Nudging Towards Smart Cities:
a *Social Media* consideration of *Smart Governance*-aided *nudges*

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Abstract

As smart cities use data and technology to improve citizens' quality of life in various areas, they also raise ethical and social challenges when employing nudging techniques to subtly and non-coercively influence citizens' behavior and choices; these practices may shape moral and societal concerns regarding domains such as accountability, paternalism, manipulation, and invasion of privacy. Therefore, it's crucial to comprehend how citizens perceive and evaluate such practices in light of smart city initiatives and objectives. This study, unlike most other studies that focus on experts or policymakers, offers a novel perspective based on ordinary people's point of view by examining how citizens may perceive and assess nudging practices in smart cities, and how such practices are influenced by smart governance structures that use digital data flows to improve public decision-making and service delivery.

On the social media platform Reddit, such ordinary people's discourse is examined using a qualitative thematic analysis approach; five subreddits and twenty-five posts were selected using a purposive sampling method as they were deemed pertinent and representative of the research topic. Since no preexisting coding scheme was used, the inductive approach implied that the themes were to be identified and categorized based on the trends that appeared in the gathered data; ultimately, following the data analysis phase of this study, five were the themes that emerged: types of nudges, public opinion, government policing, smart city initiatives and goals, implications and opportunities. These themes assisted in addressing the research questions that were posed and, in addition, the findings demonstrated how nudges cause citizens to express a range of complex and varied opinions and emotions based on their personal experiences, background knowledge, perceptions of advantages and disadvantages, and ethical standards. However, they ultimately suggested nudging practices to be created and put into use in a human-centric manner that respects citizens' autonomy, privacy, consent, while balancing innovation with regulation, and while also adjusting to the local context and culture that is in line with the general objectives and values of smart city concepts.

This study contributes to the existing literature by offering a novel viewpoint on how smart governance should be developed based on ordinary people's discourses; it also provides recommendations and insights for smart city practitioners and developers who may want to use nudging techniques in a human-centric manner. The findings' implications for future research on ethically nudging citizens towards safer, healthier, and more sustainable behaviors are discussed, and arguments are made for promoting the need of constantly taking into account and evaluating citizens' opinions.

Keywords

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[1] Introduction

This research paper sought to investigate people's knowledge and perceptions of *nudges* in the context of *smart cities* and their *governance*, rather than to investigate the feasibility of their use through data collection. The purpose of this study was to better understand how citizens may perceive and respond to *nudges* in urban environments, as well as to consider their perspectives on issues such as those of surveillance and privacy (Fusaro & Sperling-Magro, 2021; Ranchordás, 2019; Woetzel & Remes, 2018); social media discussions were used to conduct a thematic evaluation of *nudges* in the context of *smart cities* and *smart governance*, with a focus on individual opinions and conversations from online Reddit communities.

Brough forward by Richard Thaler and Cass Sunstein in 2008, the *nudge theory* is based on the idea of choice architecture, stating that people need structure in order to make decisions and that such structure can be used to steer individuals towards making better decisions. The concept of *nudge*, as defined by its coiners, is an intervention that alters people's behavior in a predictable way without forbidding any options or without significantly changing their economic incentives; they are designed to maintain freedom of choice while also guiding people in a particular direction (Thaler & Sunstein, 2009). The proposed discourse addresses some of the major challenges faced by cities today, including those of sustainability, liability, and resource management; by addressing these critical issues, this study sought to contribute to the development of more resilient and sustainable cities that are capable of providing high-quality services to their citizens. Furthermore, the results of this and of previous research could inform the creation of *smart cities* and the use of *nudges* to guide behavior in urban areas; these subtle interventions have the potential to effectively and efficiently address city challenges while also preserving individuals' freedom of choice.

Nudging could effectively prompt behaviors to improve energy conservation, waste reduction, transportation, and enhance sustainable practices while their embeddedness in *smart governance* could enable informed and targeted *nudges* with a wider reach and impact; in a city governed by digital information flows, *nudges* would play a crucial role in ensuring a well-functioning environment (Beckwith et al., 2018; Gharesifard et al., 2021; Klieber et al., 2020). The proposed research was of great societal relevance as it delves into the important topic of modern *smart cities* and the use of *nudges* for shaping human behavior. This research paper offered a unique and fresh perspective by analyzing social media discussions as a source of thematic evaluation of *nudges* within the context of *smart cities* and *smart governance*. By incorporating the perspectives of citizens and their engagement with plausible *smart city* technologies and *governance* structures, this study aims to provide a more

nuanced understanding of both the potentials and limitations of *nudges* in shaping behavior in urban environments. Moreover, while existing literature on *nudging* and *smart cities* often examines government policies or previously published studies, this research focuses on the opinions and conversations of individuals on social media platforms.

This study poses several research questions in order to reach the intended goal. In the context of *smart cities* and *smart governance*, what kinds of *nudges* are citizens familiar with? What are the potential benefits and drawbacks of *nudging* in *smart cities*, and how do citizens feel about being encouraged to engage in particular behaviors through such *nudges*? What do people think about privacy and surveillance in this context? How do citizens perceive the use of *smart governance*-aided *nudges* in terms of preserving their freedom of choice? These were some of the questions posed as an effort to advance the creation of efficient governance procedures that were resident-centered, human-centered, and inclusive; by shedding light on citizens' knowledge and perception of *nudges*, this study hoped to provide insightful information for urban planners, policymakers, and other parties involved in guiding the future of cities and informing the development of such practices.

In conclusion, the purpose of this research paper is to investigate how ordinary people perceive *nudges* within the context of *smart cities*, including how familiar they are with various *nudge* types (Deakin & Al Waer, 2011; European Commission, n.d.; Rocha, 2021). Furthermore, this study tried to comprehend how residents could feel about being encouraged into engaging in particular behaviors as well as considering their overall plausible perception of *smart governance*-aided *nudges*. By addressing these concerns, from the standpoint of those same ordinary people, the hope was to better their understanding of both advantages and disadvantages that *nudging* can have in *smart cities*; alongside this purpose, the emphasis was on encouraging the development of cities that were more livable, sustainable, and resilient while also offering high-quality services and upholding residents' freedom and rights. By considering the viewpoints of ordinary people, the study aims to offer insights to urban planners, policymakers, and other stakeholders involved in determining the future of new cities. Doing so, this research aims to contribute to the development of effective governance practices that take into account the concerns and preferences of the residents by shedding light on the knowledge and perceptions of *nudges* in *smart cities*; the hope is to create a future that is not only smart but also human-centered, inclusive and in which ordinary people feel at ease as well as cared for. Ultimately, what were the opinions of citizens on topics of surveillance, privacy, and freedom of choice when exposed to *nudges* happening in within *smart cities*? How could these considerations guide the creation of such inclusive and human-centered governance practices that successfully employ *nudges* to promote desired behaviors?

[2] Theoretical Framework

This chapter outlines the theoretical understanding of the concept of nudging, which is for this research determined through literature on the topic at hand. Nudging is a concept belonging to behavioral economics that proposes the use of positive reinforcement and of indirect suggestions to influence individuals' or groups' behavior and decision-making without coercing or limiting their freedom of choice (Thaler & Sunstein, 2009). Nudging can be employed in order to encourage individuals to act in their own best interest, or in the interest of society, such as adopting more sustainable behaviors, improving health outcomes, or increasing civic engagement; moreover, nudges can also be implemented in various contexts and domains such as in smart city concepts, where they can further influence the design and use of smart governance.

The aim of this chapter is, first of all, to understand what theoretical approaches exist to change behavior, and position the role of the situational context within these frameworks; secondly, this chapter introduces nudging as a behavior tool by looking into its definition as popularized by Thaler & Sunstein (2009). Moreover, the discourse is contextualized within the environments on which this research paper focuses, such as smart cities and more specifically within smart governance. Here, the goal is to provide an overview of how nudging practices are relevant for the discussion of data-rich environments. This chapter is divided into the discussion of three of the main pillars of this research, these being *Smart Cities*, *Smart Governance*, and the *Nudge theory*. The main research question guiding this study wonders how governance can be developed to be inclusive and human-centered while also employing the use of nudging practices to successfully promote desired behavior; the main objectives of this research are to explore the state of awareness surrounding nudging practices of plausible ordinary citizens, to conceptualize such awareness within the concept of smart cities, and to lastly evaluate the implications and opportunities of smart governance-aided nudging in such environments.

The concept of smart cities has emerged as a promising paradigm for urban development in the 21st century, as cities around the world had faced unprecedented challenges such as those of exponential population growth, environmental degradation, social inequality, and public health crises (Deakin & Al Waer, 2011; Rocha, 2021). By leveraging newly discovered digital technologies and data-driven solutions, smart cities had aim to optimize city operations, services, and the well-being of their citizens, as well as fostering innovation, collaboration, and resilience (Berry, 2018; Gandy & Nemorin, 2018; Klieber et al., 2020). However, the implementation of smart city initiatives also entails significant ethical considerations, especially in the areas of privacy,

surveillance, and the balancing of technological solutions with human needs (Beckwith et al., 2018; Berry, 2018; Bovens, 2009; Zoonen, 2016). These considerations became often overlooked in the attempt of pursuing efficiency, competitiveness, and economic growth (European Commission, n.d.; Rocha, 2021) and it is therefore essential to adopt a critical and holistic perspective of the smart city discourse that takes into account diverse and complex implications of smart city initiatives for urban governance and social justice.

