplementary Table S1.

After completing an informed consent, participants completed an online survey that consisted of questions about their TikTok use, identity, sense of belonging, and demographic information. Compensation was \$2.00 per participant. Institutional Review Boards at the authors' institutions

approved Study 1 and Study 2. Hypotheses, procedures, measures, and data analysis plans were all preregistered on OSF (<https://osf.io/cs2aj/>).

Measures

Identity on TikTok

Participants were instructed to reflect on their sense of self, considering different social identities, groups, hobbies, or interests currently important to them. Participants were then given five open-ended text boxes to list aspects of their current sense of self and identity. Common examples from participants included “Woman,” “Foodie,” and “Video Games.”² Participants rated the importance of each identity on a scale from 1 (Not at All Important) to 5 (Very Important). Participants who rated any of the five identity categories as not at all important (i.e., value <2) were excluded ($n=4$). All identities were rated as greater than slightly important to their sense of self ($M=4.05$, $SD=.60$, $\text{Min}=2.20$, $\text{Max}=5.0$). For each identity, participants rated how frequently they saw content on TikTok’s For You feed about that identity (1 = Never, 5 = Very often; $M=3.69$, $SD=.63$) and assessed the valence of the content (1 = Very negative, 7 = Very positive; $M=5.74$, $SD=.75$). An index for the frequency and valence identity representation on TikTok was created by averaging reports from all five identities.

PAR and PAI

[Taylor and Choi’s \(2022\)](#) perceived algorithm responsiveness and insensitivity scale (PARIS) was used to operationalize individuals’ perceptions of the TikTok algorithm. The scale contains two factors: eight items for responsiveness (e.g., “The TikTok algorithm really understands me,” $M=3.03$, $SD=.86$, $\alpha=.92$) and seven items for insensitivity (e.g., “The TikTok algorithm dismisses my interests,” $M=1.89$, $SD=.78$, $\alpha=.90$). Perceptions are reported on a scale of 1 (Not at all) to 5 (Completely).

Social connectedness

We contextualized the General Belongingness Scale ([Malone et al., 2012](#)) to measure connectedness on TikTok. This three-item measure captured participant’s responses on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Example items include “On TikTok, I feel accepted by others” and “TikTok makes me feel connected to others.”

Average reports were 3.50 ($SD=.82$), with satisfactory reliability ($\alpha=.88$).

Covariates

In addition to age, several covariates were captured to control for potentially confounding relationships in our model. First, the frequency of TikTok browsing was measured with four items (e.g., “Scroll through TikTok viewing videos in the For You feed”) on an 8-point rating scale ($M=5.51$, $SD=1.47$, $\alpha=.87$). Second, self-concept clarity (i.e., the clarity and certainty of one’s own identity) was measured with five items ([Mohr & Kendra, 2011](#)) on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree, $M=3.87$, $SD=.90$, $\alpha=.90$). Third, group vitality outside of TikTok (i.e., the extent to which participants believed their various identities are positively represented across a variety of domains, including mainstream media, government, work/school, etc.) was measured for each identity and then aggregated ($M=3.45$, $SD=.75$) as recorded on a 5-point rating scale of 1 (Not at all) to 5 (Extremely). Fourth, [Zarouali et al.’s \(2021\)](#) algorithm awareness scale was used to summarize participants’ awareness of algorithm content filtering (i.e., an algorithm was used to tailor content on TikTok; $M=4.20$, $SD=.78$, $\alpha=.84$) and human-algorithm interplay (i.e., their behaviors on TikTok influences the content they view on TikTok; $M=4.10$, $SD=.80$, $\alpha=.85$) on 5-point rating scales. Full details of covariate measures are available on OSF.

Results

Bivariate correlations for Study 1 variables are available in [Table 1](#). Hypotheses were tested using OLS regressions in R, with 95% confidence intervals from 10,000 bootstrapped resamples of coefficients. Parameters were considered statistically significant when 95% CI did not include zero. Models included all covariates: age, frequency of TikTok browsing, self-concept clarity, group vitality, algorithm content filtering awareness, human-algorithm interplay awareness; see [Table 2](#) for results.

We predicted that the frequency of identity-relevant content (H1a) and more positive valence of identity content (H2a) would have a positive association with PAR. Both hypotheses were supported. More frequent exposure to identity-relevant content on TikTok predicted more PAR. In

Table 1. Bivariate correlations and descriptive statistics for Study 1 and Study 2

	1	2	3	4	5	6	Study 1 M(SD)	Study 2 M(SD)	Study 2 ICC
1. TikTok use	–	.27***	.17***	.23***	-.20***	.30***	5.51 (.46)	2.86 (1.00)	.42
2. Identity Freq	.30***	–	.51***	.29***	-.18***	.32***	3.69 (.63)	2.71 (.87)	.64
3. Identity valence	.05	.16**	–	.33***	-.31***	.34***	5.74 (.75)	5.55 (.93)	.60
4. PAR	.22***	.31***	.13*	–	-.49***	.50***	3.04 (.86)	4.59 (1.24)	.73
5. PAI	-.07	-.18**	-.16**	-.70***	–	-.33***	1.89 (.78)	3.25 (1.18)	.61
6. Connectedness	-.09	.01	.37***	.12*	-.15*	–	3.50 (.82)	5.29 (1.17)	.46
7. Self-esteem	-.11	.02	.33***	.10	-.14*	.83***	–	3.70 (.75)	.49

