Towards Digital Segregation? Problematizing the Haves and Have Nots in the Smart City

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Scholars, policymakers, and issue advocates have long pointed to the digital divide and systemic injustices that pervade designs for the smart city. For many, this debate centers around the "haves" and "have nots" and the differences between those social groups. This research problematizes that binary classification and articulates a more nuanced set of social groups. Evidence from surveys and participant observations suggest that the smart city is further segregating urban residents along socio-economic lines. While some users will reap financial and social rewards from digital commerce, recreation and social life, others will be preyed upon, victimized or excluded. This will privilege a small group of elites and allow them to perpetuate *digital segregation* in the smart city. We close we a discussion on how to create pathways for greater inclusion and community-based governance.

Keywords: governance, responsible innovation, participatory research, community-engaged research, social justice

INTRODUCTION

In the past 20 years the devices and systems that enabled Self-Monitoring Analysis and Reporting Technology, hereby termed *smart*, have gained popularity as a way to improve urban life. Smart was conceived of as a term to broadly imply connection to the emergent Internet of Things (IoT) and as a means to realize efficiency and productivity gains. The rhetoric and political messages about smart cities often evoke images of clean, green and utopian urban landscapes. For example, the United States (US) Department of Energy issued this definitional statement in 2000.

> The vision of "Smart Cities" is the urban center of the future, made safe, secure environmentally green, and efficient because all structures–whether for power, water, transportation, etc. are designed, constructed, and maintained making use of advanced, integrated materials, sensors, electronics, and networks which are interfaced with computerized systems comprised of databases, tracking, and decision-making algorithms (Hall et al., 2000, p. 1).

This definition was neither the first, nor the most evocative, yet it serves to identify key aspects of the vision for smart cities that have been roundly critiqued as top-down, techno-utopian, and technologically deterministic (Sadowski and Bendor, 2018). Such definitions of the smart city demand residents have high levels of technological literacy and proficiency to access and exploit the services presented in such visions of the smart city. To this end corporate providers have started to market and sell the smart city to people in the hope of attracting technology enthusiasts and to "crowd out" competing visions (Sadowski and Bendor, 2018).

A challenge to the smart city agenda was identified early on by the US National Telecommunications and Information Agency (NTIA, 1995) who surveyed US

citizens to understand what percentage of the population had access to the Internet. Larry Irving, the former Assistant Secretary for Communications and Information, contributed to a follow up report in 1997 called *Falling Through the Net: Defining the Digital Divide*, which coined the term *digital divide*. That report demonstrated that "the digital gap has *widened* in the last year" (NTIA, 1997, p. 2, emphasis in original). Those two reports pointed to an emergent divide between people with physical access to the Internet and those without access. The reports highlighted economic conditions, specifically household family incomes, as a key determinant of adopting the Internet, while race and ethnicity were also correlated with a lack of Internet access. Since then, the digital divide has been studied widely and the key drivers are understood to be age, education level, labor markets and minority status (Serrano-Cinca et al., 2018). To address those drivers many policymakers and advocates have promoted *digital inclusion* to motivate political action and to close the gap between "haves" and "have nots" (Carmi and Yates, 2020). Yet, as Andrade and Techatassanasoontorn point out this, "implies that the digital divide is a technological problem that requires technological solutions—that is, making everyone an Internet user" (2020, p.186).

Shelton and Lodato (2019, p.35) document a shift from the "stereotypically top-down, neoliberal and repressive visions" of smart cities to rhetoric that centers around *smart citizens*. That rhetoric advocates for greater inclusion of citizens in planning and design phases as a way to support bottom-up governance. Shelton and Lodato's (2019) research articulates a duality between what they call *general citizens* and *absent citizens* and how they are discursively and materially involved in planning the smart city. Returning to the research by Andrade and Techatassanasoontorn (2020) there is clear evidence that absent citizens are being forced to engage politically, economically and socially with the smart city agenda and incurring real harms in the Global South. Willis (2018) argues that when citizens are forced to engage with smart technologies their right to choose is lost and this loss of freedom creates political and social harms.

This body of knowledge, which is reviewed in more detail below, suggests that discursive, material and social factors are dividing citizens in ways that goes far beyond a binary classification. This paper seeks to problematize the notion of "haves" and "have nots" and to document the nuanced differences between the social groups engaged (or excluded) from the smart city and approaches to identify those groups. Further, this research demonstrates how negative outcomes arise for citizens living in an urban center in the Global North. The next section reviews prior literature and offers a means to analyze and interpret the results from a contemporary, place-based case study in New York City (NYC).

THEORETICAL BACKGROUND

The extant literature that informs this research includes prior works on technological innovation, digital literacy and the persistence of the digital divide. That foundation is important to consider prior to addressing how *technological citizenship* and

smart citizenship can be used to articulate rights and obligations of those different social groups. Then we introduce *social worlds* by Clarke and Star (2008) who argue that some persons can wholly disappear from one reality, while other people might very well be designing a series of alternative realities.

Technological Adoption, Literacy and the Persistent Digital Divide

Rogers (1995) informs many studies on the *diffusion of innovation.* While a full restatement of that theory is beyond the scope of this paper, we pay attention to the definitions offered by Rogers regarding key actors. First are the *innovators* who have the, "ability to understand and apply complex technical knowledge [. . .] cope with a high degree of uncertainty" and have a "desire for the rash, the daring, and the risky" (Rogers, 1995, p.264). These attributes suggest that innovators are the progenitors of innovative technical prototypes and systems. This social group aligns well with Hughes (1987) ideal-type *systems builders* whose efforts are to extend novel technologies across large-scale infrastructure and through complex socio-technical systems. The next social group identified by Rogers (1995, p.264) are the *early adopters* who, "are not far ahead of the average individual [. . .] they serve as a role model for many other members of a social system." These persons help decrease the uncertainty inherent in novel technologies and demonstrate the uses for novel technologies. They are followed by the *early majority* and soon after by the *late majority*, two social groups that are differentiated by Rogers in regards to the higher levels of skepticism. Lastly, Rogers identifies *laggards,* who are people that resist adopting new technologies and whose "resources are limited and they must be certain that a new idea will not fail" (1995, p. 265–266).