[2.1] Smart cities

The concept of *smart city* has been gaining popularity in recent years, yet it lacks a universally accepted definition. Nonetheless, the concept centers around the integration of Information and Communication Technologies (ICT) and sustainable practices to enhance city governance and management (Chourabi et al., 2012; Thales Group, 2021). *Smart cities* are intricate systems that encompass multiple components such as people, organizations and businesses, policies and laws, and processes that are integrated together to create the desired outcomes of efficiency, sustainability, livability, inclusiveness and resilience (Chan, 2018; Woetzel & Remes, 2018). The success of *smart cities* depends on the collaboration between the city itself, its citizens, its governing bodies, and other stakeholders working towards delivering innovative solutions to increase city efficiency, improve safety, health, and residents' overall quality of life; they offer unique opportunities harnessing technology and data in order to create sustainable and livable communities (Ranchordás, 2019; Woetzel & Remes, 2018). Ultimately, their smart governance allows them to manage and integrate resources effectively, tackle pressing challenges and, ideally, create a better future for all citizens (Ristvej et al., 2020).

In order to plan and implement *smart city* projects, it is essential to create comprehensive frameworks that guide the decision-making process, as well as aligning the expected actions to the desired outcomes; Chan (2018) proposed a *smart city* ecosystem framework that consists of seven main layers: *1) value layer*, *2) innovation layer*, *3) governance, management and operations layer*, *4) policy, processes, public-private partnerships, and financing layer*, *5) information and data layer*, *6) connectivity, accessibility and security layer*, and *7) smart city technology infrastructure layer*. Each layer has its own clear and defined purpose: *[1]* is the most visible for city residents, businesses, visitors, workers, students, tourists, and others. It is a catalog of smart city services centered around desired outcomes, offered by value creators and consumed by the city stakeholders; *[2]* serves the purpose of maintaining relevancy by continuously innovating and optimizing services; *[3]* hosts management models and integrates them in new ecosystems; *[4]* supports the engagement models,

operates and maintains the logistic aspects of the city; *[5]* is a pillar of a *smart city* as it facilitates open data initiatives, data marketplaces, analytics services, and monetization policies; *[6]* ensures that all systems and infrastructures are interconnected in order to provide seamless layer of trusted connections; *[7]* handles the scaling of the smart city technology infrastructure. This and similar frameworks help to structure the interrelated and complex aspects of these data-rich environments; they also have clear visions for the role of various factors, and provide stakeholders a way to communicate and collaborate while allowing citizens to become part of the city development.

Despite the existence of many indicators and frameworks that have been developed to assess progress and success, one of the main challenges for *smart cities* remains that of measuring their performance and evaluate their impact on different contexts; Chourabi et al. (2012) suggest eight critical factors that influence smart city initiatives: management and organization, technology, governance, policy context, people and communities, economy, built infrastructure, and natural environment; these are the basis of their suggested framework and can be used as criteria to evaluate the strengths and weaknesses of different smart city projects, and examine how local governments are envisioning smart city initiatives. The European Union alike has offered a framework called CITYKeys aimed at measuring the performance of data-rich environments and inclusive of 75 different indicators. Moreover though, *smart cities* should not solely aim at increasing performance through technology but should rather focus on the people. Their ultimate purpose should be to improve the quality of life of their residents by addressing their needs and aspirations; it is therefore important to involve citizens in the co-creation and co-delivery of smart city solutions.

Ranchordás (2019) suggests that technology can be used as a tool to nudge citizens towards more desirable behaviors and contributing to benefit the city as a whole; according to her work, smart parking apps can encourage car drivers to use public transportation by providing real-time data on parking availability and costs near convenient public transportation locations. Smart meters can also encourage households to reduce energy consumption by providing feedback and rewards; smart health apps can similarly nudge users towards healthier lifestyles by monitoring physical activity and diet. However, suing data and technology to nudge citizens raises ethical issues of privacy, consent, transparency and accountability; it is therefore essential to ensure that citizens are aware of how their data is being collected and processed, and to allow them the freedom of whether and how to be nudged. *Smart city* environments are neither fixed nor static, but are rather an evolving concept that adapts to the changing needs and preferences of the residents; while technology is an enabler, it should not become the sole driver of *smart city* development. Although the idea of

creating a better place for all may seem optimistic and unrealistic, it is possible to achieve through the use of a holistic approach that considers all aspects of a city's ecosystem while leveraging engagement; by doing so, *smart cities* may not only become efficient or sustainable, but also inclusive and human-centric.

[2.2] Smart Governance

As previously mentioned, the governance and management of smart cities are key theoretical concepts for their discourse; *smart governance* refers to the use of ICT to improve decision-making, delivery of public services, citizen participation, and accountability of public institutions. Moreover, *smart governance* necessitates collaboration and coordination across different levels and sectors of government, private, and civil society actors. This section focuses on the main opportunities and implications of *smart governance* in the context of smart cities.

This discourse ranges across various topics, from the development of tailored comprehensive strategies to implement smart solutions, such as intelligent transportation systems and smart energy networks, to the assessment of impact and outcomes of such solutions on the urban environment and society (Keshvardoost et al., 2019; Pereira et al., 2018). *Smart governance* applications aim to uphold sustainability, transparency, and accountability while also aligning with the changing needs and priorities of both city and its residents. Given the vast amount of data generated and gathered by smart cities due to extensive usage of sensors, cameras, and other devices (Beckwith et al., 2018), data management, including data security and privacy, is a critical component for the *smart governance* of these data-rich environments; it is its effective deployment which is most essential for ensuring responsible and ethical development while also protecting the citizens' privacy. Citizen participation also plays a vital role for development of *smart governance* as it supports the creation and implementation of smart city initiatives such as those of open data (Ranchordás, 2019) and public meetings; which allow residents to participate in a city's decision-making process while guaranteeing that such initiatives are in line with the needs and priorities of the. Ultimately, this process ought to increase engagement throughout the city, which will then boost the adoption and effective use of the services offered by the city and enabled by its governance. It is collaborative efforts between stakeholders, government agencies, the private sector, and civil society organizations such as the citizens themselves, that can help to improve *smart governance* (Scholl & Alawadhi, 2016); by combining knowledge, resources, and networks, these organizations can develop and implement timely smart city solutions and tackle locally and globally shared challenges.

The governance of smart cities has been extensively studied by researchers, academics, and practitioners from various sectors, both theoretically and in practice (Cavada, 2022; Lopes, 2019); scholars have established numerous frameworks (Ristvej et al., 2020) and roadmaps (Antunes et al., 2021), such as those proposed by Scholl & Scholl (2014), that view and understand *smart governance* as the foundation for a transparent and inclusive governance model. By employing nudging practices and fostering responsible governance, *smart governance* offers a promising approach to achieving sustainable, livable, and efficient urban outcomes for all citizens; this constitutes a novel paradigm for urban policy making, planning, and management that can improve our understanding of how *smart governance* can enhance urban environments for everybody (Pereira et al., 2018). However, the discourse does face several challenges that must be addressed in order to achieve the full potential of *smart governance*. To coordinate multiple actors, sectors, levels, and interests in smart city initiatives (Lopes, 2019; Scholl & Alawadhi, 2016), effective communication, collaboration, and integration are essential. These mechanisms help balance the diverse perspectives and expectations of different stakeholders in such interconnected data-rich environments. Furthermore, there exists a constant uncertainty of both impacts and outcomes of smart city solutions on multiple contexts and dimensions such as social, economic, environmental, legal, ethical, and political (Keshvardoost et al., 2019; Pereira et al., 2018); this issue requires approaches that are adaptive and flexible in order to monitor, evaluate, and adjust the implementation of initiatives according to the ever-changing nature of the smart city environment. Moreover, there are many risks associated with the use of such new technologies, such as cyberattacks, data breaches, privacy violations, digital exclusion, algorithmic bias, and technological dependence (Beckwith et al., 2018; Ristvej et al., 2020), thus requiring robust and resilient frameworks capable of ensuring data security and privacy protection while also promoting digital inclusion and literacy among the residents.

In order to overcome these challenges and seize the opportunities offered by smart city governance innovations, it is therefore necessary to adopt a holistic and systemic perspective that considers the interdependencies between different elements of the smart city ecosystem (Scholl & Scholl, 2014); moreover, it would be essential to foster a culture that promotes learning and experimenting and that encourages innovation while also ensuring accountability and responsibility for the impacts of smart city solutions (Pereira et al., 2018). Ultimately, it is fundamental for the citizens to engage as active co-creators and co-producers of smart city initiatives that most reflect and aid their needs.

[2.3] Nudge theory

The *nudge theory*, also known as the libertarian paternalism theory, is a concept of behavioral economics that proposes the use of positive reinforcement and indirect suggestions in order to influence individuals' or groups' behavior and decision-making process (Simon & Tagliabue, 2018). Moreover, the *nudge theory* proposes that individuals may be be *nudged* to make better decision without coercing nor limiting their freedom of choice (Thaler & Sunstein, 2009). Such theoretical concept is practically accomplished by making slight adjustments and minor changes to the choice architecture, including changing the way options are presented, which is demonstrated to have a significant impact on human behavior and decision-making (Borgohain, 2021).