Note. Above the diagonal are correlations for Study 1. Below the diagonal are between-person correlations for Study 2. TikTok use = frequency of TikTok use; Identity Freq = frequency of identity-related content on TikTok; Identity valence = positivity of identity-related content on TikTok; PAR = perceived algorithm responsiveness; PAI = perceived algorithm insensitivity; ICC = intraclass correlation coefficient.

*** $p < .001$, ** $p < .01$, * $p < .05$.

Table 2. Predicting PAR, PAI, and social connectedness in Study 1

	PAR			PAI			Social connectedness		
	B(SE)	t	95% CI	B(SE)	t	95% CI	B(SE)	t	95% CI
Intercept	-.11(.37)	-.29	[-.78, .60]	4.48(.34)***	13.34	[3.85, 5.10]	1.48(.37)***	3.95	[.70, 2.28]
TikTok use	.09(.03)***	3.73	[.04, .14]	-.09(.02)***	-3.92	[-.13, .05]	.09(.02)***	3.97	[.04, .13]
Identity Freq	.17(.06)*	2.58	[.04, .29]	.01(.06)	.12	[-.11, .12]	.16(.06)**	2.86	[.05, .27]
Identity valence	.23(.06)***	4.06	[.12, .34]	-.28(.05)***	-5.40	[-.38, -.17]	.11(.05)*	2.28	[.01, .22]
Algorithm CF	.01(.08)	.11	[-.16, .17]	-.12(.07)	-1.59	[-.26, .03]	-.01(.07)	.10	[-.12, .14]
Algorithm HAI	.02(.08)	.21	[-.15, .18]	.06(.07)	.76	[-.09, .20]	-.11(.07)	-1.53	[-.24, .02]
Self-concept	.08(.04)*	1.98	[-.00, .16]	-.14(.04)***	-3.63	[-.21, -.06]	-.03(.04)	-.71	[-.10, .05]
Group vitality	.03(.05)	.62	[-.07, .14]	.06(.05)	1.36	[-.03, .15]	-.02(.04)	-.37	[-.11, .08]
Age	.01(.00)	1.24	[-.00, .01]	.00(.00)	.35	[-.01, .01]	-.00(.00)	-.10	[-.01, .01]
PAR							.35(.04)***	8.44	[.26, .43]
PAI							-.10(.05)*	-2.18	[-.20, .00]
R ²	.16		.15				.33		

Note. TikTok use = frequency of TikTok; Identity Freq = frequency of identity-related content on TikTok; Identity valence = positivity of identity-related content on TikTok; Algorithm CF = algorithm content filtering awareness; Algorithm HAI = human-algorithm interplay awareness; Self-concept = self-concept clarity; PAR = perceived algorithm responsiveness; PAI = perceived algorithm insensitivity; 95% CI = nonparametric 95% bootstrap confidence intervals from 10,000 resamples.

*** $p < .001$, ** $p < .01$, * $p < .05$.

Table 3. Indirect effect of PAR and PAI on social connectedness in Study 1

X → M → Y	Indirect effect		
	Effect	SE	95% CI
Identity Freq → PAR → Connect	.058	.025	[.012, .110]
Identity Valence → PAR → Connect	.080	.021	[.041, .123]
Identity Freq → PAI → Connect	-.001	.007	[-.017, .012]
Identity Valence → PAI → Connect	.027	.016	[-.000, .061]

Note. Significant paths are bolded.

addition, more positively valenced TikTok content about one's identity also predicted greater PAR.

For PAI, the frequency of identity-relevant content (H1b) and positively valenced identity content (H2b) were predicted to have a negative association with PAI. H1b was not supported because there was a non-significant relationship between the frequency of identity content on TikTok and PAI. On the other hand, H2b was supported because more negatively valence content about the self-predicted greater perceived insensitivity of TikTok's algorithms.

We anticipated that PAR (H3) and PAI (H4) would predict social connectedness on TikTok. PAR shared a significant relationship with social connection; however, the 95% CI for PAI included zero, suggesting a non-significant relationship. Greater PAR was associated with more social connectedness, but PAI was not. H3 was supported, but H4 was not supported. Moreover, controlling for PAR and PAI, the frequency of identity-relevant content on TikTok and the valence of identity content were both positively associated with social connectedness on TikTok.