Studies on Internet adoption have followed this model with a 2021 Pew Research Center survey showing that 7% of adults in the United States still do not access the Internet and would be classified as laggards by Rogers (1995). Many adults not connected to the Internet live in rural areas, while those in urban centers are persons that have received less formal education, earn relatively less income, and identify as African American or Hispanic. In the US approximately 30% of the adults with less than a high school education do not use the Internet and one-in-eight African American and Hispanic adults are not connect to the Internet. The reasons for staying offline are largely attributed to the lack of relevance and usability, while other offline adults point to the difficulty of going online because of inexperience or not being physically able to partake in the use of the Internet. Some adults have deemed themselves "too old to learn" and keep up with rapidly advancing technology (PEW Research Center, 2019).

Yet, van Deursen and Mossberger (2018) show that it is not just access and cost that prohibit people from adopting the Internet. They detail the requisite skills from the operation skills of typing and manipulating user-interfaces to formal skills in understanding the forms of media, platforms and utility of different software packages. This is coupled with critical thinking skills, information literacy and understanding the

variety of potential harms from the Internet. Their work also tracks communication skills from writing emails to generating compelling messages via online platforms, such as social media. van Deursen and Mossberger (2018) demonstrate that negative outcomes arise for people with the requisite skills to engage in digital platforms. Simply being online and having the skills to make use of the functionality of digital platforms is not enough to avoid exposure to greater risk. They conclude, "there is evidence regarding the benefits of Internet use for economic opportunity, civic engagement, and political participation [...], these gains are not equal across all Internet users" (van Deursen and Mossberger, 2018, p. 133). They raise important questions about the *responsibilities* of the designers of smart devices and policymakers about how to address those harms affecting Internet users.

Sylvain (2015) argues that policies that focus on technological solutions are based upon the theory that novel technological advances will "trickle down" from high wealth users to lower socio-economic communities—an analogy taken up from economics. Sylvain (2015, p. 449) argues that "trickle down innovation" will only intensify existing disparities since, "the relative advantage in access that networked elites hold will reproduce itself over time until it eventually becomes entrenched." Sylvain suggests that the lack of Internet access will not simply affect this generation, but will be perpetuated into the next generation, since "relative advantage that privileged groups hold in income, wealth, educational attainment, and job security, for example, reproduces itself online and offline over time until it eventually becomes entrenched in both" (Sylvain, 2016, p. 470). Sylvain's argument offers a stinging critique to the diffusion of innovation theory and points to the persistence of the technological divide that is perpetuated by that model.

Technological Citizenship and Smart Citizens: A Brief Review

In a move away from technical innovation, Frankenfeld (1992) published *Technological Citizenship: A Normative Framework for Risk Studie*s, as a way to articulate the complex social contract that protects citizens from technological hazards. Frankenfeld argues that technological citizens should be afforded certain rights including knowledge about the technologies that are intentionally political and opportunities to participate in the decision-making processes regarding the introduction and management of such technologies. Yet those rights are accompanied by obligations to be borne by technological citizens, such as seeking and possessing civil literacy, participating in political discourse, and exercising judgment about the impacts of new technologies in society. Years later, Andrews took up Frankenfeld's work and offered a synthesis, "[i] rights of access to knowledge, [ii] participation in public decisions, [iii] informed consent, and [iv] reasonable levels of risk exposure. Duties include [i] achieving technological literacy, [ii] engaging with the problems of the day, and [iii] protecting the civic good." (Andrews, 2006, p. 4). Andrews argues to protect citizens from technological harm, they must uphold their obligations to seek knowledge, engage in political life and express their desires for the good life. Not all scholars

agree with such an approach, Zimmerman (1995) contends that expanding direct participation into technological design will be inadequate to instill democratic principles into products and broader systems. The crux of Zimmerman's argument rests on the ideals of informed consent and he argues that publics are unable to fully comprehend the implications of different alternatives and then discern the option that best supports the broader public interest among those choices. Zimmerman suggests that people are not morally competent and routinely contradict or oscillate between moral positions and ultimately lack consistency in their moral expression, which can be understood as irrational behavior, i.e., discontinuity between stated values and decisions. Zimmerman (1995) suggests that *representation*, rather than direct participation offers a way forward and that role playing might be explored in quasi-experimental and educational settings to elicit representative values to inform design decisions.

As Hartley argues, "the smart cities phenomenon invites critical reflection about tensions between technocracy and democracy" (Hartley, 2021, p. 1). This essential tension is vital to understand the future imaginaries and social constructs that frame smart city narratives. The concept of technocracy draws from deep roots that can be traced back centuries pertaining to the relationship between the state and citizens. Recently, Sadowski and Selinger (2014) categorized how technocratic decisions affect changes through mandates, nudges, and technical mediation. Further, they reviewed the forms of harm that can arise from technocracy as: political harm, recognition justice, existential harm, and discursive harms (ibid). We return to these forms of harm later on in the paper. Technocratic decision-making and the means of enacting changes in the city does not occur in isolation. Winner's (1980) contribution to this literature focuses on the exertion of political power through the design of technological artifacts and the outcomes that occur as a result. Hecht (1998) advanced that work and claimed technology is an expression of state-building and exerts power beyond traditional geographic boundaries of the state. The practice of technocracy shrouds political values under the guise of technical expertise. Returning to Hartley (2021, p. 3), the smart city is a particular form of technocratic design that raises questions about, "the role of power in policymaking but with a uniquely modern technological flourish".

Returning to Shelton and Lodato's (2019) work on expertise and (non)participation in the smart city, some key lessons from their research stand out. As they noted, the shift to a citizen-centric focus for smart city planning and governance has facilitated numerous attempts to engage diverse publics in the process. Their observations of the semi-public workshops and private meetings in Atlanta, Georgia, highlighted how participants were designated as "general citizens" of Atlanta and asked to bring their perspectives on the challenges to the sessions. Yet, all the participants also held positions of power with government and corporate organizations, although not all were from Atlanta. The authors concluded that, "At worst, we observed the general citizen being used [as] a vessel for stereotypes and groundless assumptions that reinscribe existing power relations and hierarchies" (Shelton and Lodato, 2019, p. 44). Their observations pointed to the non-participation in the

formal meetings and lead them to conclude, "in observing smart city events has been the distinct absence of people participating in these workshops, meetings and discussions in their capacity *as citizens,* rather than through some other institutional or organizations capacity" [italics in original] (Shelton and Lodato, 2019, p. 44). They extend this logic to describe the "general citizen" as an imagined public, while the vast majority of people in Atlanta can be grouped within the "absent citizen" category. Foth et al. (2016) identified genuine and meaningful participation as problematic in London, as well, and offered a game-based solution for engagement. Yet, the challenge to meaningfully engage diverse publics remains and the outcomes for citizens can yield dire consequences, as Virginia Eubanks points out.

