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Youth Critical Data Practices in the COVID-19 Multipandemic

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This study investigates how youth from two cities in the United States engage in critical data practices as they learn about and take action in their lives and communities in relation to COVID-19 and its intersections with justice-related concerns. Guided by theories of critical data literacies and data justice, a historicized and future-oriented participatory methodological approach is used to center the lived lives and communities of participants through dialogic interviews and experience sampling method. Data were co-analyzed with participants using critical grounded theory. Findings illustrate how youth not only aimed to reveal the dynamic and human aspects of and relationships with data as they engage with/in the world as people who matter but also offered alternative infrastructures for counter data production and aggregation toward justice in the here and now and desired possible futures. Implications for studies of learning with/through data practices in everyday life in relation to issues of justice are discussed.

Keywords: *justice, COVID-19, learning, data practices, participatory research*

Since March 2020, we have co-documented, with youth[1] in the Midwest and West Coast of the United States, how people learn and take action in relation to COVID-19 and how this is shaped by racial and economic concerns. Youth are aware of and have personally experienced the ways in which the pandemic has amplified racial and economic inequalities (Greenberg et al., 2020). Many of their parents are essential workers, and some have lost their jobs. They have seen White supremacists protest at their state's capitol and block access to the city's main hospital with vehicles and guns, all in the name of freedom to disregard COVID-19 restrictions. They have gone online to learn how to make masks and hand sanitizer when those were hoarded by others, and they have sought to provide each other help and solace in the struggles of online schooling and social isolation associated with their lives in a pandemic.

One insight from this work has been how youth learning and action taking related to COVID-19 is tied to their engagement with data and data infrastructures. As youth navigate the pandemic, they encounter wide-ranging forms of data of different epistemological and ideological origins, such as local COVID-19 dashboards for their schools and cities, visualizations of viral spread, and TikTok videos describing mental health strategies for coping with long-term isolation. Youth access data to learn about their world and solve new problems. They also critically examine how data are used in power-mediated ways to construct knowledge about, organize activity, and surveil them and their worlds (Kitchin & Lauriault, 2014).

Youths' experiences in the pandemic have been rendered through data, or datafied, in ways that have quantified and categorized how they have come to understand what the pandemic is about, who it affects and how, and its meaning for everyday living (Cukier & Mayer-Schoenberger, 2013). Yet layered datafication of this multipandemic does not affect youth equally. How youth access, engage with, and are positioned by and position data in relation to their lives and communities are central to their processes of coming to know and act in the pandemic. As data collide and reveal an array of asymmetries connected to racial and economic injustices, youth find themselves in contentious spaces, needing to create new

ways of engaging with data for navigating and transforming these spaces to survive and thrive. Youth have sought to reform their engagement with data in ways that resist, protect, care, and transform their experiences with and in the pandemic. We are interested in these ethical and political dimensions of youths' navigations as they seek to come to know and act in the increasingly abstracted and datafied world (Vakil, 2018). We ask the following question: How do youth engage in critical data practices as a part of their everyday learning and action-taking related to COVID-19 and its intersections with in/justice?

As datafication introduces new challenges of representation and positioning of people and the world, we give witness to youth resisting, disrupting, and transforming such challenges during/through innovative digital navigations of crisis events (Goldkind et al., 2018). We argue that youth have a developing critical awareness of these powered processes, and in relation to the decisions and actions they make. They use and produce critical data practices toward navigating fraught contexts.

Critical Data Practices

As the field of data science solidifies, there is an urgent need to explore questions of what it means to engage with data, what data are, what gets datafied, and who benefits and gets hurt in the process (Wilkerson & Polman, 2020). As data have become commoditized and democratized (Kross et al., 2020), there are increasing calls for new approaches that extend beyond how people learn with/about data to include proleptic and future-oriented arrangements for learning and the social world (Pangrazio & Selwyn, 2019). These approaches center the power of human ingenuity to contribute critically to perspectives on how people learn and engage with data in everyday living (Neff et al., 2017). However, limited attention has been paid to how youth from Black, Indigenous, and People of Color (BIPoC) and low-income communities leverage their lived lives and community wisdom to engage with data, or how their practices have been marginal to the legitimized practices within the data science community (Van Wart et al., 2020).

We draw on research in critical data literacies to frame our study because it calls to attention how data practices are related to both coming to know and coming to act in social worlds through data (e.g., Philip et al., 2016). Critical data literacies frame how data are inherently socially constructed in ways that stratify individuals and populations (Irgens et al., 2020). Central to this work are questions of how and why people come to engage with, understand, and critically examine what data *are* and how data are *used* to produce knowledge, conduct business, and structure governance (Radinsky, 2020; Wise, 2020). This stance reflects the field's shift from data literacy to data fluency, where the emphasis is on the "careful consideration of the contexts in which data is situated and why that matters" and how that shapes one's ability to "apply insights from data to real-world decisions" (Clegg et al., 2020, p. 2).

Data and data practices are "neither neutral nor independent of the thought systems that create, collect and aggregate them" (Pangrazio & Selwyn, 2019, p. 420). They are not just technical knowhow. People deploy technical knowhow in socially and culturally mediated ways for specific purposes and within specific contexts. We use the term *critical data practices* to refer to practices, with hoped-for liberatory effects, that are oriented around data, including its production, consumption, and sharing (Milan, 2019).

Youths' epistemological engagement with data always takes place in sociohistorical and political context, shaping what data are made visible, who and what is represented in data, and the stories told with and about data (Stornaiuolo, 2020). Understanding how people navigate, critique, and transform data toward empowered meaning making that inform decisions and actions can advance how the field understands data literacies and people's reasons for dis/engaging with data (Philip et al., 2013). We know from studies of learning that people's lived lives and community wisdom yield powerful forms of cultural knowledge/practice relevant to engaging with data (Van Wart et al., 2020). Furthermore, data practices involve not only "what people do with data and data infrastructure" but also "what in turn these do to them" (Milan, 2019, p. 213).

Thus, we are concerned with practices around big data (e.g., national and institution-sanctioned databases) and small data (e.g., daily life experiences, perspectives, stories, and family/community histories as worthy data to grapple with). We are also concerned with how youth counter dominant data practices that invoke harm through how they are gendered and racialized (Walker et al., 2018). From news and governmental outlets to social media, it is well documented that people have differing access to data in relation to the COVID-19 pandemic, with differing opportunities for and contexts within which to produce new insights around such data. Furthermore, data, and the insights produced from them, change daily.