H5 predicted an indirect effect from (a) frequency of identity representation on TikTok and (b) valence of identity representation on TikTok to social connectedness via PAR. Conversely, H6 predicted less social connection via an indirect effect of PAI. We conducted a parallel mediator analysis using the PROCESS Macro for R (95% CI from 10,000 resamples) to test these hypotheses (Hayes & Rockwood, 2020); see Table 3. Significant indirect effects emerge from the frequency of identities on TikTok and their valence to social connectedness via PAR, supporting H5. In other words,

more frequent identity representation in the For You feed and more positive representations of identities predicted greater PAR, which in turn predicted more social connection on TikTok. However, the direct effect of each of these variables remained significant after controlling for PAR, which means that the PAR only explained part of the relationship with social connectedness. PAI did not predict social connectedness, so no indirect effects were present, rejecting H6.

Discussion

The aim of Study 1 was to address one problem of lonely algorithms by elaborating the algorithm responsiveness process, focusing on (1) the curation of frequent and positive identity-relevant content as fundamental dimensions of algorithmic personalization and (2) PAR and PAI as possible mechanisms linking algorithm personalization to social connectedness despite limited social interaction. The results offered support for the notion that frequent, positive curation of identity-relevant content on TikTok predicted greater PAR, whereas more negative valence about the self predicted greater PAI. Consistent with other work on identity and algorithms (e.g., Lee et al., 2022), perceptions of responsive and sensitive algorithms are related to algorithm personalization that correctly identifies and affirms the various aspects of one's identity.

Extending PAR and PAI outside of interpersonal interaction facilitation, Study 1 suggested that PAR, but not PAI, predicted more social connectedness on TikTok. Furthermore, PAR operated as a mechanism between algorithm personalization of identity-relevant content and social connectedness, showcasing that feeling understood and validated by algorithmic recommendations buoys a sense of online connection with others. Study 1 provides a preliminary answer to our research question: algorithmic personalization may foster feelings of social connection if the personalization is perceived to validate the person's sense of self.

Although Study 1 offers evidence that PAR helps to explain the relationship between algorithmic personalization and social connection, the cross-sectional data does not offer a test of the process. Taylor and Choi (2022) theorize that the algorithm responsiveness process is iterative in nature, underscoring the need to capture the within-person dynamics of

human-algorithm interaction. Both algorithms (Matias, 2023) and people (DeVito, 2021) adapt their behavior based on information gathered about the other in previous engagements. Daily, users engage in various activities on TikTok, generating a wealth of data that TikTok's algorithms use to tailor the personalized For You feed, shaping the perception of algorithm responsiveness. By using a daily diary method, we can evaluate how day-to-day changes in algorithmic personalization, particularly identity representation frequency and valence, can foster (or undermine) social connectedness. Thus, Study 2 provides a comprehensive framework to map out the ongoing, cyclical process of algorithm responsiveness, offering insights into how algorithmic perceptions are formed and their outcomes. To make the case for PAR and PAI as potential mechanisms of the lonely algorithm problem, we include self-esteem as a dependent variable alongside the measure of general social connectedness. Self-esteem, which reflects an individual's sense of self-worth, was chosen for two key reasons: (1) increases in self-esteem are the primary predicted outcome from positive media representations of social identity (Trepte & Loy, 2017) and (2) to establish if PAR and PAI are uniquely associated with relational well-being, as opposed to broader aspects of well-being.

H7: There is a positive relationship between PAR and self-esteem.

H8: There is a negative relationship between PAI and self-esteem.

Study 2

Method

Participants and procedure

Data collection occurred in batches between July and August of 2023. Participants were recruited for a 14-day daily diary study about their social media use via random selection from an email listserv of students enrolled at a large midwestern U.S. university. An *a priori* power analysis suggested a sample of 150 was needed to achieve 95% power for an effect size of $F = .08$ with 14 repeated measures ($N = 2100$ observations). We oversampled to account for attrition. Of the 777 individuals who responded to the invite, 330 were deemed eligible (i.e., daily TikTok use and algorithm awareness), and 290 individuals completed at least two surveys, resulting in an acceptable attrition rate of 12.12% ($N = 2812$ final observations). The average age was 21.49 ($SD = 2.81$), with a gender distribution of 74.14% female, 22.41% male, 2.41% non-binary, and 3 participants not disclosing. See *Supplementary Table S1* for demographic details.

This study used an online daily diary design to capture the daily experience of using TikTok and its impact on well-being because daily fluctuations in media use can impact state psychosocial well-being. On Monday morning, participants were sent a presurvey to capture their general TikTok use, algorithm awareness, and demographics. Starting Wednesday of the same week, participants were asked to complete a daily diary survey for 14 consecutive days. Every evening at 8 PM, participants received an email containing a personalized link to that day's survey. Participants had until midnight (4 h) to complete the 5-min survey about their daily TikTok use and well-being. Participants were compensated \$0.75 per

completed survey, and they were incentivized with a \$11 bonus (\$20 total) if they completed at least 10 daily diaries. The completion rate of the 14 daily surveys was 69.26%, with a median of 11 surveys per participant, an expected completion rate for daily dairy studies.