Eubanks argues that civic leaders look to connected devices as solutions for societal problems and that often leads to, "systemic, structural bias into its supposedly objective, scientific tools and practices" (Eubanks, 2018, p. 1). Disenfranchised persons that use the Internet don't even have the opportunity to recognize violations of their civil rights. For some, Eubank's sharp critique of digital services that exploit families-in-need demonstrates that opting-out is a false choice for many people. Often corporate leaders and elected officials suggest that if people want to avoid sharing private information with advertising firms, they should simply opt-out. However, there is little consideration for the consequences of doing so. Opting-out excludes individuals from the freedom to purchase goods and services online and engage in other civic, educational and political action. Thus, opting out is not a viable solution, especially as employment opportunities, education or government services are increasingly dependent on Internet technologies (Eubanks, 2017).

Andrade and Techatassanasoontorn (2020) go further and argue that many citizens are unable to opt-out and subjected to *digital enforcement*. In other words, people are forced by government and corporate organizations to use digital platforms for necessary services. They assert that the emphasis on digital inclusion defines the non-users as the problem to be solved. Thus, the non-users that lack the access, skills or motivation to engage in digital technologies are "deviant individuals" insofar as they are unwilling (or unable) to ascribe to the norms of an increasingly digital society. They conclude, "As a consequence, a group of people may be losing control over how they want to live their lives" (Andrade and Techatassanasoontorn, 2020, p. 192). They draw upon Kantian perspectives of ethics and demonstrate how digital inclusion interventions can violate a person's rights as, "free agents who are entitled to make their own choices" (ibid, p. 192). Willis (2018) pursues a similar line of reasoning and draws from a case study in Chennai, India and focuses on the urban poor who often rely upon informal economies and informal settlements. Willis (2018, p. 29) details how smart city planning views marginalized citizens and informal economies as a way of addressing the "leaks" in a system that need to be optimized and rationalized" and this leads to the further exclusion of urban poor. By synthesizing this literature, a hierarchical framework for the smart citizen emerges and addresses the access, skills, motivation and outcomes for different social groups, see **Table 1** below. Wilkerson's (2020) award-winning research on social structures

argues that social hierarchies are designed to create a *caste system* that segregates people by racial, ethnic or religious association. Wilkerson illustrates how historical notions of case are perpetuated today and that appears to be evident in the literature on the digital divide.

Social Worlds: Separate and Not Equal

Clarke and Star (2008) offer *social worlds* as a concept that might well prove useful as a means to problematize the hierarchical social structures articulated in the literature on the digital divide. This sociological theory builds upon past scholarship on discursive communities (Strauss, 1978) and was enriched by science and technology scholars in the following decades. Social worlds theory seeks to distinguish social groups by the norms, languages, and informal institutions that guide human behavior and actions and support their interpretation of physical artifacts and ecological systems. Within discrete geographies multiple social worlds can co-exist within explicit, formal institutional arrangements and political boundaries. Persons can even move between social worlds—often termed "codeswitching"—by seamlessly transitioning from one social world to another without cognitive overload (Heller, 1988). Yet, as Clarke and Star (2008, p. 113) articulate, "when the number of social worlds becomes large and crisscrossed with conflicts, different sorts of careers, viewpoints, funding sources, and so on, the whole is analyzed as an arena." Urban regions within nations that support immigration and aspire to promote pluralism are often understood as arenas for multiple social worlds to converge. It is when contestations between social worlds arise that the disparate norms and discourse can reveal fundamental misunderstandings (at best) or conflicts (at worst). More often though, people living in the same geographic community very well inhabit different social worlds and are therefore blind to the differences or ignorant of the harms that affect other persons. Clarke and Star (2008) point out that social worlds can be constructed to isolate and insulate different social groups from one another.

RESEARCH DESIGN, CASE CONTEXT AND METHODS

Drawing upon the theoretical construct of smart citizens, this research seeks to problematize the dichotomy between the haves and the have nots. Empirical evidence was collected with a mixed methods approach that blended qualitative and quantitative approaches to inform a case study in Harlem, New York City. Semi-structured observations were recorded as persons sought Internet services from the Digital Van program run by the New York City Housing Authority (NYCHA). Those observations were complemented by one-one interviews with individuals by the faculty researcher and quantitative data in the form of survey responses from persons living, working and recreating in the Harlem NYC community. Prior to detailing the research methods here is a brief case context.

TABLE 1 | Extant literature on smart citizens organized by descriptions of social groups.