The *nudge theory* was popularized by American scholars Richard Thaler and Cass Sunstein in their now-famous book *Nudge: Improving Decisions About Health, Wealth, and Happiness*, which was firstly published in 2008; in recent years though, the theoretical concept of *nudging* had gained attention and it had been widely adopted, although to different extents and contexts, by public policymakers, governments and companies alike. *Nudging*, as it was proposed by Thaler and Sunstein, aimed to apply slight modifications to the choice architecture in order to steer people towards a specific direction without imposing any regulations, financial penalties, or any major limitation. Although a general classification of types of *nudges* provided by Thaler and Sunstein would include a total of seven types, a number of revisions by other scholars have been made to include much higher numbers of *nudges*. Generally speaking though, the *nudge* promotes decision-making by assisting individuals in overcoming biases or errors and providing additional information, without limiting their options or changing their economic incentives (Hortal, 2020). Despite its popularization and widespread adoption, the *nudge theory* has been criticized a number of times for its practical correlation to ethical concerns; some of these critics have argued that regardless from the context, forcing people to take certain decisions undermines their autonomy and freedom of choice (Lin et al., 2017; Mols et al., 2014). Furthermore, some have also expressed their concerns regarding the accuracy of the theoretical framework on which *nudges* are based, particularly in terms of human behavior predictability (Lin et al., 2017; Simon & Tagliabue, 2018). However, in the complex context of smart cities, *nudging* has been proposed as a means for encouraging citizens to adopt more sustainable and healthier behaviors such as reducing energy consumption, improving waste management, promoting environmentally friendly transportation options and exercising for one's benefit (Gandy & Nemorin, 2018; Gharesifard et al., 2021; Klieber et al., 2020; Rocha, 2021); although the *nudge theory* is a promising approach for encouraging

positive behavior change, it is yet not a final nor singular solution for steering populations' behavior.

Nudging practices may be applied, and even more so when aided by smart governance and data, to various contexts of urban environments to influence behavior and decision-making in subtle yet effective ways. A commonly mentioned context is that of health care, in which *nudges* may be used to promote blood and organ donations rates by changing the default option from an opt-in approach to an opt-out one (Thaler & Sunstein, 2009). Another context is that of the workplace, in which *nudging* may be used to increase employee's engagement and productivity by providing recognition, rewards, feedback, or employing gamification strategies (Borgohain, 2021). Yet another context is waste management, in which *nudging* may help to encourage citizens to recycle their waste by providing them with subsidies and social norms information, feedback, or other forms of incentives (Lin et al., 2017). Even civic participation may be improved with the use of *nudges* to increase voter turnout rates by sending personalized reminders, simplifying registration procedures, or even by offering free transportation to the location where one's ballot can be casted; or in tax compliance in which nudging may be used to increase voluntary payments (Mols et al., 2014).

These are only a few of the many instances in which *nudging* practices may be applied to influence behavior and decision-making in positive ways; however, these do not change the fact that ethical concerns are raised regarding who decides what is best for individuals and society as a whole, which actors are accountable in those scenarios where the outcomes of such practices were not the expected ones, and how to ensure transparency and respect of each and every one individual's freedom. *Nudging* should therefore be designed and implemented with particular care and caution while also taking into account and consideration the potential benefits and harms they may entail.

[2.4] Sociological & Psychological dimensions

The concept of nudging is not only based on economic and technological principles, as it might be dictated by the *technological fix* term coined by Alvin Weinberg in 1965 (Johnston, 2018), but it is most importantly a matter of psychological and sociological insights into human behavior and decision-making. As nudging relies on the assumption that human beings are not perfectly rational agents, but are rather influenced by various cognitive biases, heuristics, emotions, social norms, and other factors that affect their choices (Thaler & Sunstein, 2009), nudges aim to exploit such factors order to guide an individual towards choices that are beneficial for themselves or for society. Given

that these practices do raise a number of ethical and social questions, one possible way to address such concerns is to adopt a human-centric perspective that considers the needs and preferences of the people who are most affected.

In a 1943 paper, American psychologist Abraham Maslow presented a framework known as Maslow's hierarchy of needs (Maslow, 1943), which proposed that human beings have five levels of needs: *1) physiological*, *2) safety*, *3) belongingness and love*, *4) esteem*, *5)* and *self-actualization*; these needs are to be arranged in a pyramid-like structure, with the more basic and fundamental ones at the bottom. According to this framework, human being seek to satisfy their lower-level needs before moving on to their higher-level ones, and ultimately strive to achieve their full potential and self-fulfillment. Such hierarchy of needs can be applied to the context of developing smart governance and nudging in future smart cities (GovInsider, 2019):

[1] At the bottom of the pyramid, these are the basic needs for survival such as food, water, air, and shelter; nudging practices can help people to pursuit these needs by providing them with information, feedback, incentives, or reminders to adopt healthy behaviors such as eating well, drinking enough water, exercising regularly as well as conserving resources such as energy and water by making them aware of their consumption patterns and offering them alternatives or rewards for reducing their usage (Lin et al., 2017). In China, Shenzhen has implemented smart meters and smart grids to monitor and optimize energy consumption and supply, as well as to encourage residents to use renewable energy sources (GovInsider, 2019).

[2] At this layer, nudging can help citizens to cope with uncertainty and risk by providing them with guidance, advice, or reassurance in situations where they may feel anxious or confused. The same city of Shenzhen has deployed smart surveillance cameras and facial recognition systems to prevent and detect crimes, as well as to provide emergency services and disaster management (GovInsider, 2019).

[3] These are needs for social connection, affection, intimacy, and belongingness, for which nudging practices may help people to foster social interaction, cooperation, and trust among citizens; by encouraging citizens to participate in civic engagement, nudging can help support the co-creation of smart city solutions (Ranchordás, 2019). In Shenzhen, online platforms and mobile apps allow residents to access public services, provide feedback, and share ideas for improving the city (GovInsider, 2019).

[4] This layer of needs covers people's pursuit of self-respect, recognition, achievement and competence, and nudging may aid in the process by providing timely feedback, rewards and

recognition for ones's achievements or contributions to smart city goals as well as offering opportunities for learning, training, or personal development.

[5] The last layer is for personal growth, self-fulfillment and creativity, for which nudging practices may inspire people to pursue their passions, interests, or aspirations by helping the discovery of new possibilities, challenges, or experiences exposing them to diverse and innovative smart city solutions (Gandy & Nemorin, 2018).

By applying *Maslow's hierarchy of needs* to the discourse, it can be better understood how nudging practices may affect people's well being in various domains. This more nuanced understanding can also help to identify potential gaps, trade-offs and conflicts between the different layer of needs of the citizens, to develop smart governance and nudges that are more balanced, ethical, and effective; nudging practices that satisfy some needs at the expense of others, may be more efficiently avoided, such as those that increase security at the expense of privacy, or efficiency for freedom of choice. This hierarchical framework may help developing a smart governance that employs nudging to satisfy multiple levels of the residents' needs, and guiding the creation of smart city environments that are not only smart but also human-centric, inclusive, and fulfilling.

[3] Methodology

[3.1] Research design & Objective

This research paper examines how members of online communities perceive and are aware of nudges in the context of future smart cities governed by digital data. The perspective of individuals over the function of nudges in policymakers' decision-making is the main emphasis and priority of this study. Additionally, this paper aims to contribute to the field of nudging and of smart governance by providing a unique and fresh perspective on the topic by *1)* evaluating how citizens may perceive the potential implications of digital data collection for nudging their behavior, protecting or compromising their privacy, as well as hindering their right to autonomy; *2)* using an *inductive thematic analysis* approach to identify, explore and discover the themes and patterns in Reddit discussions about nudging and smart governance, rather than solely relying on pre-existing themes or codes; and *3)* drawing on existing literature to provide context and to consider the implications of the findings for the plausible future state of smart governance-aided nudging and for that of policymakers, researchers and the general public alike.

This research paper employs an *inductive thematic analysis*, which enables researchers to find themes and patterns in the gathered data, deduce their significance, and present their findings (Boeije, 2010; Maguire & Delahunt, 2017); the *inductive* aspect of this approach gathers information through a bottom-up examination of Reddit posts and comments to identify said patterns and themes (Braun & Clarke, 2006). This approach is particularly well-suited for this study, as it allows to identify and analyze the different ways and forms in which nudging is being understood *by* and *within* Reddit communities. By collecting sufficient information regarding these digital environments, it is hopefully possible to consider the instances of nudging that emerged from the data in order to inspire tomorrow's future and guide the development of smart governance towards what it should be; thus understanding how this behavioral practice can be used to promote the future development of a people-centered governance. In other words, the *inductive* approach is characterized by the use of data-driven analysis, where patterns are discovered and categories are created from the data rather than from preconceived ideas or theories (Peterson, 2017).

[3.2] Sampling

[3.2.1] Selection criteria

This research paper focuses on the perception and awareness of online communities, and to ensure that the collected data was to be relevant, representative, and sufficient, a variety of methods

had to be used in order to choose and select these communities. To do so, the subreddits were initially selected through a provisional Google search that used keywords related to the topic at hand, such as Nudge Theory, Smart City, and Smart Governance. The following step was to conduct a more targeted search on Reddit, which was supported by the previously found results. Lastly, a number of subreddits were searched and noted down for future analysis. Due to the nature of the research, which studies and draws conclusions from themes and patterns discovered in online discussions, the sample selection was fundamental for ensuring the data's inclusiveness of enough nudging-related instances so to allow the conduction of the analysis. Three main criteria were employed to narrow down the selection of subreddits: *1) Relevance to the topic of nudging*, *2) Representativeness of different perspectives and opinions*, and *3) Availability of sufficient number of posts and comments*. Although some of the obvious choices were the likes of *Smart cities: the future of the built environment* (r/SmartCities) and *Choice Architecture and Economic Incentives* (r/Nudges), they respectively had 2,2k and 420 members with an average of 1 comment per post; therefore not meeting the basic criteria and thus being excluded from the analysis.

[3.2.2] Selected communities

Once the selection process was conducted and the subreddits were selected according the three main selection criteria, the research could proceed by investigating the remaining five communities: *1) Sustainability: The Capacity to Endure* (r/Sustainability), *2) A place for Urban Design Geeks!* (r/UrbanDesign), *3) Urban planning: The built environment* (r/UrbanPlanning), *4) Tracking the Internet of Things* (r/IoT), and *5) Behavioral Economics* (r/BehavioralEconomics).