Measures

We frequently shortened validated measures to operationalize each variable in Study 2 to minimize survey fatigue and attrition, following best practices for intensive longitudinal designs (Bolger & Laurenceau, 2013). All measures are available verbatim on OSF (<https://osf.io/cs2aj/>), as well as preregistered hypotheses, power analysis, and procedures. Descriptive statistics, intraclass correlation coefficient, and between-subjects correlations are available in Table 1. Reliabilities were calculated for each day (see *Supplementary Table S2*).

Identity on TikTok

Similar to Study 1, participants first generated five identity categories³ (e.g., "Liberal," "Mother," "Taylor Swift Fan"). Then, they reported the frequency and the valence of the identity representations on TikTok that day. The frequency of identity representation was measured on a scale of 1 (Never) to 5 (Very Often) scale. The valence of identity representation was captured on a scale of 1 (Very negative) to 7 (Very positive). If participants reported never seeing that identity on TikTok that day, they were not asked about the valence of the representation. The denominator for the valence composite was adapted to the total number of identities participants reported viewing that day (i.e., if participants reported seeing only two of five identities on TikTok that day, their valence score was divided by two).

PAR and PAI

We used a shortened version of the PARIS (Taylor & Choi, 2022), with three items for PAR and three items for PAI, to capture perceptions of algorithm responsiveness (1 = Strongly Disagree, 7 = Strongly Agree). Items were selected based on the strength of factor loadings in the original study.

Social connectedness

Participants reported their daily sense of social connectedness with four items (e.g., "I felt accepted by others"). We solicited responses on a 7-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree).

Self-esteem

From Rosenberg Self-Esteem Scale (1965), three positive items (e.g., "Today, I felt satisfied with myself") and three negative items (e.g., "Today, I felt like a failure") were used to measure daily self-esteem. Answers were reported on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree), and negative items were reverse coded.

Covariates

For day-to-day covariates, participants indicated the frequency of TikTok use on a 3-item scale (1 = Never, 5 = Very Often) and the occurrence of any significant or unusual events that day, such as illness, death in the family, etc (1 = Yes, 0 = No). A baseline measure of algorithm awareness of human-algorithm interplay (Zarouali et al., 2021) was

captured on a 5-point scale ($M = 4.49$, $SD = .56$) and covaried in all analyses.

Analytical approach

We implemented the SPSS Macro MLmed (Hayes & Rockwood, 2020) to conduct multilevel modeling and estimate indirect effects. Multilevel modeling is necessary to test our hypotheses because of clustering in the data. Each participant provided up to 14 daily diary reports (Level 1) nested within each person (Level 2). Because the independent (X), mediating (M), and dependent (Y) variables in our hypothesis were measured on Level 1, a 1-1-1 level multilevel mediation analysis was appropriate. This analysis required group-mean centering the data to create between-person and within-person coefficients. Between-person coefficients represent the average relationship between variables across all daily surveys. Within-person coefficients represent deviations from the person's mean, illustrating how day-to-day fluctuations in the independent variables are associated with changes in the dependent variables. All multilevel models included a random intercept for each participant.

MLmed conducted three analyses to test the hypotheses. The first multilevel model estimated the relationship between TikTok variables as predictors of PAR and PAI ($X \rightarrow M$). The second multilevel model estimated PAR and PAI as predictors of social connection and self-esteem, controlling for TikTok variables ($M \rightarrow Y$). The test for indirect effects, the third analysis, used 10,000 nonparametric bootstrapped samples, with replacement to estimate the effect of X on Y through M. PAR and PAI were treated as parallel mediators, and indirect effects were considered at both between-person and within-person levels. Tables 4 and 5 display the results of our MLmed analyses.

Results

Our first set of hypotheses posited that more identity representation on TikTok (H1a) and positively valenced content (H2a) would predict higher PAR. Between-person analysis

for PAR found that more frequent identity-relevant TikTok content, on average, predicted greater PAR, but the average valence of that representation was unassociated with PAR. Within-person level analyses revealed that days with more identity representation on TikTok and more positively-valenced videos were associated with greater PAR.

Regarding PAI, higher levels of PAI were predicted to be associated with less identity representation (H1b) and more negatively valenced content (H2b). At the between-person level, average frequency and positive valence of identity representations were negatively associated with PAI. Averaged across 14 days, infrequent, negative content about one's various identities in the TikTok For You feed predicted more PAI. There was also a significant negative within-person association for identity representation frequency and PAI, meaning that on days when participants saw less identity representation on TikTok, they also reported greater PAI.

Our second set of hypotheses anticipated that PAR predicted greater social connection (H3) and more self-esteem (H7). Conversely, PAI was expected to have a negative association with both social connection (H4) and self-esteem (H8). Although PAR was not associated with social connectedness at the between-person level, it was positively associated at the within-person level. This result suggests that days with higher-than-average daily PAR were associated with greater social connection that day. Neither average nor day-to-day variations in PAR were associated with self-esteem. PAI showed no association with social connection or self-esteem.