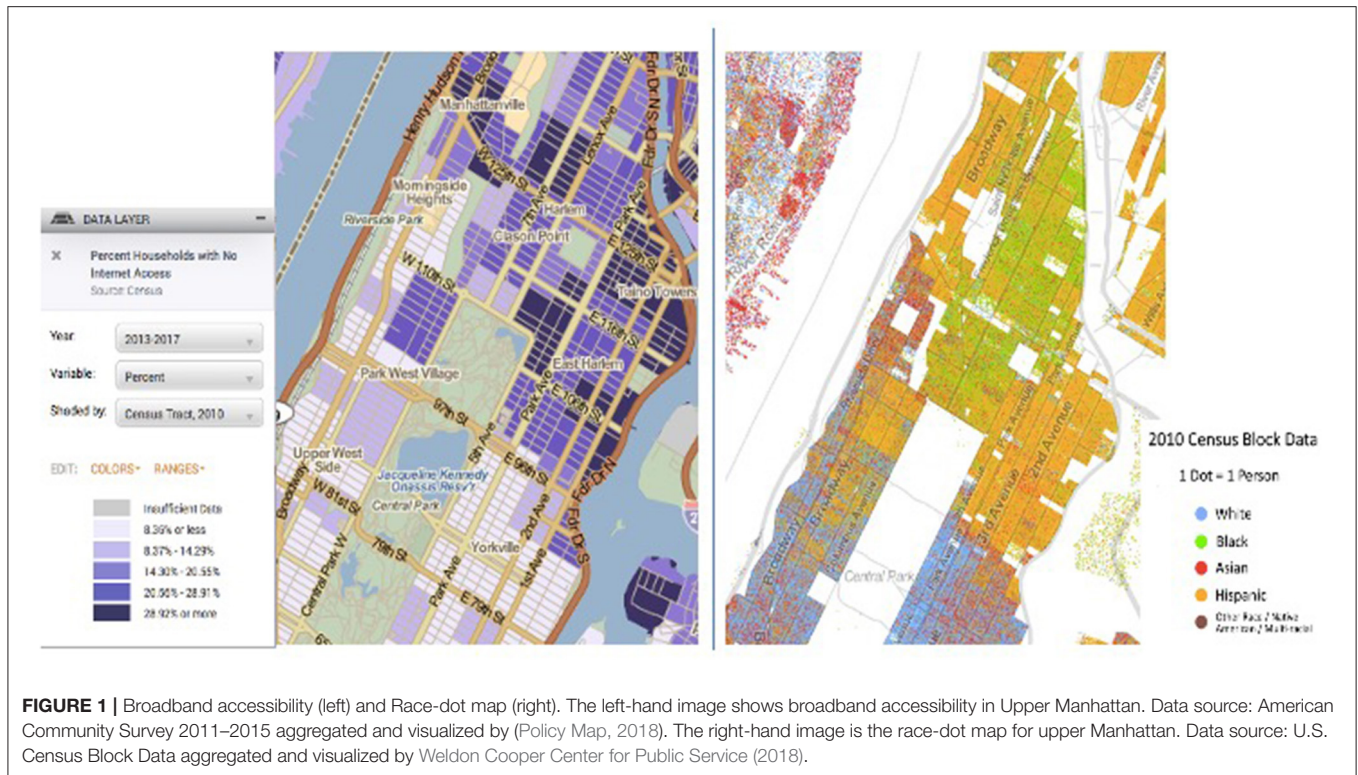| Social groups	Descriptors	Source
Systems builders	Highest level of access, skills, use and most beneficial outcomes are "experts-qua-citizens"	Shelton and Lodato (2019)
	Technological determinists that seek efficiency and productivity through data analytics. High levels of responsibility, yet lack accountability	van Deursen and Mossberger (2018)
	Innovators	Rogers (1995)
	Technological utopians	Sadowski and Bendor (2018)
	Highest levels of control, autonomy and social capital	Foth et al. (2016)
	Highest levels of operational knowledge, formal training, information literacy, communication skills and strategic uses	Carmi and Yates (2020)
Elites	Moderate level of access, skills, use and net positive outcomes are "normalized users"	Shelton and Lodato (2019)
	Willing to adopt and live in smart cities and are adopters of advanced services, service users	Willis (2018)
	Professional and educational users	Serrano-Cinca et al. (2018)
	Early adopters and early majority	Rogers (1995)
Exploited	Low level of access, skills, use and net negative outcomes are "general citizens" that are portrayed by a "smart-phone centric vision of civic engagement" or "citizens-as-sensors"	Shelton and Lodato (2019)
	Online systems inflict harms on working poor through data exploitation, coercion, and algorithmic bias	Eubanks (2018)
	Late adopters	Rogers (1995)
	Recreational and social users	Serrano-Cinca et al. (2018)
Enforced	No or very low access, skills, use and net negative outcomes or "problematic other" or "deviant individuals" that leads to the "stigmatization of non-users" and lack choice or digital enforcement	Andrade and Techatassanasoontorn (2020)
	Informal and marginal populations and in needs of digital inclusion interventions	Willis (2018)
	Laggards	Rogers (1995)
	Offline citizens	Foth et al. (2016)
	Absent citizens	Shelton and Lodato (2019)
	Excluded users	Serrano-Cinca et al. (2018)

Case Context: Harlem, New York City

To ground our research in a specific context that exhibits multiple social worlds, this project focuses on a diverse community within NYC. Harlem is located in upper Manhattan Island and while the exact boundaries are subject to debate and not discretely mapped, it is a distinct community within the larger city. Manhattan itself is one of the most densely populated areas of the city and is often prominent on the global stage as an economic and governmental center with the NY Stock Exchange located on Wall Street and the United Nations on the banks of the East River. Harlem gained international prominence over a 100 years ago as literary leaders, musicians, artists, and political figures congregated in the homes, recreated in speakeasies and built businesses in the community.

A distinct characteristic of NYC are the multi-unit apartment buildings that are privately owned and the large public housing buildings owned and operated by NYCHA. NYCHA is home to 400,000 persons and another 800,000 people receive subsidized housing. In private housing it is often the case that the building owner signs a contract with the Internet Service Providers (ISPs) and then increases the rent in a manner that is proportional to the increased cost of providing Internet. This means that some privately-owned buildings are not "lighted", meaning that residents cannot individually opt-in to Internet contracts and

this is more often the case in privately-owned buildings where a majority of the residents are receiving housing subsidies. In those cases, the rent payments are often fixed and thus there is no incentive for the building owners to contract with ISPs and, thus they do not provide internet to the building occupants. For many others living in NYCHA buildings there is a pattern of contracts signed with ISPs and, yet Internet services are not provided.