However, there is limited research on how youth navigate critical data practices in everyday life, let alone during a pandemic with significant intersections with racial and socioeconomic justice requiring rapid and ever-changing responses. Our approach to investigating youths' critical data practices in a time of COVID-19 accentuates their ingenuity for social change making through their engagement with data (Bang & Vossoughi, 2016). In privileging students' ingenuity, we call attention not only to their already-present brilliant, rebellious, and agentic acts of everyday practice and its transformative potential but also to how we, as educators and researchers, perceive the possibilities of youth and communities.

Bridging Critical Data Practices With Data Justice

Data justice refers to how people are made (in)visible, (mis)represented, and (mis)treated in the production of data (Taylor, 2017). Data justice centers the ethical and political dimensions of engagement with data (Dencik et al., 2019). By *ethical* we refer to how people engage with data toward affecting people's lives, social relations, and possibilities (Vakil, 2018). By *political* we refer to the contentious power-mediated tensions between bottom-up and top-down processes of datafication, along with the critical awareness and contestation of existing data narratives, and the reappropriation of data practices for new purposes (e.g., Beraldo & Milan, 2019). Furthermore, what constitutes legitimate data remains an open question, as well as who gets to decide that answer and from what sources legitimate data can originate.

Data justice raises questions about the infrastructures that frame people's opportunities to engage with data. Data infrastructures refer to the systems designed to protect, preserve, move, and make accessible data so that they can be used by people and organizations (Kitchin & Lauriault, 2014). This "growing volume, velocity, variety and visibility of data, with greater use of new forms and streams of data in decision-making" have contributed to data injustice (Heeks & Shekhar, 2019, p. 993). Furthermore, those in power—big business and government—play central roles in shaping these discourses through the dominant data infrastructures they make possible (Pangrazio & Selwyn, 2019). How the individual components of any infrastructure relate to each other (Star & Ruhleder, 1996), including in their algorithmic decision making, open and foreclose possibilities for how youth are able to engage with data. For example, dominant scripts of data usage, especially in how they are amplified through data infrastructures, can reinscribe existing power relations in society, privileging or excluding individuals and populations (Van Wart et al., 2020).

However, data infrastructures, as designed, serve some and not others. Taylor (2017) describes how such infrastructures oppress, for example, through (in)visibility and discrimination/misrepresentations (e.g., when media stories organize data around COVID-19 vaccine worries through a lens of deficit narratives about Black community relationships with doctors and vaccines). Medina (2017) refers to this willful data-mediated misrepresentation as "epistemologies of ignorance" (p. 247).

We are concerned with how youth identify and engage with how existing infrastructures are unjust, zooming into how epistemic dimensions of data engagement intersect with the political and the ethical. We draw on Penuel's (2019) use of the term *infrastructuring* to call attention to the kinds of critical design work that people engage in to "redesign components, relations, and routines" (p. 659) in direct response to such infrastructure breakdowns. Data justice calls attention to how current organization of data infrastructures have erased the experiences and practices of people and communities (Milan, 2019). Infrastructuring seeks to redress injustice by creating new conditions to support innovative and political organizations and disruptions within systems (Bødker et al., 2017). Deepening the definition of infrastructure in this way, then, questions the dominance of the power holders who built structures of practice and interaction (Dantec & DiSalvo, 2013). It opens up possibilities for considering porosity, movement, and transformation to allow for democratized actions and redistributions toward ideals of justice. From a data justice point of view, infrastructuring does more than mangle new innovations with existing infrastructure of large systems. It offers new tools and access points into the system for critiquing foundational systemic assumptions and designs (Penuel, 2019).

In a pandemic that has amplified inequalities, a focus on how people engage with data toward learning in relation to COVID-19 is urgent—especially given the role of government and corporate mediation in information sharing (Nguyen, 2020). Engaging in a datafied society involves a kind of criticality around data practices that explicitly engage with these political and ethical issues. There is a need for a more textured understanding of how and why young people purposefully engage in a datafied society toward social transformation in relation to issues of injustice in this multipandemic.

In this study, we center attention on how data practices are shaped by power and positioning in context and community and can orient toward creatively authoring more just social worlds. We pay attention to the big/small data divide with regard to access and representation and on how "reliance on such data sources could lead to . . . a lack of representation of marginalized groups with limited digital footprints" (Goldkind et al., 2018, p. 175). How youth seek to add to and/or foster new relations across system components, locally and across scales of activity, is central to our efforts (Bødker et al., 2017).

Method

Using a historicized and future-oriented participatory methodological approach, we seek to give witness to and learn with youth and communities (Villenas, 2019). This requires centering participant voices as opposed to researcher voice, placing importance on methods such as open-ended interviews with codetermined protocols and co-analyzed findings.

This study examines data generated March–July 2020 with 23 youth during the initial waves of the pandemic in the United States, part of a larger study involving 60 participants across two U.S. metropolitan areas (Table 1). The first setting, a Midwestern urban community, is one with

TABLE 1
Youth Participants in March–July 2020

Geographic region	Youth aged 12–24 years	Racial demographics
West Coast City	13	6 BIPoC, 3 White, 2 Asian, 2 Middle Eastern
Great Lakes City	19	13 Black/Biracial, 2 Indigenous/Native American, 4 White

Note. BIPoC = Black, Indigenous, and People of Color.

TABLE 2
Remote Methods: March Through July 2020

Approach	Generation	Focus	Remote methods equity considerations
Dialogic interviews	4 interviews/participants—90 to 240 minutes each	What COVID-19 information individuals access/apply, how, and why Personal/community COVID-19 experiences Use of resources and social networks Critical political awareness, clarity, action taking	Range of tools: phone, video conferencing, text Range of contexts: one-on-one to whole family Co-strategizing interview times/days/structures (e.g., completing interviews over separate days if needed) Co-constructing time line using multimodalities
Informal conversations	Organic spillover from participant-led interviews	Share their complex and layered stories in multimodal ways, giving depth to each of the layers while also capturing interactions among layers	Critically being with and witnessing over time via informal texting, social media link sharing, photo/video and meme sharing
Experience sampling methods	Monthly Google surveys, text reminders to share updates	What updates participants experience between interviews	Asynchronously bearing witness and centering participant voices over time Personal reflections, social media link sharing, photo/video and meme sharing, narrative building

whom we have collaborated over a decade. Many of our youth participants attend a community center where we have run ongoing STEM (science, technology, engineering, and mathematics) programming since 2006. The second setting, a West Coast urban community, is home to low-income, immigrant, and refugee youths, with whom we have collaborated since 2013.