After controlling for PAR and PAI, the valence of identity content on TikTok, not frequency, remained a significant predictor of social connectedness and self-esteem. In terms of social connectedness, a more positive valence of identity representation was positively associated at both between-person and within-person levels. Self-esteem was positively related to the valence of identity representation on TikTok at both levels. Viewing more positively valenced, identity-relevant content curated by the TikTok algorithm predicted greater social connection and self-esteem overall and day-to-day.

Table 4. Predicting PAR, PAI, social connectedness, and self-esteem in Study 2

	PAR		PAI		Social connectedness		Self-esteem	
	B(SE)	t	B(SE)	t	B(SE)	t	B(SE)	t
Within-person level								
Intercept	2.12(.69)***	3.09	5.44(.62)***	8.79	3.23(.72)***	4.48	2.43(.48)***	5.10
TikTok use	.03(.02)	1.45	.06(.03)*	2.20	-.15(.03)***	-4.79	-.09(.01)***	-4.83
Identity Freq	.15(.03)***	5.25	-.15(.03)***	-4.39	-.04(.04)	-1.12	-.03(.02)	-1.40
Identity Valence	.08(.02)***	3.38	.00(.03)	.09	.11(.03)***	3.58	.07(.02)***	3.76
PAR					.07(.03)*	2.37	.02(.02)	.94
PAI					-.03(.03)	-1.33	-.03(.01)	-1.78
Unusual day	.05(.05)	.93	-.12(.06)*	-2.03	.15(.07)*	2.31	.02(.04)	.50
Between-person level								
TikTok Use	.22(.09)*	2.29	-.01(.09)	-.15	-.16(.07)*	-2.18	-.10(.05)*	-2.13
Identity Freq	.39(.09)***	4.29	-.20(.08)*	-2.50	-.05(.07)	-.75	-.01(.05)	-.16
Identity Valence	.12(.08)	1.44	-.18(.07)*	-2.41	.36(.06)***	5.62	.23(.04)***	-.38
PAR					.10(.06)	1.56	.04(.04)	.37
PAI					-.00(.07)	-.06	-.02(.05)	-.38
Unusual day	.36(.41)	.88	.34(.37)	.90	-.54(.33)	-1.64	-.10(.22)	-.44
Algorithm HAI	.01(.11)	.11	-.14(.10)	-1.42	.06(.09)	.71	.04(.06)	.73
Random effects								
Intercept	.99(.09)		.77(.07)		.51(.05)		.23(.02)	
Residuals	.41(.01)		.54(.02)		.70(.02)		.28(.01)	

Note. Unusual days were coded as 1.

*** $p < .001$, ** $p < .01$, * $p < .05$.

Table 5. Indirect Effect of PAR and PAI on social connectedness in Study 2

$X \rightarrow M \rightarrow Y$	Indirect effect		
	Effect	SE	95% CI
<i>Within-person level</i>			
Identity Freq → PAR → Connect	.011	.005	[.002, .021]
Identity Valence → PAR → Connect	.006	.003	[.001, .012]
Identity Freq → PAI → Connect	.005	.004	[-.002, .014]
Identity Valence → PAI → Connect	-.000	.001	[-.003, .002]
<i>Between-person level</i>			
Identity Freq → PAR → Connect	.012	.013	[-.006, .043]
Identity Valence → PAR → Connect	.039	.027	[-.010, .097]
Identity Freq → PAI → Connect	.001	.016	[-.030, .034]
Identity Valence → PAI → Connect	.001	.014	[-.028, .030]

Note. Significant paths are bolded.

Our third set of hypotheses concerned the indirect effects of TikTok identity frequency and valence on social connectedness via PAR (H5) and PAI (H6). Two within-person indirect effects for social connectedness were significant (see Table 5). First, days with more frequent identity representation on TikTok predicted greater social connectedness partly due to higher daily PAR. There was no significant relationship between the frequency of identity representation and social connectedness after controlling for PAR. Second, days with more positively valenced identity content on TikTok predicted greater PAR, which, in turn, predicted higher social connectedness. The relationship between valence and social connectedness remained significant after controlling for PAR. These within-person indirect effects, although significant, were small and ought to be interpreted accordingly. No significant indirect effects emerged for PAI and social connectedness. PAR and PAI were unassociated with self-esteem, so there was no indirect effect.

Discussion

The primary objective of Study 2 was to advance algorithm responsiveness as a within-person process that explains the effects of algorithmic personalization on TikTok. Overall, Study 2 suggested that frequent, positively curated content on TikTok's For You feed can promote feelings of connection via perceptions that algorithmic personalization validates the multifaceted aspects of the self. These findings support a within-person algorithm responsiveness process. Our results indicate that PAR is a mechanism of the relationship between algorithm personalization and social connection because on days when individuals perceive greater responsiveness from TikTok's algorithm, they also tended to report greater social connectedness. Replicating Study 1, PAI was not associated with social connectedness, demonstrating a distinction between responsiveness and insensitivity.