[1] Sustainability: The Capacity to Endure (r/Sustainability) is a subreddit for the discussion of sustainability as well as environmentalism and the more general future of the planet; the official description found on its own homepage states that "Sustainability is the ability of a system to endure. While most people associate the term with the environment, true longevity requires social and economical sustainability as well as ecological sustainability", and with over 400 thousand members, this is the most followed community of the ones selected in this analysis. r/Sustainability provides discussion ground to a vibrant and active community that engages in a broad spectrum of issues related to sustainability such as those of green business, renewable energy, waste management, environmental activism, and more.

[2] A place for Urban Design Geeks! (r/UrbanDesign) facilitates discussion on urban design, architecture, and the built environment; with over 300 thousand members, it is the second most popular community in this study. r/UrbanDesign self-describes itself as a place "For everything that

is about design mixed with urbanism! The design of urban furniture, the design of roads, of pedestrian areas, [and] the design of traffic calming measures", while also covering topics of urban architecture, planning of transportation, of public spaces, of landscapes, of roads, and of pedestrian areas. This community may discuss the ways in which urban designs can influence human behavior and choices by subtly changing how and which options are presented to the citizens, thus aiding or restricting their freedom.

[3] Just shy of 200 thousand members, *Urban planning: The built environment* (r/UrbanPlanning) is closely related to the previous community as it "aims to improve the built, natural, social and economic aspects of towns and cities […] [and focuses] on all that makes the built environments that live, work and create"; it discusses "transportation, land use, and community development" as well as zoning, housing, infrastructure, policy, economics, and much more. Furthermore, discussed in this community may be anything examining how urban planning might improve the built, natural, social and economic aspects of towns and cities by using ICTs to enhance the quality and efficiency of public services and decision-making processes.

[4] *Tracking the Internet of Things* (r/IoT) is a small community of 37 thousand people passionate about the latest developments in the network of physical objects connected to the internet; these objects communicate and exchange data with other devices and systems and are the core characteristic of the IoT. As members of this community might be interested in various aspects of these networks, the subreddit provides its members a space for discussing smart devices, applications, security and privacy, as well as everything else that might be understood as a way of creating more efficient and intelligent digital environments.

[5] Behavioral economics is the study of how psychological, social and emotional factors affect human decision-making and behavior in economic contexts; the subreddit *Behavioral Economics* (r/ BehavioralEconomics) discusses its homonymous field of study. Despite being the community that most relates to discussions of nudging, biases, heuristics, and behavioral incentives, it is the smallest and least popular community of this analysis as it is formed by 35 thousand members only.

Despite doing so in different ways, the compiling of this list aimed to be in accordance with the criteria mentioned above, which required relevance to the nudging discourse, variety of both human perspectives and opinions, and a sufficient amount of fostered discussions; although the subreddits differ in terms of audience and focus, they all met these criteria and were thus chosen for discussion.

[3.3] Data Collection

The next step of this research was to proceed with the data collection phase, which was contingent on the prior selection of Reddit communities. This collection phase involved accessing and retrieving publicly available data from the Reddit platform without violating any ethical or legal norms imposed by the company. The data collection, and thus this section, focuses on Reddit submissions from selected subreddits, while all the comments of each selected post was analyzed directly from Reddit without the need to be collected nor to be sorted and selected. Ultimately, the collected data was subjected to sorting, cleaning and thorough analysis complying to the scope of this research paper.

[3.3.1] Scraping Medium & Data Source

The first step of the data collection phase was setting up a scraping tool to work on Troddit: an open-source alternative front-end web client for Reddit that offers a more intuitive user interface and which is therefore easier to systematically to process for a scraper. As Troddit was only the source from which data was to be collected, Easy Web Data Scraper was the tool that allowed the process to happen: it is an extension available for Google Chrome that allows users to create "Recipes" and selectively scrape information from webpages.

[3.3.2] Sorting & Filtering Criteria

The subreddits were sorted by the "Top" category and the time range was set to "Last year" to ensure that the collected data was meaningfully representative of the most popular and relevant content; the number of upvotes and comments on each submission determined its ranking with the more upvotes and comments, the higher the rank. However, while these parameters ensure the data reflects the preferences and opinions of Reddit users, they may not capture the diversity and variety of content on the subreddits, as some posts may be overlooked or downvoted by the users; the exact composition of this algorithmic sorting is not publicly known, as such knowledge would lead to abuse, feed-manipulation, and spamming. Similarly to the prior selection criteria, three major requirements determined what submissions to scrape from each subreddit: *1) Relevance to the topic of nudging*, *2) Creation within the last year*, and *3) A bare minimum of 10 comments*. These as well have advantages and disadvantages though: they help reduce the amount of data that needs to be scraped, saving time and resources while ensuring a sufficient level of user engagement; they may, however, exclude content that was potentially relevant to the analysis.

To ensure further coherence and comparability between the various communities, and to avoid scraping-induced errors occurring due to the large but limited amount of data, a limit of at least 50 and at most 100 submissions was imposed for each subreddit in conjunction with these criteria.

[3.3.3] Scraped Data

Each submission was scraped of: *1) subreddit* (the name of the subreddit where the submission was posted), *2) author* (the username of the user who submitted the post), *3) title* (the title of the submission), *4) body* (the body text of the submission), *5) URL* (the URL of the submission), *6) date* (the date the submission was posted), *7) comments* (the number of comments on the submission), *8) upvotes* (the number of upvotes the submission has received), and *9) attachments* (any attachments or linked media that are included in the submission). Although they are the focus of the conducted thematic analysis, the comments of each submission were not scraped nor separately collected, as all comments were analyzed in their collective entirety and this process was done directly from Troddit without any sorting nor filtering; their discussion will happen in future sections.

Furthermore, subsequent to the sorting and filtering criteria, the output contained a variety of information from the collected submissions; the data was ultimately comprised of 359 raw submissions that were then imported into spreadsheet software for further analysis. At this very stage though, it is important to acknowledge that sensitive identifiers were not yet censored they were useful for assuring the accuracy and origin of each outputted submission. However, these identifiers are to be omitted during the data cleaning phase.

[3.3.4] Data Cleaning

For studies where large amount of data is collected, a thorough and systematic data cleaning process is essential for ensuring quality and validity while also guaranteeing a proper fit for a subsequent analysis. This section describes the data cleaning and preprocessing steps that were performed on the data; the cleaning and preprocessing consisted of six main steps: *1) Standardization of the data*, *2) Removal of duplicate posts*, *3) Identification and removal of outliers*, *4) Correction of errors*, *5) Categorization of the data*, and *6) Removal of personal identifiers*.

[1] Troddit's interface showed how long ago submissions were published and it adapted the formatting to be as intuitive as possible; although intuitiveness is better for people, it is not for optimal for data processing. Such formatting was thus normalized alongside fonts, font sizes, and hyperlinking was removed except for attachments.

[2] The data was checked for validity and efficiency by removing redundant or repeated posts and posts that might have been scraped or posted more than once, or crossposted from one subreddit to another. This avoided bias or distortion in the analysis due to duplicate or overlapping data.

[3] The validity of the results by removing or correcting outliers, data points produced by scraping anomalies or inconsistencies during the spreadsheet conversion. As some posts' comments and upvotes did not match their actual popularity or engagement level, these instances were excluded thus providing more accurate results to represent the communities.

[4] Further cleaning and validation was done by finding and correcting various other errors including missing, corrupted, or mislabeled values, all of which was in fact quite frequent; these were manually adjusted by filling-in missing gaps, correcting corrupted values with accurate data, and relabeling where necessary.

[5] The data was organized by origin, as each subreddit was categorized into its own spreadsheet sheet; this step was important to make access and comparison easier for further analysis within and across the communities.

[6] In order to follow ethical standards, the data was anonymized by removing personal identifiers that might have revealed the users' identity. However, the submissions' URLs were retained as they allowed future reference as well as external parties to access the data, if needed; notably though, Reddit is a mostly public platform, meaning that the authors could be traced back by simply using the posts' titles as reference, rendering anonymization almost impossible.

After following these measures, the cleaned output was stored in a separate spreadsheet file distinct from the raw data to preserve the integrity of both. The processed data was then ready for the coding and content analysis.

[3.4] Operationalization

[3.4.1] Focus

This section focuses on understanding the elements that are to be looked for in the collected data and how they relate to the posed research questions. As this research paper prioritizes the perspective of individuals, rather than simply evaluating the application of choice architecture and nudges in a smart city environment, selected comments and discussions will be approached considering all the factors that helping to answer the research question; these include elements that could relate to a) the kind of nudges citizens are familiar with, b) the potential benefits and drawbacks, c) the citizens' perception and feel of nudges that encourage them to engage in a certain behavior, d) the citizens' opinions and concerns regarding privacy, surveillance and freedom of

choice, and e) how human-centered governance can successfully develop with the employment of nudging to promote desired behaviors. Narrowing down the focus is fundamental to operationalize the research process and conduct an easier and more effective study.

[3.4.2] Approach & Research questions

As it was previously mentioned, the data must be examined using the research questions as a guide; this research takes into account the perception and knowledge of Reddit users based on their comments and discussions, rather than simply looking at how nudging can be used in a strictly theoretical sense. The open coding process of the research is anticipated to allow for the extraction of sufficient themes for a later creation of axial codes; even though the thematic analysis is inductive and does not require the use of a preexisting codebook. During the process of reviewing the data, the research questions will help determine what is worth being noted down as a theme and what will not. Following the research questions certain elements and content will be looked for and made use of:

[1] What kinds of *nudges* are citizens familiar with?