Mayor Bill de Blasio set out to provide 99% of city residents with Internet access by 2025 and signed a contract with FiOS (Verizon). The project sought to address the, "more than one in five New York City households [that] lack home Internet service; among households below the poverty line, the number is more than one in three" (Lewis-Krauss, 2016, p.1). Verizon violated the terms of the contract (according to the NYC Mayor's office) and that gave rise to this statement and a lawsuit, "Verizon must face the consequences for breaking the trust of 8.5 million New Yorkers. Verizon promised that every household in the city would have access to its fiber-optic FiOS service by 2014. It's 2017 and we're done waiting. No corporation—no matter how large or powerful—can break a promise to New Yorkers and get away with it" (New York City, 2017, p. 1). What persists in Harlem are structural inequalities that do not afford Harlem's residents and businesses the same opportunities that lower Manhattan

FIGURE 1 | Broadband accessibility (left) and Race-dot map (right). The left-hand image shows broadband accessibility in Upper Manhattan. Data source: American Community Survey 2011–2015 aggregated and visualized by (Policy Map, 2018). The right-hand image is the race-dot map for upper Manhattan. Data source: U.S. Census Block Data aggregated and visualized by Weldon Cooper Center for Public Service (2018).

experienced in the dawning of the Internet age, not to mention over the past century. The digital divide can be observed in the installation of broadband Internet in homes, see **Figure 1** below. As such, for many residents in Harlem "smartphones" are the primary mode to access the Internet, a characteristic of persons facing the digital divide (Anderson et al., 2018).

Data Collection and Analysis

The research team conducted observations of the Digital Van program operated by NYCHA between June 1 and August 15th in 2018 and June 1 and August 1st of 2019. The Digital Van program was launched in 2011 and the initiative sought to provide residents in public housing with access to computers and printers. The van driver supports users' needs for housing complexes that lack computer resources. The vans physically travel to designated locations twice a month with a typical work day being 10:00 am to 4:00 pm. Residents in NYCHA housing are the target users of the Digital Van program, but anyone within the community who needs to use the Internet is allowed to enter the vans and use one of the eight laptop computers. Two undergraduate researchers conducted the observations, with the first five observations being conducted together and in consultation with the faculty researcher. The following observations were conducted independently by undergraduate researchers. The faculty researcher replicated one of the observations by visiting a location that had been previously observed. While each event was unique, patterns emerged and the research team achieved consensus in their interpretations of the events.

Additionally, a long-form survey was administered to persons living, working and recreating in Harlem, NY throughout the summer of 2018. The survey questions were derived from prior efforts by the General Social Science Survey, PEW Research Centers' Internet & American Life Project Spring Tracking Survey (2013), as well as from pre-tested scales pertaining to use/non-use of the Internet, computing, functionality and use of the Internet, and ownership and maintenance of computing resources and adapted from the ORAIS Scoring Key for computing activities (2018). To sample the community the research team conducted on-the-street survey collection at parks, as well as at community forums, and in apartment buildings where the researchers were given permission to survey residents. Further recruitment targeted persons that worked in co-working offices that offered Internet services to small business owners. This approach aimed to collect surveys randomly from the workforce, residents, and persons recreating in public spaces. The survey results were analyzed using the conceptual framing in **Table 1** and compared our results to prior work by PEW Research Center (2013). Differentiating persons among the different social groups listed in **Table 1** became a subject of vigorous debate and the research team turned its attention to the analytical methods to distinguish different user groups from non-users. This spurred the research team to demonstrate three approaches to categorize social groups and to explore the implications for the future of the smart city.

The survey data was first cleaned by removing responses in which <50% of the questions were completed. This yield 374 survey responses that were analyzed with the three models

TABLE 2 | User classification and scoring for survey responses across three models.

User classification models	Survey response categories		
	Not in past year/never in my life	<15 times in past year	> 15 times in past year
Model 2: Unweighted Scores for all questions	0	1	2
Model 3: Weighted Scores for Level 1 Questions	0	1	2
Model 3: Weighted Scores for Level 2 Questions	0	1.5	3
Model 3: Weighted Scores for Level 3 Questions	0	2	4
Model 3: Weighted Scores for "Asking for help" on Level 1 Questions	0	−1	−2

described below and summarized in **Table 2**. The first model used thresholds to cluster the survey responses and created tipping points for different social groups: Threshold Analysis Model 1. The second model (Unweighted Analysis: Model 2) assigned points to specific survey questions pertaining to Internet access and devices, as well as questions pertaining to capacity and skills with computers, software and hardware. The research team ranked the survey questions on a scale from 1 to 3. Questions ranked as a "1" were common activities or general skills, such as viewing social media, watching videos or sending email. The questions ranked as "2" were identified as more advanced and dealt with the generation of Internet content and economic transactions, for example applying for jobs online or conducting banking online. The questions ranked as "3" were deemed to be sophisticated and required more advanced training to create, troubleshoot or augment existing Internet systems, such as installing new hardware, writing code or running software updates. Those questions were assigned scores based upon the responses. A score of 0 was assigned for responses "never in my life" and 1 for "<15 times in the past year" and 2 for ">15 times in the past year." The scores for each question were aggregated for each respondent. This approach took the unweighted aggregate score and then used a pivot table to cluster the social groups, see **Table 2**.

The third approach applied a weighting scheme to the points assigned to the questions from Model 2, see **Table 2** below and the **Supplementary Material** for a complete list of the questions and unweighted and weighted scores. For the third approach (Weighted Analysis: Model 3) each participant was given 2 points for responding to level 1 questions with "more than 15 times per year", for example sending more than 15 emails per year. Participants were given 1 point for responding that they completed the activity infrequently and 0 points for responding, "not in the past year" or "never in my life." Participants were awarded 3 points for responding to level 2 questions with "more than 15 times per year" and 1.5 points for responding "in the past year" to the same question and 0 points for responding "not in the past year" or "never in my life." The weighted score awarded 4 points for responding to level 3 questions with "more than 15 times per year" and 2 points for responding "in the past year" to the same question and 0 points for responding "not in the past year" or "never in my life." The weighted scores included negative points for "asking for help" on level 1 questions. For example, if someone asked for help on sending an email more than 15

times in the past year they were assigned −2 points, while −1 point was awarded for asking for help on sending an email <15 times in the past year and 0 points for responding "not in the past year" or "never in my life" to the question on asking for help on sending an email. The scores were aggregated and divided into four clusters.

FINDINGS

This research problematizes the binary distinction of the "haves" and "have nots" and suggests the emergence of digital segregation among distinct social groups. The survey evidence offers three alternative models to distinguish those groups and the findings are complimented with observations of how excluded persons are treated in a social world that privileges Internet-enabled communication above all other modes of information sharing. Secondarily, this research documents the potential for harm that can result from digital enforcement in the Global North. We start with the survey results before turning to the observations of the Digital Van.