A secondary goal of Study 2 was exploring whether PAR and PAI have an association with well-being beyond social connectedness. There were no detected associations between PAR or PAI and self-esteem, a standard outcome of media and social identity research. These findings suggest that PAR is more closely linked to feeling a sense of belongingness and community rather than self-worth. This positions PAR as a more evident explanation of how algorithmic personalization can facilitate connectedness when interpersonal interaction with others is limited. However, future research ought to

explore how algorithm perceptions influence mental health outcomes, especially for marginalized groups. Independent of algorithm perceptions, the frequency and valence of identity-relevant content on TikTok predicted greater daily self-esteem, supporting previous work on social identity representations in media (Trepte et al., 2018). Next, we turn our attention to how our project extends communication theory about algorithms and social connection.

General discussion

The project addresses one aspect of the lonely algorithm problem by studying how algorithmic personalization on social media influences social connectedness with others, particularly when interaction with social network members is less central to social media use. To answer our research problem, we explicated the algorithm responsiveness process in three ways. First, PAR and PAI were proposed as mechanisms that connect algorithmic personalization to social connection on TikTok. Consistent with predictions, PAR emerged as a significant mediator in both Study 1 and Study 2, but contrary to predictions, there was no evidence PAI predicted feeling connected to others. Second, we identified dimensions of enacted algorithmic responsiveness, identity representation frequency and valence, that were conceptually and empirically associated with PAR and PAI. Third, we mapped the proposed cycle of algorithm responsiveness by examining daily fluctuations in algorithm personalization, algorithm perceptions, and social connectedness. Within-person changes in algorithmic personalization were associated with more PAR (but not PAI), which, in turn, predicted greater social connectedness (but not self-esteem). Our results confirm, extend, and challenge the previous research on the lonely algorithm problem. We elaborate on the theoretical implications for understanding identity and social relationships in a world of algorithmic personalization.

Connecting enacted to perceived algorithm responsiveness

The algorithm responsiveness process posits that PAR and PAI derive from the enacted algorithm responsiveness, or the output of personalized content curated into a social feed by algorithms. Although previous research has identified differences in algorithm perceptions at individual or platform levels (e.g., Taylor & Choi, 2022), specific aspects of algorithmic personalization that predict PAR or PAI remained ambiguous. Thus, a contribution of this research is connecting PAR and PAI to the content curated by TikTok's algorithms, specifically the dimensions of frequency and valence of identity-relevant content. In our studies, PAR was associated with greater frequency and positively valenced content, whereas PAI was associated with infrequent or negatively valenced content about important identity categories. These results confirm research stating that quality algorithmic personalization mirrors the multifaceted, fluid aspects of the self (Lee et al., 2022). Individuals appear to work to align their sense of self and the algorithm recommendations, demonstrating a clear link between enacted and perceived algorithm responsiveness, confirming tenets of the algorithm responsiveness process. Although there are societal concerns about the siloing of identity or groups through algorithm personalization (Matias, 2023), such enacted algorithm responsiveness would be rated as unresponsive and insensitive, promoting

resistant efforts (Karizat et al., 2021) or platform exit (DeVito, 2022).

Study 2 extended these findings by highlighting some temporality in PAR and PAI. Both algorithm perceptions demonstrated day-to-day flux connected to TikTok's content recommendations (ie, within-person associations), signaling that responsiveness and sensitivity are interactive, malleable perceptions. As such, these daily fluctuations in PAR may align with instances where users report "training" the algorithm to match their identity or goals for using TikTok (e.g., Siles et al., 2022). Alternatively, daily fluctuations in PAI could represent situations where individuals open TikTok and the For You feed algorithm appears to silo their identity rather than reflecting the multiplicities of their identity (Lee et al., 2022). The presence of significant between-person associations suggests that some aspects of these PAR and PAI are less subject to day-to-day changes. Between-person differences in PAR may represent perceptions that the algorithm has come to know the person by consistently showing them content that aligns with their dynamic self-concept (Bhandari & Bimo, 2022). Individual differences in PAI may stem from fundamental personalization failures coded into algorithms due to biases, misunderstandings, and economically-motivated attention seeking (Karizat et al., 2021). As such, the perceived insensitivity may not be as easily "trained away." These algorithmic failures may appear as consistently overlooked identities or repeated stereotyping, suggesting an opportunity to use PAI as a lens to study algorithmic harms and biases. Connecting research on algorithm aversion and PAI may provide a valuable lens to understand how this negative perception is formed, as people are likely to distrust algorithms once they become aware that algorithm recommendations make errors (Dietvorst et al., 2015).

These results contribute to broader discussions about social identity in the context of algorithmic media. Whereas mass media representations of social identities have often been described as a self-selection process (Knobloch-Westerwick, 2015), extant research suggests that the rise of algorithm-based media can complicate this process. On TikTok, self-selection appears more as an interplay between the self and the algorithm. Individuals perceive and interact with identity-relevant content for better algorithmic representations (Bhandari & Bimo, 2022; Siles et al., 2022). Other research indicates that individuals have some agency in this negotiation, such as clicking "I'm not interested" or unfollowing accounts (Bucher, 2017; Eslami et al., 2016). The algorithm responsiveness framework opens avenues for a theoretical understanding of how algorithmic personalization interfaces with personal and social identities.