This study in located in these two ongoing partnerships. In both settings, low-income youth of color participate in youth-centered STEM afterschool programming codesigned by community and university educators. Program mentors identify as people of color, low-income students/growing up with low income, and/or immigrants/refugees. Consequently, most participants had existing relationships with someone on the COVID-19 research team and had experiences with them as partners in research/practice within educational spaces.

Our participatory approaches were not bound by the specific methods listed in this section (Table 2). Our approaches also included engagement in other forms of participation in learning with partners that they initiated and enacted as a part of everyday living and sharing with us. For example, a Midwestern teen researcher/participant recruited adult researchers to help her organize a Black Lives Matter protest. Participating in these ways provided nuanced insights that informed interview questions and follow-ups while sitting outside of this study's data collection scope. In another example, participating moms shared an ongoing text group with researchers, where they checked in with each other and co-strategized how to support their children during the pandemic. These and other collaborative experiences informed and transformed how we co-enacted the research (Table 3).

Our decades-long relationships framed and mediated our data cogeneration in ways that centered the ethical and political in learning and research (Vossoughi et al, 2020). We approach this work acknowledging the complex subject positions that shape our engagement. We have worked to navigate issues of power and positioning to make visible our unintended complicity in these powered dynamics, pushing us to continually question how we may embody the very power structures we hope to disrupt. We have built deep, lasting, and trusting relationships within these partnerships. Where/when we have been welcomed as trusted community members and friends in and beyond research, we sought to further interrogate our actions and methods to better maintain and strengthen that trust. These relationships have been made possible because we have always sought to work in participatory ways—in ways that center and amplify the

TABLE 3
Co-Design, Co-Generation, and Co-Analysis Steps

Step	March–April 2020	May–July 2020	August–December 2020
Co-design components of research activities	Participant-led family snowball recruiting, research question + protocol codesign in Zoom chats with youth and parents	Continued protocol co-design on Zoom and text group chats (e.g., debriefing on interviews, discussing how shared experiences inform protocol, brainstorming ideas/topics that reflect experiences), discussing and refining insights via Zoom and chat, co-strategizing purposes of analysis (e.g., codeciding which findings to emphasize, publish, and disseminate first)	Co-deciding dissemination audiences via text, cowriting in Google Drive via Zoom sessions, codesigning after-school online programming/ engagement options with quarantined youth participants and their parents to honor mutuality of research commitments
Co-generated deliverables	Co-designed research priorities + questions, co-designed Round 1 interview protocol	Co-organized Black Lives Matter protest events, co-participating together, participant-led data generation (e.g., links, photos, texts, etc.)	Co-designed Round 2 interview protocol, co-written research brief with moms, co-written newspaper editorials with some participants

expertise of our community partners and that seek for outcomes that matter to participants.

Our approach is shaped by our efforts to unlearn, relearn, and remix research tools that we have used in the past, toward opening up possibilities for being with/critical witnessing as a part of this remote research process. Because the pandemic made face-to-face interactions a risk, we met with long-term partners via text and phone to *co-strategize* what remote approaches youth were comfortable using and/or learning, when, how, and for what purposes. We also wished to create multiple spaces for participants to share their complex, layered stories in multimodal ways while capturing interactions among layers. In the study reported here, we draw on two rounds of remote long-form interviews, lasting between 90 and 360 minutes each, per participant, as well as experience sampling methods.

We co-analyzed data with participants using critical inquiry/grounded theory, in a constant comparative, continuities/contradictions approach, elaborated in Table 3 (Charmaz, 2017). We developed a set of emergent open codes, focused on forms and focus of data accessed, how, by whom, and for what reasons, and discussed these codes with participants (Table 4). We generated analytic memos for each participant using these codes and participants ideas as guides. These memos helped us organize open codes into relevant categories and generate insights on youths' data practices in relation to learning and action taking in relation to COVID-19 and issues of justice.

In the second phase of coding, axial coding, we referred to our conceptual frameworks of critical data literacies and data justice to establish relationships between forms/focus of data youth accessed, activated, and navigated and the agency they enacted toward taking action on COVID-19 and issues of justice (Table 5, Figure 1). We used this second round to organize our interpretations around two emergent themes (a) navigating, using, and positioning big data and its limits and (b) how data practices became sites of struggle over what/who counts in the pandemic. We identified key tensions in relation to big/small data that cut across these themes. We worked with a subset of participants to best identify the practices and specific experiences that reflected these themes. Figure 1 illustrates an analytic heuristic we cogenerated to test and refine our claims.

Findings

Youths' critical data practices involved efforts to recognize and leverage their intellectual power to participate in and challenge real and consequential aspects of everyday living and learning in a pandemic as STEM-agentic people. First, we show how youth critically navigated, leveraged, and critiqued big data to create meaning. We also show how they remixed, recontextualized, and repositioned big data through the lenses of small data as they sought to bring provenance, utility, and visibility to their meaning making. Second, we show how youth engaged these critical data practices toward liberatory effects in how they navigated and reimagined data toward their desired worlds. Youth reimagined data as sites of struggle over what and who counts in the developing data-rich narrative of COVID-19 and its intersections with justice-related concerns. They also enacted alternative infrastructures for counter data production and aggregation toward justice in the here and now and possible futures. Cutting across these findings, we show how youth often found themselves in contentious spaces as data from different epistemological, social, and political origins collided, facilitating a need to create new ways of engaging with data for navigating and transforming these

TABLE 4
Open Coding Scheme: How Data Were Accessed, Navigated, and Activated/Acted On