> The reddit discussions are to be reviewed for mentions of nudging in general; this is a good guideline to determine what is familiarized within the audience and what is not. Comments that relate to influencing citizens' behaviors will be determined worth of note and so will whether their context expresses positive, negative, helpful or intrusive sentiment.

[2] What are the potential benefits and drawbacks of *nudging* in *smart cities*?

> The potential benefits and drawbacks will be fundamental for analyzing the data and the comments relating to such will be sought for; moreover, perception and sentiment of these benefits and drawbacks will be made use for during the coding process.

[3] How do citizens perceive and feel about the use of smart governance-aided *nudges* that encourage them to engage in particular behaviors?

> Strictly relating to perception and sentiment, those comments that express these personal feelings will be used for the creation of open codes. These feelings do not only relate to the practices themselves but also to what their expected goal is.

[4] What are the opinions and concerns of citizens on topics of *surveillance*, *privacy*, and *freedom of choice* in relation to *nudges* in *smart cities*?

The comments describing citizens' opinions and concerns on topics of surveillance, privacy, and freedom of choice in relation to nudges in smart cities will be looked for, and how citizens feel about these topics will also be considered for the analysis.

[5] How can these considerations guide the creation of such inclusive and human-centered governance practices that successfully employ *nudges* to promote desired behaviors?

Discussions and comments relating to the future state of smart cities, as well as that of smart governance-aided nudging, will be taken into consideration for extracting representative themes and topics; mentions of inclusive and human-centered governance practices that successfully employ nudges to promote desired behaviors are to play an important role in the coding process.

According to Braun and Clarke (2006), there are no rigid guidelines nor fast and easy rules regarding what constitutes a theme; a theme is therefore defined by its significance and correlation to a certain discourse.

[3.5] Data Analysis

This section of the research presents the methods and procedures that were used to analyze the data collected from Reddit; the aim of this chapter is to provide a detailed and transparent account of the data analysis process, including the specific steps taken to identify the patterns found in the data and those to extract the core themes required by the analysis. While the *Thematic analysis* section of this chapter documents an overview of the method used to analyze the data, *The six-phase approach* outlines the specific steps used to conduct the inductive approach by following academic literature on the matter. By compiling this chapter and documenting a detailed account of the process, the aim is to provide transparency as well as ensuring replicability for future researchers interested in studying people's awareness and perception of nudges within the context of smart governance.

[3.5.1] Thematic analysis

As previously mentioned in the *Research design*, this study conducts a *thematic analysis* in order to analyze the collected data and provide insights on the questions posed. This approach is a widely adopted qualitative research method that allows for the identification of qualitative patterns and for the extraction of themes from a specified dataset (Boeije, 2010; Maguire & Delahunt, 2017); moreover, its aim is to organize and provide a detailed description of the data and of the themes found within it (Braun & Clarke, 2006). Despite its wide adoption in many faculties and different areas of study, there is not a true consensus on what a *thematic analysis* is, nor on how it has to be

conducted; despite this factor though, literature on the matter does exist and as such, it will be used as a guideline to conduct this study and its coding process. Furthermore, this study employs an *inductive* variation of this qualitative approach, which is solely data-driven and which refers to the method in which the organizing principles are drawn directly from the data following a bottom-up structure, as opposed to the top-down structure of a deductive *thematic analysis*, which relies on pre-existing themes and/or codebooks for drawing new topics and refined themes (Braun & Clarke, 2006; Peterson, 2017). It is also due to this factor that the *inductive* approach is particularly well suited for analyzing the sentiment of social media content, as it allows for the identification of patterns in the textual transcripts of Reddit posts despite these not being anticipated beforehand but rather being the sole result of every-day online discussions and interactions.

Ultimately, a qualitative inductive analysis was selected for this study as it would allow for the identification and analysis of the different ways in which nudging was being understood by ordinary people through their online comments and discussions. Rather than relying on the opinions of experts, policymakers, and governmental smart-city programs, this approach provides a more nuanced understanding of how nudging is perceived by those who are directly affected by it. Additionally, the relatively simple and straightforward nature of this qualitative approach can be easily understood and replicated by other researchers; moreover, such malleability and adaptability across various contexts rendered this approach the most sensible choice for exploring what a plausible future society could look like in the absence of moral social values and traits of collectivism that are necessary to develop healthy nudging practices.

[3.5.2] The six-phase approach

Researchers by the likes of Braun and Clarke (2006) have developed a six-phase process for conducting a *thematic analysis* while maintaining focus on the important aspects of the study; the steps are: *1) familiarization*, *2) generation of initial codes*, *3) search for themes*, *4) review of themes*, *5) definition and naming themes*, and *6) production of the report*. The literature suggests the undertaking of these steps to happen sequentially, with each phase building on the one before; however, the analysis should be considered recursive, with the researcher moving back and forth between each phase as needed (Byrne, 2021). This study draws upon literature on the topic as a guide for conducting the analysis and coding process (Boeije, 2010; Braun & Clarke, 2006; Byrne, 2021; Maguire & Delahunt, 2017; Peterson, 2017). Moreover, it is important to note that while all six phases are crucial for conducting a thorough thematic analysis, phase *five* and *six* imply the

reporting and presentation of the results and, therefore, belong to the *Results & Discussion* chapter that follows.

[1] PHASE ONE: FAMILIARIZATION

The first step of the six-phase process for conducting a thematic analysis, as described by the mentioned literature, is *familiarization*. During this phase, one familiarizes oneself with data by reading through the dataset of collected Reddit comments in order to better understand the content and context of the discussions. This phase allows developing contextual nuances and understanding of their complexities. According to the literature, one may need to conduct "'repeated reading of the data, and reading the data in an active way - searching for meanings, patterns and so on" (Braun & Clarke, 2006, p.16).

As discussed prior, in other sections of the Operationalization, Reddit submissions were collected from a selection of five individual subreddits, each one of which was scraped for posts that were later sorted and filtered. An exhaustive cleaning process led to a selection of five submissions per subreddit; each one of the remaining posts was read and familiarized with. Although a great difference of content and context existed between each post, coherent notes were made for each and annotated on spreadsheet software. Overall, given a total amount of over 1700 comments across the twenty-five submissions, the *familiarization* helped to lay a foundation and bedrock for the rest of the analysis (Braun & Clarke, 2006).

[2] PHASE TWO: GENERATION OF INITIAL CODES

The second step of the six-phase process is *generation of initial codes*; during this phase labels are assigned to the segments of data that best capture their meaning and relevance for the research questions. Generally identified as *open coding*, this process identifies features of the data that may form the basis of repeated patterns or themes across the data set (Braun & Clarke, 2006); the data is then organized into meaningful groups and the result of these initial codes differs from the units of analysis, the themes, which are often broader and more interpretive (Tuckett, 2005). Although it is not unusual for researchers to conduct open coding with the aid of qualitative software, no automated mechanism was used for conducting this study's analysis and the data was organized in a regular spreadsheet application. The inductive approach of this analysis allows to generate codes without being restricted to existing codebooks; the selected twenty-five posts yielded 293 codes in total and while many of them clearly represented a pattern, some others were solely representative of what was being discussed in each post and nothing more.

Analyzing the dataset, an initial generation of codes revealed that the most frequent topics were related to *Environmental impact*, *Government policies and regulations*, *Smart city initiatives and*

goals, *Challenges and barriers*, *Benefits and opportunities*; slightly less frequent were *Community engagement and participation*, and *Social equity and justice* while the remaining codes were much less frequent, as shown in Appendix 1.

[3] PHASE THREE: SEARCH FOR THEMES

The third step is *searching for themes*, during which the open codes generated prior are analyzed with the aim of identifying patterns of meaning and potential themes. This phase revolves around the grouping of initial codes into broader categories capturing the essence of the data. A total of 293 open codes was deduplicated into 43 entries, as shown in Appendix 1, making it apparent that the collected discourse varied in form and content, spanning from cynical to optimistic sentiment and from individualistic to collectivistic values. Of the 1713 collected comments, the vast majority appeared to be of extremist sentiment, which was to be expected given the data originated online and from social media platform, infamously known for offering proliferating ground to extremist behaviors, and often free of consequences or repercussions.

Discussion of sustainability and affordability were frequently encountered when a post focused on specific practices or when a discussion shifted to the concept of future smart cities; however, these were far less common than the skeptical visions of political and economic challenges for implementing nudging practices in data-rich environments which process data flows to offer better services to citizens (Beckwith et al., 2018). Oppositely, although less frequent, some commenters focused on *what could improve* rather than *what was certainly going be destroyed*; fueled by the desire of doing better, these discussions often mentioned reduced costs of living and enhanced quality of life, due to the idea of *being taken care of* by governance bodies. Admittedly, this last point, *being taken care of*, is also the most frequent selling point with which Smart City concepts and initiatives are made appealable to the masses (Leverage & Duong, 2022; Marr, 2021; McKinsey Global Institute et al., 2018; Skyfii & Haas, 2021; Wahba, 2019). The gathered insights reveal trends in the way specific issues are handled and discussed; a preliminary list of potential sub-themes was recorded and is displayed in Appendix 2. As this third step necessitated the development of a candidate selection of connecting themes, six main themes emerged, these too are shown in Appendix 2; although seemingly representative and inclusive, these themes still need to be revised and improved in the following step in order to ensure their validity and coherence.