Survey Results: Toward Digital Segregation

The research team used three models to differentiate the social groups and to further articulate categories, before critically reflecting upon those categories. The survey results shown in **Table 3** can be aligned with the analytical framing in **Table 1**. The survey responses reflect the levels of skills, motivations, as well as the outcomes. While Serrano-Cinca et al. (2018) sought to differentiate users by recreational, educational and professional uses, this approach seeks to highlight the emergent hierarchy among the social groups. The goal is not to establish a new classification system, but to synthesize prior work in this area and bring survey evidence to bear on the theory that the digital segregation is occurring and detail some of the harms imposed. The outcomes and implications for the smart city are discussed throughout the findings. First, we describe the social groups and articulate the characteristics of each group.

The first group that was distinct was called the *system designers* following Hughes (1987) definition of the persons that build, design and contribute to the creation of complex socio-technical systems. This group is inclusive of the *innovators* that Rogers (1995) describes but, system builders is more expansive and includes the urban planners and others involved in designing and implementing smart city plans. These participants indicated they frequently use the full range of Internet applications

TABLE 3 | User categories using three models to differentiate the participants by frequency and functionality of networked computing.

Social groups	Models		
	1: Defined thresholds	2: Unweighted scoring	3: Weighted scoring
System Builders	45 (15.1%)	19 (5.1%)	6 (1.7%)
Elites	164 (55.0%)	197 (52.7%)	180 (48.0%)
Exploited	65 (21.8%)	87 (23.3%)	114 (30.5%)
Excluded	24 (8.0%)	71 (18.9%)	74 (19.8%)
Totals	298 (100%)	374 (100%)	374 (100%)

represented on the survey, but they also upgraded, modified and changed hardware and software. Respondents that fit this group indicated that they frequently wrote code and installed hardware, which portrays activities that contribute to the dynamic and everchanging content and architecture of the Internet and connected devices. This social group, depending on the model, ranged from 1.7–15.1% of the total participants, see **Table 3**. This is a wide range and suggests that identifying the system builders is not trivial and further research is needed. Nonetheless, the findings across all the models suggest that a small or very small minority of persons fit this definition. Carmi and Yates (2020) define this social group as having the highest level of operational knowledge, formal training, information literacy, communication skills and use Internet resources strategical to advance their goals. van Deursen and Mossberger (2018) argue the goals of this social group include economic efficiency and productivity through data analytics. While Foth et al. (2016) states that this social group has the greatest level of autonomy and control over Internet and smart city designs, yet need to be more accountable for their actions and responsible for the implications of their designs.

The research team started using the term "proficient users" to define the next social group, and later agreed upon the term *elites*. This social group demonstrated high frequency use and reported owning and using multiple devices in a diversity of places, but reported limited software coding or hardware skills. This is akin to Willis (2018) classification of adopters of advanced technologies and service-users. This group's frequent uses of Internet resources affords them access to employment opportunities, similar to Serrano-Cinca et al. (2018) classification of professional use. This group is benefitting from existing Internet resources and is "willing to adapt and live in smart cities" (Willis, 2018, p. 30). From a diffusion of innovation position, these are the early adopters and early majority (Rogers, 1995) which reflects our data insofar as this group is the majority of persons in Harlem with a range of 48–55% depending on the model, see **Table 3**. However, while this group reaps benefits, there are potential risks and harms associated with their Internet use. van Deursen and Mossberger (2018) point to the lack of visibility, less autonomy, and data generated that can exploit their use of the Internet. In summary, while this group reaps benefits in terms of education, employment, recreation, and other social

benefits, their Internet use can lead to indirect and direct harms and exploitation.

The next social group can be closely associated with Serrano-Cinca et al. (2018) characterization of users that rely on the Internet for social or recreational activities, including email and social media. This group had rarely or never applied for employment online and did not conduct banking or other financial transactions nor did they report activities such as coding or hardware installation. This group was named the *exploited users*, as these persons consume online media, while engaging in social media for entertainment and to maintain social connections or "citizens-as-consumers" (Shelton and Lodato, 2019). This group does not engage in commerce or professional activities, e.g., employment seeking or banking. This group is frequently online, but remains quite passive in their use of the Internet for political and economic activities. They might become the "citizen-as-sensor" and certainly are the "smart-phone centric" users that Shelton and Lodato (2019) describe. This group is exploited in the ways that Eubanks (2017) describes through the resale and manipulation of data and usage patterns. Their high levels of Internet use is exploited by other social groups, namely, the system builders through data analytics, marketing, and other revenue generating activities.

The group that is often referred to as non-users or the have-nots in relation to the digital divide was not difficult to identify, yet here we have categorized these persons as *excluded*, since they are almost entirely absent from digital-life. The first model, using defined thresholds, suggests that 8.0 percent of the survey participants are non-users, see **Table 3**. What struck the research team was the difference between the threshold model and the two approaches that used a scoring system. Both Model 2 and 3 reveal that close to 20% of participants might well be defined as non-users and have very infrequent and limited knowledge and use of the Internet. As one participant stated in an open text box at the end of the survey, "A lot of this Internet stuff that I read about is amazing and all, but I still don't even know how to check my email. I still get my son to do it for me." This is the social group that is targeted by many of the digital inclusion policies and efforts. Andrade and Techatassanasoontorn (2020) characterize this group as "deviant individuals," which does not infer they are bad, but that their behavior deviates from that of "normalized users".

The external validity of our survey results was tested by comparing our findings with prior work in the field by Foth et al. (2016). A subpart of this survey directly used questions from the PEW survey. Of the participants that reported they did not use the Internet, 38% claimed that they did not use the internet because it was a waste of time, they were too busy, they were not interested, or did not find a need/want to use the internet. While, 36% believed that they did not use the internet because of their age, physical ability, distrust its safety, and the difficulty that they may face with rapid innovation. Additionally, the remaining 26% of respondents attributed their lack of access to the price of computers and internet connection costs. These **Table 4** results match prior statistics from the PEW research study and suggests a high level of external validity, see **Table 4**.

TABLE 4 | Case comparison.