Codes	Categories
Accessing data sources	• Content experts and databases directly (e.g., CDC, WHO, Fauci) • Visual social media (e.g., TikTok, YouTube) • Broadcast media (e.g., parent watching in the background, youth overheard) • "Big media" websites (e.g., Vox, *The New York Times*) • Local but large-scale media (e.g., county dashboards) • Online resource center (e.g., health care system sites) • Symptom trackers • Local school/district communications
Navigating data	• "Followed/subscribed" (already trusted expert sources) • Targeted campaigns from national experts or celebrities • Clicking/receiving/mentioning "viral" videos (e.g., from peer text) • Recommender systems/auto-tools (found via suggested by a site/app, hit "like" to get further, similar recommendations) • Googling specific terms and concepts (or searching apps via specific hashtags) • Communications, personal, digital, noninteractive (e.g., TV) • Timing, for example, in relation to key personal and public events in immediate follow-up to a conversation or surprising findings
Learning with, analyzing, critiquing data	• Knowledge building/interest, personal decision making, health decision making, action taking, etc. • Connections to/complicated by racialized, politicized, and ethical stances • Human action/interaction in social network, via tech • How interactions supported, promoted, and discussed, with whom, why, etc. • Metadata and surveillance: Who is watching who, who sees what, and why? • Evaluating information: How do participants decide what is trustworthy and why? • How information is combined and evaluated across political, ethical, scientific, and public health sources?
Actions taken with data to protect self and/or others (activating or transforming data)	• Sharing data peer to peer • Relate/apply to community and personal health/safety (e.g., in planning actions, in making informed consumer decisions, etc.) • Retweet, repost, and share on social media • Informing family, friends (e.g., check-ins with updated advice in person, in text, etc.) • Supporting social/mental health of peers, family (e.g., sharing COVID-related jokes)

Note. CDC = Centers for Disease Control and Prevention; WHO = World Health Organization.

TABLE 5
Axial Coding Scheme: Youth Agency in Relation to Critical Data Practices

Agency in acting with and on data	Purposes	Relationships with coming to know and coming to act in a pandemic
Remix data practices and author new hybrid ones	Socially/critically navigating, understanding, and repurposing data into/of their worlds	• Merging and putting into contradiction data of different epistemological and social origins • New data assemblages with provenance and utility • New data narratives with provenance and utility
Critique and recontextualizing data and data narratives	Reimagining data about their worlds and hoped-for future worlds	• Transforming "big data" into "small data" • Data reflexivity • How data are taken up, mobilized, and legitimized on public platforms as valued/worthy
Reauthor producer/director vs. consumer/observer	Positioning oneself and one's world into data and data science	• Youth developing identities/repertoires as data experts in relation to their practices • Youth reclaiming data narratives with/for/within communities
Navigating and developing/sharing knowledge of data terrains	Navigating, mapping, and communicating landscapes of un/safe data locations to empower action/activation of data	• Coalition building with/through data • Creation of new spaces of data engagement • Infrastructuring

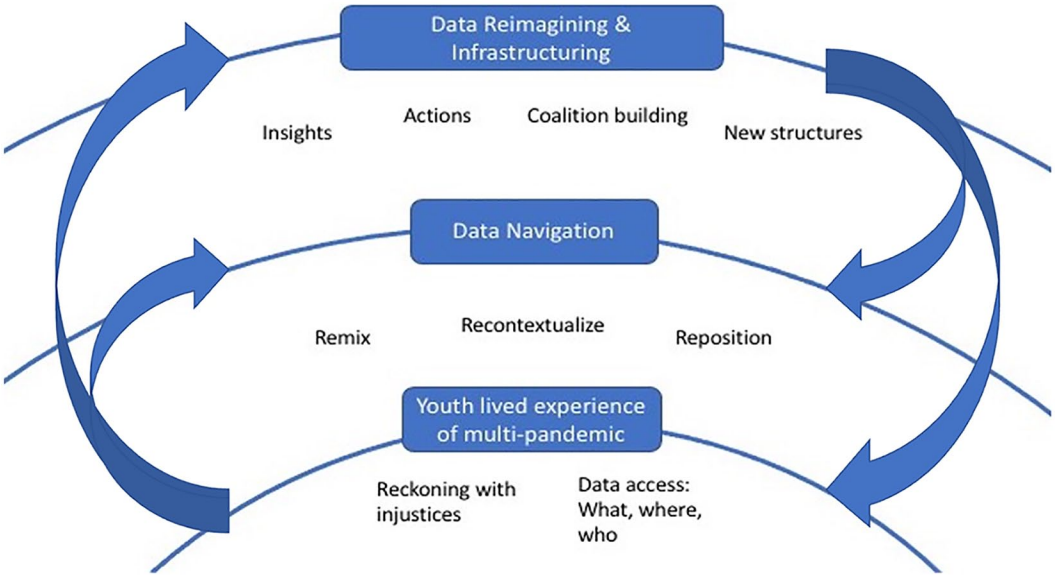

FIGURE 1. *Analytic heuristic for building and refining claims.*

spaces to survive and thrive individually and as members of communities. Table 6 overviews the findings.

Critically Navigating Big/Small Data

Critical Uses of Big Data. Youth actively sought out and made meaning with big data in relation to COVID-19 and justice-related concerns. This included searching for and accessing data such as large-scale data sets and symptom tracker apps in response to personal and family needs. They also paid attention to where data originated, with whom, and for what purposes. For example, all the youth in our study indicated looking for data about COVID-19 infection rates in federal and international science-related websites, such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO), as 12-year-old Prez explained, "On the CDC website, I looked at its spread-per-day worldwide. What I figured out really scared me."

Youth also sought data for making connections to their local contexts, such as how several youth compared national data with data available on state and county health department dashboards to make sense of how the pandemic was affecting their communities relative to the world. For example, 14-year-old Ivy requested one researcher's assistance in looking for rates by zip code in her county's dashboard to see where cases clustered and how that compared with overall cases in their state: "Since corona was coming here, I wanted to know exactly how it was hitting us. I looked in the CDC but it just showed the state [infection rates]. What about [my city]? That is what I was searching."

Youth also cared about data that were "credible" and "useful." 17-year-old Bella explained why she felt large-scale data offered more credible updates:

> I trust the CDC way more than the president and the White House press briefings because they know what they are talking about. It's their job. It's what they studied. . . . They have procedures they follow. They check their findings. They are way more credible. *Way more credible.* Trump has no background in science or medicine. . . . It's unbelievable some of the things I hear Trump saying. How can that even be allowed? People are dying.

Similarly, 18-year-old Binh described how he, especially with vaccine development information, was leery of "false information" and of "vaccine scammers preying on frightened people." In October 2020, he was especially wary of vaccine release date predictions: "I usually say if it doesn't have a .gov at the end of the URL, then it's not safe . . . for a vaccine [release date]. It's not like a release of a new game or product."

Youth also used these data to check and challenge politicized information on COVID-19 risk mitigation behaviors they heard on the news and over social media, such as 17-year-old Arim did when she described her frustration with how participation in peaceful protests was criticized while social gatherings were not. For example, holiday party hosts, in Arim's experience, did not offer the preventative risk-mitigating information sharing that protest organizers provided to participants via flyer warnings:

> People are worried about the wrong thing. They're more worried about protests than going out on July 4th and not wearing masks. . . . My boss for the NAACP Youth Council shared a study with us. It said that compared to other events, like holidays opposed to protests, protests are so low. They're causing almost no cases in Coronavirus spikes. . . . 'Cause I've been going to some protests, all the flyers, it says social distance. They're outside, which helps. On the flyer, it says it's mandatory to wear masks.