[4] PHASE FOUR: REVIEW OF THEMES

The fourth step is *reviewing the themes* and is aimed at refining and validating the themes that emerged in the previous phase; the candidate themes are to be coherent and consistent while they respective sub-themes need to be represented accordingly. Certain improvements were made to both

the sub-themes and their respective parent groups, while some overlaps existed, certain themes were also too broad or not broad enough. In the attempt of making the list of candidate themes more representative and coherent, some groups were also renamed and so did their sub-themes; although this selection seemed much more exhaustive while also remaining representative of the data, the recursive nature of this methodological approach allowed to assess the outcome based on the dataset. After reevaluating the data and the Reddit discussions, some shortcomings emerged and certain comments that addressed important aspects of the discourse were not properly represented in the list of candidate themes and were therefore implemented; these comments discussed the ethical dilemmas relating to employing nudging practices in smart cities. The final outcome of this refinement process was a revised set of themes that were more focused and distinct, as shown in Appendix 3.

This chapter concludes by stating that, as steps five and six involve finalizing the findings, they are not described in detail here but, instead, they are outlined in *Results & Discussion*. The primary themes that emerged from the thematic analysis are presented and discussed in the following chapter along with how these relate to addressing the research questions; the themes are arranged in accordance with their applicability and frequency in the data set, and they are backed up by data-extracts from Reddit comments.

[4] Results & Discussion

This chapter presents the findings from a thematic analysis of Reddit posts that addressed nudging practices in smart cities. The analysis sought to understand how ordinary people viewed and responded to nudging techniques, as well as the implications and opportunities they saw for smart governance. A qualitative methodology that was thoroughly explained in previous sections served as the foundation for the analysis. Five major themes and fifteen sub-themes that emerged from the data were used to organize the chapter, as shown in Appendix 3, and every theme is explained in relation to the research questions and pertinent literature, with examples from the data to illustrate each point. From the viewpoint of ordinary people, the five major themes examined various facets of nudging practices in smart cities. Based on their mechanism, design, or context, users recognized and discussed various nudges under the first theme. The second theme looked at how users expressed their awareness of and trust in nudging practices used in smart cities as well as their opinions on these practices as a whole. The third theme focused on users' ethical and social concerns regarding nudging practices, as well as the role and influence of governmental organizations in creating and putting them into practice. The fourth theme examined how nudging practices relate to smart city frameworks and goals and evaluated their advantages and disadvantages for various smart city stakeholders. The fifth theme examined how users assessed nudges based on a variety of standards, including innovation potential, cost-benefit analysis, moral standards, well-being indicators, social impact, and socio-political ideals.

The goal of this study was to take a different approach than most academic research on smart cities, which focuses on policymaking and the practical aspects of developing smart governance. Instead, the primary focus of this paper was on how ordinary citizens perceive and understand nudging practices supported by data-rich environments. The data was gathered using online communities such as r/Sustainability, r/UrbanPlanning, r/UrbanDesign, r/IOT, and r/BehavioralEconomics that were only indirectly related to the subject at hand; this ensured that views and opinions were those of ordinary people rather than of experts.

[4.1] Discussion of the findings

[4.1.1] Types of nudges

The goal of the nudging technique is to change people's behavior in a variety of areas, including sustainability, health, and education. Nudges are not, however, a one-size-fits-all approach and, based on the situation and the type, they may have various outcomes and levels of acceptability.

Economic, social, and physical nudges are the three categories covered in this paper: physical nudges use physical cues to appeal to people's habits and convenience, social nudges use social pressure or norms to appeal to people's emotions and need for belonging, and economic nudges use financial incentives or disincentives to appeal to people's rationality and self-interest. These nudges reflect various presumptions regarding human psychology and behavior modification, and they may also affect various groups of people in various ways. A qualitative analysis of Reddit posts was carried out to investigate how ordinary people view and assess different nudging practices; below are presented and discussed the key findings.

The first research question aimed to investigate the *types of nudges* that were commonly recognized and discussed by potential citizens which, in this case, were Reddit users; the theme of *types of nudges* perfectly fits this question and illustrates how people may categorize various nudging practices based on their mechanism, design or even context. The three main sub-themes were identified to represent economic, social and physical nudging practices. For example, people in r/Sustainability seemed to often discuss nudging practices related to food consumption. Previously in this chapter, economic nudges were described as the use of "incentives and disincentives to influence behavior by appealing to people's rationality and self interest"; a member of r/Sustainability, posting on a thread that addressed food waste, mentioned that "[…] the EU commission just accepted an initiative to redirect meat and dairy subsidies to plant based meats and lab meat research. […] the EU commission will actually have to consider it. It's huge! Even cheaper and more accurate plant meats as well as lab meat could be closer than we think. […]" (Reddit user, Appendix 4). At the end of the comment, there was attached a webpage from an official EU website titled "End The Slaughter Age"; this is a perfect example of economic nudging as the comment relates to the use of incentives to promote sustainable food consumption and does so by appealing to people's rationality. Another example was for social nudging, previously described as the "use of peer pressure or social norms to influence behavior by appealing to people's emotions and need for belonging", which was unknowingly addressed in the same thread by a comment that stated "Try pushing for more plant-based options at restaurants, conferences, and events in your area. People are more likely to choose plant-based foods when it's the default option and not something singled out as 'other'. It's a tough road but not too long ago it was even harder to convince people" (Reddit user, Appendix 5); the user is fully aware of how nudging can influence citizens' behavior, especially when the nudge revolves around the feel of belonging, together as "the default" as compared to alone and "the other". Lastly, physical nudges were often discussed in r/UrbanPlanning and r/UrbanDesign as means for promoting healthy planning and design of modern cities; in a

thread about the prioritization of infrastructure for bicycles and pedestrians over the infrastructure for cars, a user noted that "[…] The problem […] in North America right now is that the car is favored above everything else. A better city would incorporate solutions from a variety of methods: better biking infrastructure, increased frequency of busses within the city, a larger rail network for inter-city travel, and the construction of more mixed-use zoning and walkable streets"; the user continued stating that "All of these things together make for a livable city. Right now, the scales are tipped so far towards car-centrism that investments into any of these areas would help reduce the problem" (Reddit user, Appendix 6). In all of these three examples, it is evident how people may be more aware of practices that are employed around them and are often aware of what their intended outcome is or should be; whether it is the production of food, its waste, the prioritization of more sustainable transport, or the other many instances discussed in the selected Reddit threads, people are aware and informed on a variety of nudging practices.

[4.1.2] Public opinion

Although nudging in smart cities frequently aims to influence citizens' behaviors in a variety of areas, such as sustainability, health, or security, such practices may not always be successful or well-received by the general public, depending on how they are viewed and assessed by the residents. Based on Reddit data, this section's theme investigates how the general public may feel about nudging policies in smart cities; moreover, such data can offer insightful information about how ordinary people converse and express their opinions. The sub-themes of awareness and trust in such practices, which capture users' knowledge, assurance, and positivity about nudging, both generally and in particular contexts, emerged from this domain. According to the discourse, awareness and trust are two important factors that determine how users experience and respond to nudges, as well as how transparent and accountable such practices may be in smart cities. Below, the findings on this subject are summarized and illustrated.

Given that the web is infamously known for being proliferating ground for the expression of individuals' strong opinions, and even more so on a platform such as Reddit, which promotes the discussion and interaction between internet users, people's sentiment generally belonged to either side of the spectrum; *public opinion* captured in the data was therefore often not neutral. A thread in r/BehavioralEconomics discussed a news article about the COVID-19 pandemic and how it brought the worst out of the people (Bruno, 2022), the article mentioned that a major factor that impacted citizens' trust for the worst was limiting their freedom of choice with, for example, vaccine-campaigns that nudged them into getting vaccinated; a user on the thread commented asking "Isn't

part of good citizenship behavior being skeptical of and questioning the govt? Not taking things at face value, etc.?" (Reddit user, Appendix 7) To which someone else responded "that's not allowed any more" (Reddit user, Appendix 8). These examples are not but a representation of how the *public opinion* is hard to fully satisfy, as individuals will always have different perspectives from one another. In r/IOT, a user built an air quality monitoring station and offered the other members the information necessary to build one just alike; the station would make use of sensors to measure temperature, humidity, pressure, dust and levels of CO, eCO_2, NH_3 and NO_2, to then send the data to a smart assistant and later to the user. On a different website, the author of that same post admitted that that information would be used to react accordingly, opening windows, cleaning its house and other responsive activities. Another user on the same thread replied with "Awesome! Is this a kit that someone can buy and build? How are you accessing the data collected?" (Reddit user, Appendix 9); despite the appreciation for the project, which would nudge the user into behaving a certain way, the main concern was one of trust and of data-handling, which in turn affected the user's attitude towards the project altogether. More generally speaking, the analysis revealed that the level of awareness and trust in nudging practices varied among users depending on their background knowledge, personal experience, and perceived benefits or risks of nudges; some users of r/BehavioralEconomics demonstrated high levels of awareness and trust in nudges by recommending books or articles that explained the theory and application of nudging practices. For example, a user commented "[…] 'Nudge' by Thaler/Sunstein and 'Thinking fast & slow' by Kahneman are obvious choices […]. I would also suggest 'Applying Social Psychology: From Problems to Solutions' by Buunk & Van Vugt. They offer a good explanation of how to identify problems, develop possible solutions and implement them. […]" (Reddit user, Appendix 10), while yet another commenter replied "Adding to these, 'Designing for Behaviour Change' (Wendel) is a good read, and a handy reference book too" (Reddit user, Appendix 11). These comments prove that some users are indeed well informed about the concept and application of nudging while also trusting its scientific validity and usefulness; on the other hand though, someone with less trust stated "Google is a serial killer" (Reddit user, Appendix 12), implying distrust in Google's use of nudges to manipulate users' online behavior, allegedly for its own benefit.