A sociotechnical perspective on the lonely algorithm problem

A second contribution of this paper was applying the algorithm responsiveness process to the lonely algorithm problem, identifying PAR as a mechanism for how algorithmic personalization predicts greater social connectedness. In both Study 1 and Study 2, PAR partly explained the relationship between algorithm personalization and social connection on TikTok, a platform that prioritizes interpersonal connections (Bhandari & Bimo, 2022). While other work identified that personalization to the multifaceted aspect of the self can build a sense of community on TikTok (Lee et al., 2022), our data suggests that social connectedness is promoted because

this type of algorithmic curation is perceived as understanding, validating, and caring for their multifaceted self. Study 2 documented this indirect effect at the within-person level, showing that daily algorithm personalization predicted social connectedness because of corresponding shifts in their daily PAR. Our findings support the propositions of the algorithm responsiveness process, suggesting that social connectedness is intertwined with algorithm personalization via PAR (Taylor & Choi, 2022).

Our findings also challenge the algorithm responsiveness process, as PAI was unassociated with social connectedness in both studies. These findings suggest perceptions that algorithm recommendations on TikTok were insensitive to the self did not influence the participants' sense of belongingness. Although this finding diverts from previous longitudinal research that found PAI on Instagram was associated with greater loneliness (Taylor & Choi, 2024), there are multiple explanations for why PAI was not a mechanism in this project.

One explanation is that PAI may be salient among those who experience internalizing symptoms, such as loneliness, as negative self-perceptions and feelings of social inadequacy drive these experiences. In contrast, social connectedness involves a broader sense of community that may not be as easily disrupted by PAI. Accordingly, the extent to which PAR and PAI function as mechanisms linking algorithmic personalization to psychosocial well-being may depend on the specific well-being outcome under investigation. A second explanation could be TikTok's shift away from building and maintaining social networks compared to other social media (Bhandari & Bimo, 2022). PAI may impact social relationships on social media involving communication with friends, family, and social network members because algorithms prioritize some relations over others. For instance, Bucher (2017) found that algorithmic insensitivities toward a person's goals and desires for using Facebook ruined some friendships because of faulty predictions. TikTok's content is less focused on these personal connections, making insensitivity more about identity than social relationships. This explanation suggests that the norms and expectations of a social media platform likely shift the role of human-algorithm interaction in producing well-being outcomes, consistent with DeVito's (2021) algorithmic folk theory formation process. A third explanation is that PAI is infrequent and less likely to be a social media cognition on TikTok, given that social media algorithms typically seek to accurately infer the identities of individuals to keep them engaged on the platform. These explanations highlight future opportunities to clarify when and how various pathways in the algorithm responsiveness process are activated.

Advancing PAR as one mechanism of the lonely algorithm problem builds theory about the interpersonal consequences of algorithms. This research suggests that algorithm personalization can influence how people relate when personalization cultivates validation and support, showcasing the role of human-algorithm interaction in understanding algorithmic effects. As described in the lonely algorithm problem, current thought about the impact of algorithms on social relationships often opts for a deterministic mentality, suggesting code causes changes among ties. Instead, our data support a more sociotechnical perspective on this problem, as how individuals engaged with and perceived TikTok's For You algorithm shaped the consequences. Thus, as Matias (2023) describes,

we argue that understanding algorithm effects requires examining how humans and algorithms work together to produce outcomes.

This interplay between humans and algorithms highlights the fundamental human desire for interpersonal responsiveness (Reis & Gable, 2015), meaning that the sense of connectedness provided by algorithms signifies a person's fundamental need to feel understood and validated by others. Even unembodied, opaque recommendation algorithms seem to fulfill this need to some extent. However, there are likely limits to the duration of the algorithm-driven connectedness, as multiple studies suggest that these connections quickly dissipate (Lee et al., 2022; Wang et al., 2023), unless they facilitate interpersonal interactions (Taylor & Choi, 2024). Nevertheless, the dynamic effects found here showcase that algorithms may act as interactive agents on social media, with individuals perceiving messages from them and providing feedback, thereby rendering seemingly mundane behaviors, such as "passive" browsing, an interactive experience.

Our findings also highlight a boundary of research on algorithm perceptions: Dimensions of algorithm personalization were significant predictors of social connectedness and self-esteem after accounting for PAR and PAI. That is, algorithm perceptions were only part of the story. This suggests that, although perceptions matter, enacted algorithm responsiveness as a concept may be more essential to outcomes than initially theorized (Taylor & Choi, 2022). Although the algorithm responsiveness process was informed by interpersonal theory, this finding highlights a distinction from research in interpersonal interactions, which typically finds that perceived responsiveness supersedes enacted responsiveness (Choi & Toma, 2022; Reis & Gable, 2015). Fox and Gambino (2021) argued that identifying how mental schema for human-machine communication differs from interpersonal communication represents a research frontier. Perceived responsiveness from another person is likely more crucial in creating social connection than responsiveness from an unembodied, ambiguous, hidden computational model that curates content. Edits to the algorithm responsiveness process should account for the effects beyond perceptions. One such avenue could be leaning into research on positive distinctiveness in media representations predicting salient in-group membership (Trepte & Loy, 2017).