TABLE 6
Overview of Findings

1a: Critical users of big data: Actively sought out and made meaning with big data in relation to COVID-19 and intersecting justice-related concerns	
Accessed a wide range of big data and associated infrastructures in response to specific needs	• Large-scale data sets through the CDC and the WHO along with new sites, such as *CNN*, to determine national and state infection rates and spread • Local but still large-scale data in regional dashboards that can be modeled by zip code, race/ethnicity, age, and gender • Symptom tracker apps • Infection risk and mortality risk calculators • Online resource centers
Applied purpose/intended use/perspective	• Scientifically based data for credibility • Check and challenge politicized information on COVID-19 risk mitigation behaviors heard on the news and over social media • Make personal health decisions • Resolve conflicts in information • Model risks, health, etc. (e.g., tech tools for symptom tracker and risk calculator apps, incorporating personal biological data into infection/mortality risk formulas)
1b: Challenging big/small boundaries and remaking the big/small divide: Recognizing the limits of big data and responding with critical data practices	
Critiques of big data	• Not representative of youth experience: Reflecting people who generated/organized them • Lacked immediate utility • Impersonal, decontextual, dehumanizing
Accessed a wide range of forms of small data	• TikTok • Reddit • SnapChat • YouTube • Discord • Instagram • FaceBook • Twitter • iMessage/Whatsapp • Twitch
Brought big/small data into dialectic	• Personal provenance • Utility • Representation/visibility
Practices that supported small/big data dialectic	• Remixing tools of small data: ◦ Filters for making sense and critical lensing of big data ◦ Texture and layer data curation efforts across forms of expertise • Critiquing and recontextualizing forms of big/small data: ◦ Deciding what was most useful, what was harmful, etc. ◦ Big data accountability ◦ Shifts the focus of responsibility from individual to systems • Repositioning data inside communities
2a: Reimagining data as sites of struggle: Youth engaging with/in the world as people who matter	
Practices as new forms of data agency	• Positioning themselves into new aggregations of data as fully human and agentic people • Challenging the dehumanization of dominant data narratives • Made their lives visible and connected to a broadly conceived public • Made visible how personal reactions to data matter
2b: Producing alternative data infrastructures for new social futures: Youth coproduced new counter infrastructures of data practices to recreate the present while working toward enacting alternative futures	
Co-constructing data structures	• Co-constructing data structures to share counter narratives lives during the pandemic • Supporting selves, families, and peer communities • Infrastructuring new local and needed forms and mobilizations of data as resources • Scale making
Remixing technologies	• Share, co-interpret, and debate COVID-19 data and its community impacts • Resource sharing and community empowerment • Scale making

Note. CDC = Centers for Disease Control and Prevention; WHO = World Health Organization.

Many youth laterally compared data between sources (Wineburg & McGrew, 2019), pointing out how misinformation campaigns foster deepening racial and socioeconomic injustices. Prez explained visiting the CDC website for "accurate data" when conflicting data on the news increased his stress: "Since I have bad anxiety . . . it's not that I don't trust the news all the time, it's just that I always have suspicion. . . . I like to check the facts." Similarly, 18-year-old Kim learned to be critical of data visualizations presented on the news. She analyzed "how they got their data, and what their population of interest was, reflecting if that population is a good choice to be generalized to other people." She noted that oftentimes it is not if "data you see in the news" are "right or wrong," but it's about "how it's used."

Youth described seeking more directly applicable data using technological tools like symptom trackers and risk calculator apps, incorporating their personal biological data into infection/mortality risk formulas. Ivy described learning about these apps from her friend who worried about her risk due to asthma. She wondered how accurate the apps were since "they don't actually know anything about me besides the simple things I tell it." Twelve-year-old Jazmyn also used such apps to "cross-check" information from news media and parents on "need-to-know" topics, such as when her cousin exhibited "corona symptoms":

> I was like, OK, don't take ibuprofen. . . . The reason my mom said not to take it is X, Y, and Z. Then I looked up to cross-check, see if it was true. That's how I found out that it wasn't.

In short, youth accessed big data to make personal health decisions, provide information to family and peers, to challenge politicized messages on COVID-19-related behaviors, and to model risk.

Challenging and Remaking the Big/Small Data Divide. While youth by and large trusted some central sources of big data (e.g., the CDC) due to their scientific origins, they also were clear about their limits, as Ivy points out, "They don't actually know anything about me." While big data offered statistical power, it still reflected the people who generated it. Jazmyn was critical of the lack of representation of the Black community. She stated, "I don't see myself in [these data]." Similarly, Bella stated, "It's not numbers that will solve the pandemic, but the stories people tell with numbers. . . . If we don't have different perspectives on the numbers, it will only offer one story. That won't help everyone."

Youth sought out a more nuanced truth by merging such big data with small data to incorporate provenance, utility, and representation/visibility. For example, youth layered big data with small data that had personal provenance—such as first-person narrative accounts to challenge and/or contextualize the impersonal aspects of these data (Goldkind, et al., 2018). Data were particularly important to youth when it were voiced by people who live or work in and/or for their community, including frontline and essential workers. For example, Jazmyn discussed not only how she used her social media apps as a gateway to the CDC's database of COVID-19 information (e.g., clicking on CDC banner ads posted to her YouTube homepage) but also how she used TikTok's search and hashtag functions to look up culturally situated instantiations of viral-transmission mitigation protocols that she could not find in these big data sources. While the CDC offered big data numbers, TikTok and YouTube allowed Jazmyn to engage with personalized narratives to contextualize and further conceptualize the big data narrative. She paid attention to videos in which individuals talking looked like people she could trust, for example, Black female doctors, remixing the tools of small data as filters for making sense of big data. For her, TikTok became a legitimate medical data tool to enhance her ability to protect her younger brother, whom she described as in a high-risk category.