[4.1.3] Government policing

Different actors and stakeholders, including for-profit businesses, government agencies, and civil society organizations, may be involved in nudge practices in smart cities. Given that they have the ability and authority to affect citizens' behaviors in a variety of domains, governmental entities play

a critical role in developing and putting into practice such nudging practices. The legitimacy, transparency, and accountability of their actions are just a few ethical and social concerns that may arise from governmental entities engaging in nudging. Focal in this section, with importance given to *governmental policing*, the observed commenters often pointed out how it is governments that oversee and carry out nudging practices. Regulation, legislation, and funding are the three sub-themes that emerged and were identified; they show how users express their views and expectations regarding the role and influence of governmental bodies in the growth of nudging practices. Showing how users express their trust or distrust in governmental entities based on their political ideology, public interest, moral values, economic considerations, or even personal experience, the results are presented and discussed below

Discussing personal political preferences is for many people a practice to not publicly indulge due to others' different opinion and due to possible backlash; despite this factor though, *governmental policing* is fundamental for considering the healthy development of smart cities and the proper implementation of any form of nudging. The analysis of the reddit comments revealed how strongly opinions and experiences vary depending on different jurisdictions. It was frequent for users in r/UrbanPlanning to be negatively invested in the actions of the government; in a thread discussing a video about *streetcar suburbs* in Toronto, a term used to define residential areas where the usage of streetcar lines as the main mode of transit has shaped their growth and development, some of the interactions were of people discussing how the government strongly nudged citizens into traveling by car by denying residents to build anything but houses in certain residential areas. The outcome of this legislation though, was segregating entire towns from any commercial or recreational business; one user commented "Why do you have these sorts of strange regulations? Are your officials so incompetent? Is this due to lobbying from car or oil companies? I don't get it" (Reddit user, Appendix 13) suggesting that many of these citizens were not happy with being forced to behave a certain way and would have rather preferred more freedom. Another user commented that "[…] Austin […] [is] a city which is deeply opposed to change, […] they're a couple decades beyond the point of no return in terms of population. […] Despite being the most "progressive" city in Texas, that doesn't make them at all progressive […], and their laws are still deeply rooted in a legacy of racism endemic to Texas municipal law. I don't see this changing anytime soon, they can't even get their light rail started, even though it's supposedly been right around the bend for the past 25 years." (Reddit user, Appendix 14), implying once again that *governmental policing* is deeply rooted in the society and is often directed towards the path of least resistance, and most profiting, rather than that of correctness; citizens struggle to be trustworthy of nudging conducted by

governments, whether voluntary or not, due to how their political and legal barriers strongly hinder the implementation of nudges that could improve social justice and sustainability. But not every discussion was of critical sentiment, as some user was confident that governments would one day help reducing food waste and meat consumption by stating that "Avoiding meat significantly reduces ones carbon footprint. I would even venture to predict that governments may start to subsidize those who avoid meat because of the supply chain implications." (Reddit user, Appendix 15), which suggested optimism about the possibility of governments using legislature employing nudges to promote vegetarianism as a way to reduce environmental impact.

The analysis revealed similar results for government regulations, which varied among different domains and sectors depending on the level of oversight, transparency, and accountability required or expected by each area. It was frequent for users to express concern and distrust regarding the lack of regulation or supervision of nudging practices that nudge citizens into dangerous and harmful behaviors; an example of this mistrust was a comment in a thread about Austin, Texas, revising their land development code to build affordable housing: "They are trying to control what other people can do and they will use any argument available whether it makes sense or not" (Reddit user, Appendix 16), implying concerns regarding the motives and methods of said practices, such as the outcome of the land development code revision which led to the eviction of some home owners, as well as other backlash. But once again, sentiment was not negative altogether and some of the other users expressed confidence for government regulations that implemented smart equipment-aided nudging to benefit citizens' quality of life.

Ultimately though, users in these communities were most concerned about the use of funding, which was often allegedly used to nudge citizens but towards the wrong behaviors and for the wrong reasons, such as lobbying and other monetary motives. Some users expressed dissatisfaction or disappointment with the lack of funding or support for nudging practices that they considered important or necessary, and often used irony to represent their sentiment; in a thread discussing a funding of five billion dollars for road safety, mandated by Pete Buttigieg, the US's Secretary of Transportation, users were quick to prove how in their experience nothing had really changed and no positive behavior was effectively promoted. One user started a discussion by ironically stating "My city: 'Best we can do is this painted bike lane.'" (Reddit user, Appendix 17), to which others replied "Los Angeles […]: 'the best we can do is this pothole that's been here since '86'" (Reddit user, Appendix 18), and then again "'LADOT: Here's .6 miles of unprotected bike lanes on a 6 lane stroad. It only cost $8.3mil. You're welcome.'" (Reddit user, Appendix 19); these comments suggest

unhappiness, mistrust, and dissatisfaction with the governments' use of fundings to promote better behaviors such as simple nudging practices that would help improve road safety more efficiently.

[4.1.4] Smart city initiatives and goals

The goal of smart cities is to use data and technology to enhance residents' quality of life in a variety of areas. Utilizing nudging techniques, which are subtle and non-coercive interventions that affect people's behaviors and choices, is one way they can achieve this. Smart cities may employ sensors and feedback mechanisms, for instance, to encourage residents to recycle more, use less water and energy, take public transportation or bicycles instead of personal vehicles, and adopt healthier lifestyles. However, social and ethical issues like privacy invasion, manipulation, paternalism, and accountability may also be raised by nudging techniques; as a result, it is critical to comprehend how people view and assess nudging practices in relation to *smart city initiatives and goals*, which is the subject matter covered in this section. Additionally, this theme has three sub-themes: accessibility, efficiency, and sustainability. Efficiency, on the one hand, refers to how nudging practices may improve service delivery and performance optimization, while accessibility, on the other hand, refers to how nudging practices may improve social inclusion and equity as well as allow some people to obtain and carry out tasks that they previously could not; lastly, the pursuit of *sustainability*, which in this case refers to how nudges may contribute to environmental protection and resource conservation, is undoubtedly the most prevalent of the many potential goals that may be achieved through smart governance. These sub-themes highlight the advantages and trade-offs that nudging practices may have for different smart city stakeholders. This section also discusses the interaction between nudging techniques and *smart city initiatives and goals*; these factors include technical development, data accessibility, public participation, and ethical concerns.

Due to the nature of the collected data, initiatives and goals were not often discussed directly but rather indirectly as a reply to something else, or simply as a tool to prove one's point to someone else. Similarly to the first discussed theme and its relation to one of the research questions, *smart city initiatives and goals* directly relates to the other posed questions. When analyzed as part of its context and discourse, this theme addresses citizens' perception of smart city initiatives and consequently of data-aided nudging practices, as well evaluating how citizens' viewpoints may guide the creation of human-centered governance. This theme often sees the discussions for sustainability, efficiency and accessibility, as demonstrated by some of the data extracts use so far; moreover, such pursuit for sustainability is undoubtedly the most prevalent of the many potential goals that may be achieved through smart governance. Efficiency, although less frequent and more

indirect, was often used as the argument for proving one claim stronger or more note-worthy than some other, while being proof of how nudges may have enhanced service delivery, reduced waste, or optimized some aspect of a given environment. Accessibility was surely the least frequent but extremely important nonetheless. These three aspects are some of the most important goals that smart cities should aim to achieve and are arguably all achievable through the use of nudging initiatives, if employed effectively; despite not all citizens being equally aware of, or supportive of, such initiatives as they may have different perceptions of their benefits and risks.

People in r/Sustainability were extremely prone to discussing, or redirecting a conversation, resource reservation or related topics such as the popular food consumption; mentioned in a prior section was a comment from a user stating that "[…] Avoiding meat significantly reduces ones carbon footprint" and that he predicted how "governments may start to subsidize those who avoid meat" (Reddit user, Appendix 15), implying a sense of trust for the possibility of future cities to nudge citizens towards more sustainable behaviors, even though the reasoning might have been more economical than for the sake of the planet's conservation. Similarly, another user argued against the artificial import of fauna and flora that some suburban areas witnessed, stating that "[…] whilst this shows a great amount of plants, ideally you'd want natives not just rows of introduced […] species. […]. Sustainability should focus on providing habitat and pollination vectors, as well as food, while promoting propogation of flora and fauna native to the geographical location […]. There's also nothing particularly sustainable about huge watering or fertiliser demands […] of maintaining them" (Reddit user, Appendix 20); this comment argued that although better than nothing at all, certain initiatives that may be conducted by a smart city, with the aim of reaching a certain goal of sustainability, may cause severe harm in the long term.

Another of the sub-themes that emerged from the data was that of efficiency, which was most often discussed in relation to those nudging practices that were aimed at improving the delivery of services; members of r/UrbanPlanning and r/UrbanDesign seemed to often redirect the discussion to nudging practices related to transportation modes such as the infrastructure for bicycles and pedestrians, and public transit incentives. These discussion often indirectly aligned with the goal of improving efficiency as they referred to the reduction of traffic congestions, the decrease of air and noise pollution, accidents, as well as health problems that can be commonly associated with car-centrism and car dependency; one satisfied user commented "[…] Finland is actually one of the best places for winter biking in the entire world. Finland found that temperatures and snowfall each had almost no effect on biking whatsoever. What did make a difference was the presence of separated bike paths, and the frequency of snow clearing by the city" (Reddit user, Appendix 21), suggesting

that the commenter was more than happy to bike if the nudges presented to him/her were well thought-out and backed-up by quality-of-life improvements, even if the temperature was well under the 0°C.