Reason	Description	U.S. 2013 PEW phone survey (n = 2,252)	Harlem 2018 community survey (n = 374)
Relevance	Not interested, waste of time, too busy, don't need/want	34%	38%
Usability	Difficult/frustrating, too old, don't know how, physically unable, worried about virus/ spam/ hackers/etc.	32%	36%
Price	Too expensive, don't have computer	19%	20%
Availability	No access to internet	7%	6%

Rationale offered by participants for the 2013 PEW phone survey that was administered across the United States and the for the 2018 Harlem Community Survey in New York City.

Survey participants offered statements that illuminate their reasons for not using the Internet.

"Can you explain what the internet is and how it will benefit me?"
"Spectrum and Verizon lied to me about the cost, they lied."
"I am almost 60, I ain't grow up with all that. I use my feet and brain to find a job."
"I'm a 65 baby, I hate technology. There's no more interaction. I don't fuck with the Internet".

The first statement reflects a lack of knowledge about the benefits of networked computing. The second quote speaks to issues of affordability and past injustices, while the third and fourth quotes speak to issues of generational justice, such that older persons were raised in an era when the internet was not critical to their success and they often rely other skills and approaches to find employment. The final quote embodies the distrust and bemoans the lack of personal interaction that is not mediated by technology. In the next section, we explore how the persons within the excluded group are harmed when forced to engage in digital platforms to secure government services.

Digital Van Observations

The research team made observations on 16 different occasions for a total time of approximately 44 h at four different NYCHA complexes in Harlem. The schedule for the Digital Van was posted online on a monthly basis and printed and posted in the management offices at the housing complexes. The Digital Van had eight laptop computers and office chairs in the back of the windowless vehicle, see **Figure 2**. On four different occasions the Digital Van did not arrive at the appointed time and location and on three more occasions it was over 30 min late, while nine times the Digital Van was ready to serve the public at the appointed time and location. Even when the Digital Van arrived on time there was often a large group (n = 5–10 persons) that needed assistance, as they have limited experience with computers or the Internet. Some people waited 30–60 min for the Van Driver— the designated support staff—to help them with their computing needs. At some locations the driver gave out tickets with numbers as a way to create a queue. In the mid-summer heat, waiting outside, people milled around and grew upset with the process. On eight occasions the persons waiting for the Digital Van became visibly upset and started to vocalize their displeasure and frustration with the service.

FIGURE 2 | Two unidentified persons walk toward the Digital Van after waiting an hour for it to arrive in August 2018 (Image credit: Foley).

This led the research team to investigate: Why are these people waiting for such a long time to use a computer? What was so important that these people would spend hours waiting outside in the summer heat for the Digital Van to arrive and then wait in line for a chance to sit down with the van driver and use the laptops? What became apparent was that these people needed to renew their lease with NYCHA and they had all received letters that mandated that they renew their lease via the Internet. This was clearly a form of *digital enforcement* as theorized by Andrade and Techatassanasoontorn (2020). Yet, they had no access to computers in the housing complex and no experience using computers and so they required assistance. The NYCHA residents would gather their financial statements, health records, forms of personal identification for all members of the household and bring them down to the Digital Van. The reason they had to wait was that they would be evicted if they did not register online.

Numerous persons waiting for the Digital Van did not speak English and the letters were all published in English and offered an email address for questions, yet no phone number or mailing address was offered. The NYCHA administration had constrained the process of applying for continued housing benefits to an online portal. The van driver patiently worked with each person to enter all their personal data into the portal in the back of the van. Often, people waiting to enter the van were holding a bag with the financial documents, bank account information, identification forms and

health records of their neighbor who spoke no English or was at work.

While persons waited for the Digital Van they were recruited to take the survey and a few wrote comments at the end of the survey that are poignant here:

"I bring the letter [NYCHA Lease Renewal] here because I do not know how to use a computer."

"I have no reason to use a computer. I [just] need someone with a computer to help me write a letter to NYCHA with a complaint."

"I would like to have internet for so many important issues like jobs and housing very important."

The system designers at NYCHA had created a mechanism to reduce the administrative burden of data entry for the organization's staff and transferred that burden to the residents. That change did not account for the lack of access and experience, nor did it account for the harm to the residents. The harms observed included:

- heat stress, standing over 2 h outside in mid-July on the sidewalk with elderly persons sitting on their walking-assisted devices,
- anxiety, if the Digital Van did not arrive or was late people were distraught and concerned that eviction was imminent,
- the threat of eviction, residents faced strict penalties for noncompliance, and
- identity theft, residents handed over all their personal records to the Van Driver or to a family member, friend or neighbor for the data entry.

Furthermore, when members of the research team asked to use the computers (and since they are public computers they were granted access), the laptops contained timeslips, resumes, love letters, pictures and other personal data from the past 5 years of use and it appeared that none of the computers had been configured to expunge the data generated from past uses and stored locally. The research team did not try and access protected files, but only opened folders that were unsecured. This demonstrated clear harms in the design and implementation of the Digital Van service, which was intended to increase digital access and foster digital inclusion.

DIGITAL SEGREGATION AND MOVING BEYOND BINARY CLASSIFICATIONS

What Larry Irving and the (NTIA, 1995, 1997) described over 25 years ago as the divide between "haves" and "have nots" continues to plague persons living in urban centers in the United States. Smart city initiatives and shifts to digital services will compound and reinforce inequalities that stem from economic imbalances, as well as racial and ethnic discrimination. This is not to say that rural communities are not suffering from a lack of Internet access and this is exclusively an urban issue. Yet, the population densities and network infrastructure in urban communities makes the disparities more clearly about societal factors. Prior

research continues to view the digital divide in binary terms between: general and absent citizens (Shelton and Lodato, 2019); excluded and included citizens (Willis, 2018); enforcers and enforced (Andrade and Techatassanasoontorn, 2020); or literate and illiterate (Carmi and Yates, 2020). Serrano-Cinca et al. (2018) offered quite a few users categories, but ultimately their research offers non-users vs. different types of users. Rogers (1995) theory views innovators as the leaders and all the other groups are followers from early adopters to laggards.