Youth also engaged in *remixing* to add texture to their data curation efforts by layering varied forms of expertise to get a multidimensional picture of the same phenomenon from different directions. They referenced and examined, for example, secondary news stories and information packaging/messaging, and targeted informational campaigning shared on apps from public figures in the "infotainment" space of public education media. For example, 12-year-old Ky shared links with us to a "Mr. Science" YouTube channel, stating that he continually checked this channel to layer additional context on updates as his mom relayed them via TV news. In addition to seeking alternative perspectives, youth remixed data to engage with information in deeper and more relatable ways. This happened, for example, through "youtubing" educational animations of the coronavirus's spike protein membrane and simulations of viral spread between individuals, then sharing those videos with younger family members. In such instances, youth demonstrated a critical lensing of not only what counts as evidence and how to determine validity but also what evidence was worth sharing with peers and parents.

In considering issues of representation and visibility, youth recognized that data and how people use them are not neutral and often are oriented toward the interests of the powerful. In response, youth engaged in *critiquing and recontextualizing* practices as they decided what was most useful or harmful in data they accessed. They cocreated hybrid narratives based on merging diverse data sources, offering a more complete picture about themselves and their communities. For example, Chuck, a university student, recognized that pandemic data were not disseminated to cater to marginalized communities. Their position in society as a queer, gender-fluid/two-spirit, Indigenous, first-generation college student is the non-neutral lens with which they interpreted COVID-19 data sources and narratives they presented. Chuck

critically assessed what data sources were worthy of their time and dissemination platform. With connections to university professors, Chuck acted as a go-between for their academic institution and peer identity-related communities. They recognized how big data does not always service "the people" and sought to critically engage with data more conducive to their identity communities.

> I have a bias toward folk knowledge so I was trying to see what are people feeling? How that might be connected and how the folk knowledge hasn't made it into the papers or into the symptoms that are supposed to be there. I'm looking at the science, but also I'm looking at the people.

Chuck implied how big data was divorced from histories/historicity, shifting the focus to individual responsibility for safety practices, rather than systemic injustices in health care.

Chuck exemplified how youth *repositioned* data inside communities. While the big data Chuck accessed online was helpful, though lacking in systemic accountability, the small data accessed via people close to them went further and resonated more with them as worthy of sharing.

In summary, youth employed critical uses of big data, such as questioning the validity of news reports on the coronavirus. However, they also challenged the boundaries of big/small data through layering data with provenance, utility, and visibility onto large data sets to be able to tell meaningful stories about the data. They did so through remixing, recontextualizing, repositioning, and putting into tension data of different epistemological and social origins toward honoring their lived experiences as visible and important data. In these ways, youth highlighted big data's limits as a dominant form of knowledge for telling the multiple stories of the pandemic.

Reimagining Data as Sites of Struggle

Here we show how youth engaged in reimagining data as sites of struggle over what and who counts while developing data-rich narratives of COVID-19 and its intersections with justice. Cutting across these acts were efforts to challenge dehumanizing dominant data narratives.

Youth Engaging With/in the World as People Who Matter. In working to make sense of and take action in their datafied pandemic-riddled worlds, youth repositioned themselves into new aggregations of data as fully human and agentic people. They resisted being categorized by others in impersonal, context-neutral ways. Consider how Jazmyn navigated different sources and forms of data to determine how she might safely participate in her city's protests for racial justice. She researched modes of viral transmission in outdoor settings, examined protest images online to analyze mask-wearing and social distancing behavioral trends across protest groups, texted adult researchers' clarification questions about data she found, and looked up patterns of infection and spread in her region using the city's dashboard. She drew from these sources to create contextualized understandings of different risks she might face to decide whether and how to physically partake in in-the-street actions with friends and community. She also worried that mask wearing could harm Black protesters through police racial profiling.

Jazmyn noted that data on COVID-19 and risk mitigation overlooked the challenging reality she and her friends navigated. She explained in a follow-up interview, "I had to decide whether to protect myself and my family against injustice by protesting, or to protect myself and my family by not going." Projecting the tension between "health rights" and "civil rights," her decision to protest involved a complex analytical process of weighing different data inputs to mitigate the health risks of a pandemic and fight for justice in a racist country. While her practices focused on epistemic dimensions of understanding tables/graphs about spread patterns, they also addressed the political and ethical aspects of data, which allowed her to use these practices to express herself as fully human in a racialized society.

Similarly, Prez recalled mental anguish caused by accessing statistics on COVID rates in his city and state and hospitalization and death rates in the Black community through the CDC and the WHO. These data positioned him as a statistic—in a demographic group with higher infection, hospitalization, and mortality rates. He purposefully sought out YouTube videos about safety steps that helped him "calm down" by putting the dangers of COVID in context. He explains,

> The CDC website and the WHO, like those two websites, those had the most amount of information I really need on the topic. [B]ut one of the things that really helped me get over my anxiety, over like the entirety of COVID, was watching YouTube videos of YouTubers saying to calm down, just, like, wear your mask, and be safe, and make sure you don't go out a lot.

Youth sought out relevant data for individual and communal utility. Through these data practices, youth express ingenuity to engage meaningfully with each other and their communities. They remixed practices to make their lives visible, connecting their private lives to the public.

Part of authoring themselves as an "agentic who" in the datafied pandemic, youth challenged the dehumanization of impersonal data narratives. One youth, 13-year-old Tianna, challenged the implied narrative that people can navigate and absorb pandemic facts while maintaining their mental well-being. Initially, Tianna invested significantly in learning about the new virus: "When I found out about it, I was like, okay. I looked it up to see what it was. I looked up the symptoms. I looked up everything." Her data-gathering investment changed over time as she began to learn how the virus affected her loved ones: "Cause my grandma's elderly,

and I love my grandma." Tianna found it difficult to think about how life can be taken so quickly.

Engaging with data as fully human meant acknowledging that her reaction to data mattered. Since learning about symptoms and "unjust deaths," Tianna adjusted her approach to understanding the pandemic. She shared a YouTube video to demonstrate how her efforts to seek broader narratives about the pandemic through her social media apps led her to learn more about how the virus was shaping global life, such as by "reducing pollution":

> I have a love/hate relationship with [the pandemic] because it's helping the earth in more ways than one. At the same time, people are dying. . . . But then there's good things, like about the oceans clearing up, the dolphins coming back, and everything being more cleaner.

Tianna's wisdom to seek out and consider these multiple perspectives through her engagement with data shaped how she thought others may benefit in their learning as well. Taking her research into account, she wanted to "know why the government isn't helping" people better understand the pandemic and its effects or how to stay safe. She described different data practices the government should take to better educate people in a way that "eased the burden," such as the CDC using fact-filled memes to get key messages out. She stated that the "CDC should be making memes . . . but have proven facts inside the meme."