Our inquiry addresses a sliver of the lonely algorithm problem (Taylor & Choi, 2022). In contrast to providing a definitive answer, our goal in labeling this problem is centralizing and critiquing algorithms within interpersonal communication and technology research. Questions remain about the claims social media companies make about algorithmic personalization promoting personal relationships (e.g., Mosseri, 2023; Zuckerberg, 2018). These questions include—but are not limited to—who algorithms infer as relationally important, if algorithms facilitate relational echo chambers, differential impacts of algorithms across relationship types, how users train the algorithms to attain relational goals, and sociodemographic disparities in the effects of algorithms on relational well-being and interpersonal interaction.⁴

Limitations

The results and implications of this research have limitations. First, our operationalization of the multifaceted self, discussed by Lee et al. (2022), was limited to five identities. Individuals probably consider additional identities important

to their self-concept. Furthermore, neither the cross-sectional nor diary study captured the flexibilities of identity categories. The self-report of identity-relevant TikTok videos also has limitations, as participants may not accurately recall all videos they viewed; thus, reports were based on perceptions. Previous research has documented that moments of algorithm failures are often the most memorable (Bucher, 2017), meaning there may be a self-report bias towards moments of unresponsiveness or insensitivity. Although we have longitudinal data in Study 2, the casual ordering of the variables is uncertain because a third variable may explain the observed associations. Experimental methods offer a potential way to address these limitations, such as conducting a social media simulation (e.g., Taylor et al., 2019) or partnering with a social media company (e.g., Guess et al., 2023), where algorithmic personalization of identity-related content is manipulated through a cover story or in real-time. PAR and PAI could be psychologically primed through tasks before viewing a social media feed, following interpersonal responsiveness experiments (see Reis & Gable, 2015).

The replication of findings between Study 1 and Study 2 is promising, but sampling was imperfect. Neither study used a representative sample, limiting generalizability. Additionally, our sampling did not target members of marginalized groups who are most likely to be miscategorized and underrepresented in algorithm recommendations (DeVito, 2022; Karizat et al., 2021). Understanding the algorithm responsiveness process within marginalized groups is essential for the continued development of this theoretical framework. Finally, TikTok is scheduled to be banned in the USA in 2025, with datafication and algorithms from a Chinese technology company among the chief justifications for the ban. This politicization of TikTok may have shifted people's perceptions of algorithms, limiting the reproducibility of these findings even with the same sample.

Conclusion

TikTok claims each post or swipe through the For You feed is an opportunity to forge connections (TikTok, 2024). This research aimed to investigate this claim, elaborating how human-algorithm interaction relates to social connectedness. We found that when individuals perceived algorithmic personalization as affirming their identities—evidenced by the frequency and valence of content in the For You feed—they felt more socially connected. However, some content curated by TikTok's algorithms appeared to dismiss and belittle aspects of the self, but this insensitivity was unassociated with social connection. As identified in the lonely algorithm problem, our findings point out the boundaries of the claims from most social media companies that the design of algorithms can inherently foster community and belongingness. While algorithms present opportunities for connection, how individuals perceive and engage with content matters for their effects. Countering deterministic narratives of algorithmic effects, merely tweaking an algorithm's code to show more relevant posts has limitations in fostering social connection.

Supplementary material

Supplementary material is available online at *Journal of Computer-Mediated Communication*.

Data availability

The data underlying this article are available on the Open Science Framework and can be accessed at <https://osf.io/cs2aj>.

Conflicts of interest: None declared.

Open science framework badges

Open Materials

The components of the research methodology needed to reproduce the reported procedure and analysis are publicly available for this article.

Open Data

Digitally shareable data necessary to reproduce the reported results are publicly available for this article.

Preregistered

Research design was preregistered.

Notes

1. Taylor and Choi (2022) state algorithm awareness is required for PAR and PAI to form. Accordingly, participants were screened for algorithm awareness using the AMCA (Zarouali et al., 2021) subscales of content filtering (four items) and human-algorithm interplay (four items) (1 = not at all aware, 5 = completely aware). Participants were removed from the sample if their composite awareness score was lower than 2 on either scale.
2. Supplementary Table S3 contains a list of the Top 50 identities listed by participants in Study 1.
3. Supplementary Table S4 contains a list of the Top 50 identities listed by participants in Study 2.
4. We conducted an exploratory analysis for PAR and PAI on social connectedness, with demographics characteristics as moderators (i.e., sexual orientation, gender, and race/ethnicity). No significant moderation effects were observed. See Supplementary Tables S5 and S6.

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