From that hierarchical perspective it becomes clear that *system builders* are afforded the most rights and autonomy given their access, skills, and motivations to design, plan and create smart city projects. Yet, the obligations of system builders to afford other people the same rights and autonomy is clearly lagging. The survey responses, observations of the Digital Van and selected quotes demonstrate how citizens are being harmed by the digitization of government services, which is a harbinger of smart city outcomes. If access to housing for the urban poor is constrained to digital platforms this will only exclude more people from affordable housing. As the US and other nations struggle with homelessness and poverty, transitioning government services to digital platforms will not provide a solution. This case highlights that the shift to digital lease renewal for NYCHA housing provides benefits to the NYCHA administrators at the expensive of the residents. This demonstrates a clear benefit for one social group with greater power and privilege (city administrators) and a clear harm to another social group with less power and privilege (residents). The *system builders* designed a digital platform that reflects the power imbalance between those social groups. The rights and autonomy of the citizens to engage in non-digital communication were all but eliminated. This research detailed on-the-ground harms that can arise from technocracy including as Sadowski and Selinger (2014) theorized, political harm, recognition justice, existential harm, and discursive harms.

There is a small social group whose values and norms are informing the designs of digital platforms and those designs are benefiting *elites* and at the expense of *exploited*. This forces people that have neither access, skills, nor motivation to use the Internet. The claim by Andrade and Techatassanasoontorn, 2020 that certain social groups are being forced to engage in the smart city hold not for the Global North, as well as in the Global South. This suggests that this is not a localized phenomenon, yet is pervasive globally. How can the rights and obligations offered by Frankenfeld (1992) that include the right to participate, as well as opportunities to deliberate, approve, or veto technological systems inform this research? In this case the *system designer* and city administrators did not offer avenues for resident participation in the design, introduction, and management of the housing registration system. The residents living in NYCHA housing that do not have access to the Internet were not only excluded from that process, but lack the means to share their stories and injustices via the Internet. This shows how one social group can become invisible as the norms of communication shift to primarily digital media. If we take Frankenfeld's proposal seriously, then the residents living in NYCHA are no longer citizens in a digital society and have no ability to express their

political will. For if civic dialogue is technologically mediated, then it will simply hide offline persons from the social worlds of those online.

Overcoming the digital divide by providing accessible and affordable Internet services is seen as a way to combat this social challenge. For example, in a new bill that was recently introduced by representatives Bowman (D-NY) and Cleaver, II (D-MO), called the Broadband Justice Act of 2021, aims to provide affordable broadband access to families living in federally subsidized housing, including NYCHA housing. The bill highlights the ways the digital divide plays along racial and economic lines. The serious impact that the Covid-19 pandemic has had in exacerbating this divide when it comes to limiting families' abilities to undertake essential activities such as remote healthcare visits, school assignments for students, job searches, and simply being able to access information about helpful resources. Furthermore, former Governor Cuomo (D-NY) signed a bill into law that required all internet service providers in the State of New York to offer affordable internet at high-speeds for low-income families. More specifically, ISPs can only charge $15 USD per month for a basic broadband plan and $20 a month for an increased speed boost. This would be significantly less than current average internet service prices of at least $50 a month for families in New York City. While legislative aims to curb high prices for Internet access, it is insufficient to address the challenges of technological citizenship, nor will it result in digital equality. These policies are inadequate to address the questions of democratic participation and representation in the design and implementation of digital solutions in the smart city.

As prior research shows, even if the digital divide is "solved" and all persons have access to the Internet, there will still be distinct social groups. The norms, expectations, rights and obligations of those social groups might well be differentiated by their skills, motivations, and outcomes. Clarke and Star (2008) offer *social worlds* as a concept that proves useful as a means to problematize the hierarchical social structures articulated in the literature on the digital divide. How can different social groups exist within a *digital arena* and co-exist without imposing upon each other's rights and upholding their own obligations? How can government services be provided *via* digital and non-digital platforms in a manner that is equitable and just? The smart city plans and projects that are underway are designed to serve high-wealth individuals and ignore (at best) and systematically exclude (at the worst) low-income residents. How can we move from *digital redlining* and exclusionary practices to more inclusive and equitable forms of design and governance? While significant time and resources are being poured into smart city projects, there is a far greater need to consider transformative design practices and urban planning through deliberative democratic processes. In the next phase of this research, we will convene a community advisory board inclusive of the citizens living in NYCHA housing along with small business owners and residents of Harlem. That board will be convened by a local non-profit partner with the explicit goal of establishing practices and policies to address these challenges. How that process will unfold and the outcomes are

unclear, yet they will be a small effort to experiment with the social governance and design of community resources in an increasingly digital age.

Limitations and Future Research

The observations of the Digital Van program are just one example of how people can be harmed by increasing the reliance on digital services. There are quite a number of such programs across the nation and it would be worthwhile to catalog, evaluate and compare them. Such an effort could offer more actionable knowledge to policymakers, non-profits and concerned citizens. Secondarily, the survey data presented was analyzed using three models that should not be interpreted as the best approach. This research is neither comprehensive, nor does it suggest there is a "right way" to classify social groups. Each model has flaws and warrants careful consideration and review. The models for user classification presented here relied on subjective decisions made by the research team. Those decisions included setting thresholds and assigning point values to differentiate between the social groups. Clearly, those decisions played a significant role in quantitatively defining the groups. However, rhetoric regarding the digital divide needs to be critiqued and the efforts to segregate social groups demand continued scrutiny.

CONCLUSION

Binary divisions between users and non-users or enforcers and enforced or haves and have nots do not demonstrate the stratification and social ordering that is well underway. What is emerging are distinct social groups that are perpetuating hierarchical notions of social class and that is being reified in the designs and plans for the smart city. The current smart city designs are further segregating social groups based upon digital access, skills, and motivation. All the while smart city plans are inequitably distributing the benefits and harms. Digital segregation is perpetuating historical divisions that track to ethnic, racial and socio-economic standing. There is a clear need to identify the rights and obligations of all persons in regard to digital technology and afford equal services to persons that chose to live offline. Until notions of technological citizenship are upheld in the processes of technological design, the system builders will treat non-users as recalcitrant laggards or deviants.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the dataset is difficult to de-anonymize. Requests to access the datasets should be directed to Rider Foley, rwf6v@virginia.edu.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by University of Virginia Institutional Review Board of Social and Behavioral Sciences. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RF is the faculty advisor and lead author and designed the research, data analysis, and manuscript drafts. JE, RA, SN, and PC all contributed to the data collection, analysis, and drafting the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frsc.2022.706670/full#supplementary-material

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