Youth also demonstrated awareness of what Noble (2018) referred to as algorithms of oppression, calling out and seeking to address/manage the tension of engaging with inherently incomplete, biased, and corporate-serving systems of datafied communication. They critically navigated individual social media platforms, tweaking their actions to counternarrate their—literally—coded social media identities. For example, 17-year-old Arim described strategically avoiding clicking or commenting on certain content for this purpose:

> With TikTok once you're in a certain algorithm, it's like that for every single post. When I was in the activism TikTok, it was just continually talking about what's going on in the world, what we need to do to change. And I'm just like "this is too much, I need to change the algorithm."

Likewise, An analyzed his range of social media platforms by degree of navigational freedom:

> I'm not sure what algorithms Instagram or Facebook has on me. . . . I'm not seeing certain things because of my age or race or gender. . . . [But] I do have some choice about what I follow on Reddit because there's certain sub-communities that I can join and have more of a focus on, so, I think I have some more control over that.

Many participants like An acknowledged this tension of agency versus algorithm, given their knowledge of larger structures holding more power than individuals. Still, we witnessed engagement in curatorial practices as demonstrating a concerted effort among young people to shift power by placing the gaze back on racist structures and critically managing individual actions in response. This involved deliberately following/unfollowing producers and curators of data as well as liking/disliking content not based on immediate, genuine reaction but as calculated strategy toward restructuring feeds for specific and critically aligned purposes.

In these examples, youth demonstrated agency in how they critically engaged with data on an individual scale in ways that humanized information related to the coronavirus. When faced with footage of death, for example, Tianna presented herself as an individual with agency shifting not only how she sought data and on what but also how this mattered in the narratives told about the virus, opposing seeing a loved one's death as a "body indistinguishable from a statistic."

Producing Alternative Data Infrastructures for New Social Futures. In this last section, we show how youth coproduced new counter infrastructures of data practices to recreate the present while also working toward enacting alternative futures. They further engaged these alternative practices with critical awareness of how they are positioned and toward greater collective engagement and mobilization.

Youth took up forms of data production toward *co-constructing data structures* to share counter narratives of their lives during the pandemic. Much of this youth coproduction occurred through remixing social media platforms for group chatting, information sharing, posting/producing, curating, and live-feed cultivation through liking and commenting. Ivy explained that she uses SnapChat and TikTok to curate, share, and compare different data, "Like how corona is affecting us personally." She further elaborated that "for us kids, it's affecting us different 'cause I'll never be a ninth-grader again. It's all just gone. Corona news doesn't show that. I feel like we've created our own news on TikTok." Similarly, 17-year-old Arim explained,

> On Instagram, I follow a lot more friends and family, and celebrities. Then on Twitter, I follow a lot more politicians, and news networks, and some celebrities, but not as many as Instagram. Then Snapchat is only friends.

Youth co-constructed data structures toward supporting themselves, families, and peer communities through infrastructuring new local and needed forms and mobilizations of data as resources. Consider Chuck who wanted to provide support and information for their communities, including queer and gender-nonconforming college peers, a leadership coalition representing students of color on their campus, and Indigenous peer groups. They created multiple group chats to disseminate accurate information and offer safe spaces to others. Chuck's commitment to maintain this resourcing work was amplified when a group of student sexual assault

survivors and advocates who run a hotline wanted to remain available for students even after the school went remote:

> What I was actively doing in each—I was almost desperate. I was saying, OK, I wanna get out good data. I wanna get out good resources, updates about what's going on to three different group chats, actually, four.

As Chuck remixed data that were applicable to each group chat with distinct needs, again with a critical awareness of their positionality in relation to the group itself, they participated in creating new social futures for each strategically curated chat.

Participants remixed online technologies (e.g., gaming-focused tools like Discord and Twitch; social tools like apps) to share, co-interpret, and debate COVID-19-related data and its community impacts, teaching and learning from one another. Remixing platforms was an acknowledgment of peer agency and capacity to engage in the world's realities with intelligence, criticality, and care. Daniel described how this practice enhanced his ability to make and support new friends:

> In Discord, I've met a couple of random people, and we got close there, just talking every day and playing games. . . like one of my friend's family members had COVID. . . . He was scared because he said that his aunt was a little, not old, but you know she wasn't really strong with fighting stuff off. So he was scared for her and hopes she's safe.

In this practice, youth, like Daniel, challenged what counts as data, why, how, and for whom (Dillon et al., 2017). By engaging in producing local and needed forms of scientific insights regarding the pandemic, and how it intersects with issues of family, identity, and economics in their communities, young people localized and personalized the pandemic as a topic to unpack together.

Youth are doing more than restructuring individual engagement. They are restructuring in ways that are capacity building at a community level, and at times at a national level—similar to notions of scale making (Jurow & Shea, 2015). For example, Jazmyn produced daily video content to motivate and support a specific subset of her Snapchat followers. She created a carefully organized coalition audience of trusted female peers and mentors whom she thought might benefit from her personal curation of data on mental health and the pandemic's impacts. Prez shared with us his own TikTok channel where he joked and helped his friends in other ways.

Youth were attuned to powerful archival data practices oriented toward resource sharing and community empowerment in new forms and scales. These new social future-infrastructuring efforts grew out of the necessity for social connection created by extreme social isolation as much as they were attributed to technology advancements. With these arrangements of practices, there were opportunities for co-constructing big data by building on small data in coalition with large-scale community development. This was seen in individual youth actions to create TikToks on particular forms of humor related to or speaking to quarantine as well as youth engagement in Discord and the development of large-scale Discord community spaces.

All of this demonstrates how youths are breaking down traditionally static binaries of data. These practices are pushing on the porosity of the big-versus-small data divide. They are also imploding traditional assumptions about who can own and produce particular kinds and arrangements of data. Tweaking information feeds, for example, was a particular effort to challenge whose narrations of COVID-19 and racism count as they are experienced in this time of social isolation via physical reality and connection via social media. Taking on the agency to determine who and from where they get information was a valid practice connected to a larger/broader critical questioning of who is speaking on behalf of whom.

Discussion

Youth in this study demonstrated that coordinating efforts across spaces and platforms aid in confronting contentious spaces of manipulation in and with data and data structures affecting real lives in real time (Milan, 2019). This included hanging out in the tensions and spaces of movement in between big/small data to challenge and advance what they are learning to produce meaning that is deeper and more impactful toward goals of a more just present and future. In mobilizing for more just data infrastructures, youth engaged in forms of ethical and political action integral to what it means to learn about and take action in a pandemic.

In response to the limits of big data, youth expressed powerful forms of agency as they engaged in critical data practices of remixing, recontextualizing, and repositioning. They chose to act in the liminal space between big and small data to infrastructure an alternative option for building new data-agentic futures. In this liminal space, big data became large-scale aggregations of small data. Youth presented their engagement on TikTok, SnapChat, and other places as valid data, disaggregated from invisibility and reclustered with meaning through coalition sharing (Dencik et al., 2019). As findings suggest, youths' agency with data is complicated in how it can be mediated by often-distant and unseen commercial interests and platform imperatives in a datafied society (Noble, 2018). However, youth actively sought to push back against how data infrastructures position them as powerless. They curated, shared, debated, and co-analyzed data on their lives as wholly visible with provenance and immediate utility, compared with sterilizing, impersonal big data. They re-presented their experiences as legitimate material to be analyzed with as much seriousness and urgency as what they saw as the aggregated anonymization of their lives.

Youths' practices with data map possibilities for how to reimagine what engagement with data are and could be (Van Wart et al., 2019). As youth engaged in reimagining data, their practices served as a collaborative campaign to restructure power in this datafied pandemic. Youth worked to gain access and control over data that shape their lives in the pandemic. Observing the power differential in data producers and sharers, youth discovered areas where data were sparse and/or unrelatable to them and their communities and mediated the issue by taking data deemed relevant and remixing and sharing them in an effort to rebalance power (Goldkind et al., 2018). All this created a louder and more visible presence of youth in the world during a time of crisis when adults in power did not have answers. The absence of adult knowledge did not render youth powerless, instead doing the opposite, as youths' data practices throughout the pandemic revealed their instrumentality to navigate their reality in data-rich ways and to restructure it.

Youths' critical data practices yielded new forms of counter data infrastructures as they traced over gaps in knowledge and needs left marginal by dominant society. While others have conceptualized the need for new data infrastructures to address representational concerns (Burns et al., 2018), we argue here for the active counter infrastructuring that youth make possible in the here and now in both individual and coalition-build ways through their critical data practices. Youth worked to fill in these gaps by reworking the terrain, for example, in how they leveraged TikTok for documenting their experiences as essential workers, in quarantine, and/or in community, as forms of data, when/because their specific experiences had not been equitably made visible or available otherwise in data (Kahn, 2020).

Such data remixing and recontextualizing challenges the big/small data divide with an eye toward justice. Youth efforts demonstrated in this study thus hold implications for pushing back against the educational research field's momentum toward mainly attending to big data in the formulation of data practices and learning with data. Where we posit that such a momentum orients educational practice toward a technocratic view that impersonalizes experience, we see youth efforts as revolutionary and necessary.

Implications for how the field conceives of critical data practices moving forward should attend to what we consider to be a *textured fluidity* in how youth engage with big/small data and data infrastructures. Textured fluidity centers how youths' mobility in and with data are qualified, shifted, paused, invaded, and reclaimed in constant dynamic because of the uncertainty, plasticity, and unevenness in data and data infrastructures in relation to their lives and communities. Textured fluidity pushes back against "the rise of data colonialism" (Milan, 2019, p. 222). The agency to act on and in the datafied world, especially in a time of a pandemic and heightened inequalities, is a crucial skill and capacity to publicly recognize and support as youth counter the narrative control of big data.

First, we suggest that just as big data, for its large-scale publicity and ubiquity, is wielded for change in the form of policies and practices, small data should be used similarly for its contextual focus, as youth reminded us, "I'm not just thinking about the science, I'm thinking about the people" and "it's the stories we tell with the numbers that matter." The need to make visible critical counter data and infrastructures involve resisting and transforming power relationalities of datafication—to question, call out, and identify subjectivity in the falsely neutral/apathetic. Remixing small with big data challenges dominant, impersonal messaging that reifies oppressive power structures in how youth put names and faces to these data pushing back against its supposed objectivity.

Second, data science should center perspectives of those who have been traditionally marginalized in the formation of the datafied society. Data producers and infrastructurers are often those with the most power. Previous studies show the importance of supporting youth in examining the contradictions between how big data is used to describe reality and people's experiences represented or made visible in data. We expand on this call to recognize and legitimize the counter infrastructures—existing in the liminal space between big and small data—youth author for transforming what data and narratives reach families and communities. As youth do so, they demonstrate how their perspectives matter for structuring access to and processing of data.

Third, youths' critical data practices should be viewed as working within and across scales of activity (Jurow & Shea, 2015). As youths' critical data practices supported their personal meaning making and action taking within the pandemic, they also cocreated new spaces for others to investigate, learn, organize, and create together, intergenerationally, and in support of social transformation. These collectivist forms of data engagement took on infrastructuring toward remediating inequitable systems amplified by the pandemic, as youth sought to protect, defend, connect, and support each other against the systemic oppressions experienced in daily local activity in relation to the pandemic.

Finally, publicly recognizing and supporting youth agency to act in and on a datafied world must include supporting them to engage in the required material infrastructure. We would be remiss if we did not briefly call attention to how youths' critical data practices involve an ingenuity not only with data and data infrastructures themselves but also with the material resources needed to do such work. Youth creatively seek out and share phones, computers, and WiFi access. These are the very materials that at-home-learning policies and approaches to this pandemic have assumed reliably exist. They do not. For example, even when school-issued Chromebooks allowed for improved access, local districts disregarded the need to use the Chromebooks beyond virtual school, locking access to them

over school breaks. This shut off crucial creative outlets and opportunities to connect socially with others in a time of mental health crisis-creating social isolation.

Conclusion

The COVID-19 pandemic has datafied youths' lives on broader scales than ever before. Datafication has occurred as an institutional confiscation of youths' ideas, experiences, challenges, and hopes, rendering them anonymous, interchangeable, and thereby replaceable even as that data are used on public platforms toward broad-scale decision making. Their experiences with and in the pandemic have been datafied in ways that have quantified and categorized how they have come to understand what the pandemic is about, who it affects and how, and its meaning for everyday living and communities. To care for themselves and their communities, youth critically employed big data and layered on their own understanding of the pandemic through multiple sources, reimagining big data as a site of struggle for new futures where their lives are not taken out of their and their communities' hands. The implications of youths' work lead us to call for educational researchers to create a collective space for understanding data, for combining big and small data, for centering the voices of people society has marginalized, and for focusing on understanding the textured fluidity of youths' data practices.

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Note

1. Youth references to young people up to the age of 24 years (UNDESA, 2005).

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