Lastly, a sub-theme of accessibility was at time discussed in r/IOT as well as in the other subreddits. Although this theme could aid with the development of nudging practices aimed at enhancing social inclusion and equity, as well as allowing people to obtain and perform tasks that they previously could not, for example in the health care system, it was more often discussed as a mean for people to be guided during their own daily life; many users made use of the Internet of Things (IoT) to be nudged into behaving a certain way, perhaps through a digital personal trainer, sleep counselor or simply as one's own meteorologist. It was discussed prior in this chapter a thread regarding a user building "[…] this enhanced weather station […]" (Reddit user, Appendix 22) and using it afterwards to receive personalized information on the collected data and act accordingly. Although they are not always explicit, many of these commenters seem to acknowledge the effectiveness of nudging practices but do so for issues they consider important and relevant to their persona; arguably, the key to this success remains the freedom of choice of being aware of origin, means, purpose and outcome of said practices.

[4.1.5] Implications and opportunities

In smart cities, nudging techniques can be used to influence people's actions and decisions in a variety of areas, including social inclusion, resource conservation, environmental protection, and service delivery. However, there may be some ethical concerns and trade-offs associated with nudging techniques, such as privacy invasion, manipulation, paternalism, and accountability. As a result, it is critical to comprehend how citizens view and assess the *implications and opportunities* of using nudges in smart cities, as well as any potential influences on their opinions and preferences. The technical, ethical, and economic implications, as well as improved quality of life and socio-political challenges, are the four sub-themes that make up this section, which evaluates how users assess the effects and consequences of nudges in various contexts and circumstances. Technical implications discuss how nudges may rely on or affect the availability and dependability of data and technology, ethical implications cover how nudges may bring up or address moral issues for individuals or society at large, and economic implications discuss how nudges may cause changes in costs or income for people or organizations. While socio-political challenges encompass how nudges may influence or reflect people's power dynamics and values, enhanced quality of life refers to how nudges improve or worsen people's well-being and satisfaction in their communities.

These sub-themes reflect on how users discuss their hopes and worries about the opportunities and effects of nudges in smart cities; they also show how users evaluate nudges based on a variety of criteria, including innovation potential, cost-benefit analysis, ethical standards, well-being indicators, social impact, or socio-political ideals.

The last main theme that emerged from the thematic analysis was one that included both the *implications and opportunities* of employing nudging practices *into* and *within* smart city frameworks. Deloitte Insights (2018) published an article titled *Forces of change* in which they introduced the concept of *Smart City 2.0* to indicate how "smart cities earlier focused on connecting infrastructure for better insights, the spotlight is slowly shifting to better engaging governments, citizens, and businesses with the goal of providing improved city services and a higher quality of life". The general theme of *implications and opportunities* is quickly changing in the fast-developing discourse of smart cities, as different cities and environments will have different challenges and opportunities while implementing smart city initiatives and nudging practices; some of these may be balancing innovation and regulation, ensuring data security and privacy, fostering citizen participation and trust, promoting social inclusion and equity, and enhancing environmental sustainability and resilience. The theoretical concept of either smart cities or nudging practices, is not that of that imposing and manipulating the choices or behaviors of citizens, but rather one for empowering and enabling them to make better decisions for themselves and their communities. Although this should be the framework for the development of healthy environments and smart governance, not all people are equally aware or supportive of such initiatives as they may have different perceptions and beliefs. The Reddit analysis of users' comments and discussions was indeed proof of such variation in opinions and sentiment regarding a series of topics and discourses that could be generally described by the themes emerged from this study's analysis. The fourth research question aimed to consider the opinions and concerns of citizens in regards to themes of surveillance, privacy and most importantly, of freedom of choice; the fifth and last theme that emerged from this analysis, one concerned with *implications and opportunities* of data-rich environments, strictly directed to the research question as the theme and its sub-themes, were all fair concerns for citizens to express.

This last theme included as a sub-theme the discussion of technical implications for which both accessibility and reliability of data and technology are main factors for affecting or enabling nudging practices. As they allow smart governance to collect, analyze and communicate, data and technology serve the purpose of improving public services, enhancing citizen participation, and influencing behavior change. However, they also imply the presence of significant challenges and

risks for the citizens being nudged, whether these are data breaches, cyberattacks, system failures, digital divides, and even the already common algorithmic biases. Some users, were critical about providing the government with their own information and even expressed their concerns regarding the privacy and security of their own data, which was being collected by their smart devices; such concerns would only intensify in data-richer environments where nudging practices could be aided by such personal data.

Another sub-theme was that of ethical implications, which referred to the multitude of ethical consideration that arise when discussing both nudging practices and smart governance, addressing moral concerns for individuals or for the society as a whole. Ethics is a fundamental aspect to consider when discussing smart cities as they use, by definition, data and technology to shape the behavior and well-being of the citizens and of the environment hosting them. The main concern when evaluating the ethics of the discourse is the fact that no single person should decide what is a good or desirable behavior, what criteria are to be employed to guide such decision, and what are the fair consequences and implications of smart governance-aided nudging. It is these questions and dilemmas that may most influence the acceptability and desirability of nudging practices, as well as the accountability and transparency of smart governance itself. Some of the Reddit comments questioned the ethical implications of nudging practices that may have had unintended consequences for individual and social behavior, while others criticized their moral legitimacy when they used psychological mechanisms to influence people's decisions, especially on sensitive or personal matters.

Just alike, the sub-theme of economic implications is fundamental when discussing smart city initiatives as well as their *implications and opportunities*; smart governance may use data and technology to optimize the allocation and utilization of resources, with the aim of enhancing the efficiency and the productivity of the offered services to create more opportunities. But as economics is a core factor, the discourse is bound to entail great tradeoffs and conflicts between the environment and its residents, thus affecting the feasibility of nudging practices and of opportunities alike. For example, in one of the threads discussed above, one about the American Secretary of Transportation Buttigieg mandating five billion dollars for road safety, the majority of the commenters were critical on how that money was spent, as opposed to being used somewhere else; some other users in r/Sustainability were critical of subsidizes for meat replacements as meat itself was soaring in price. One of the concerns for economic implications is *who* the bearer of the costs for nudging practices is, and *who* will ultimately gain, or lose, from such incentives or disincentives.

The last sub-theme completing the *implications and opportunities* theme was one of enhanced quality of life and of socio-political challenges, two interrelated topics representing how nudging may improve or worsen people's well-being and satisfaction in their communities, as well as their power dynamics and values. Quality of life is one of the core pillars of smart city frameworks, and these are theorized to supplement citizens' life and support them through the use of technology and smart-governance; it is a key goal of all related initiatives and relates to a number of areas such as health and health care, safety, education, culture and even just leisure in various domains and contexts. Despite being similarly important, socio-political challenges also pose threats and tradeoffs such as handling, accessing and controlling the flows of data and the technology; thus questioning the motives and interests behind nudging practices and behind those that are in control of them. The *implications and opportunities* are well embedded in the fabric of the previous themes, whether they are security and privacy, food production and food consumption, improved logistics for urban and suburban areas, or government funding and legislation. All of these factors, and their balance within each other, determine the attractiveness and acceptability of nudging practices, as well as the participation and engagement of citizens in smart governance. Ultimately though, the analysis of Reddit comments reported the presence of both quality-of-life improvements, potentially improved *if* and *when* aided by data and smart governance, and socio-political challenges such as the concern for a country's democracy and the citizens' freedom of choice; the analysis of this theme demonstrated that no quality-of-life improvement can exist without facing other implications hindering the outcome or the freedom of some other resident.

[4.2] Answering the research questions

WHAT KINDS OF *NUDGES* ARE CITIZENS FAMILIAR WITH?

To address this question, the data analysis revealed a theme called *Types of nudges*, which categorized the nudging practices that citizens may have encountered prior or recognized based on their mechanism, design, or context; three types of nudges were identified and they were economic, social, and physical nudges. Although the question was mainly answered by this theme alone, it was the variety and subtlety of the content and context of the other themes alike which fully depicted an answer; the people subjected to this analysis established awareness and knowledge about nudging practices, even if they did not explicitly refer to them using the term *nudge* or *nudge theory*. Similarly, Reddit users seemed to be capable of identifying when they were being nudged in their daily lives, such as instances related to marketing strategies, hierarchy of road topography, promotion of sustainable behavior and even smart-home appliances. However, this theme indicated

that that citizens, although conscious of the fact they were somehow being nudged towards a certain behavior, may have not always been aware of the purpose, design or impact of some of the nudges that were more subtle, complex or, most importantly, data-driven. While discussions of nudging practices in "the tangible world" were somewhat frequent, more modern forms of smart governance-aided nudges were much more scarce and seemingly unnoticed. Data-driven nudging is much more subtle and, as of now, represents more of a thread for citizens' awareness; individuals may soon not be so familiar or even be capable of familiarize with nudging practices that direct them into consuming certain content or products. This question raised important concerns regarding the state of today's context compared to the plausible one of future data-rich environments; how citizens can remain informed and educated about the existence and function of various nudges they are subjected to, is yet to be determined.

WHAT ARE THE POTENTIAL BENEFITS AND DRAWBACKS OF *NUDGING* IN *SMART CITIES*?

The benefits and drawbacks of nudging are a core pillar of the discourse of smart city development; these may depend on many factors such as the way the practices are both designed and implemented and depending of the way they are ultimately perceived and evaluated by the citizens. Nudging is to be seen as a form of behavioral governance which leverages data and technology to influence behavior in a positive and effective way; when applied to the context of smart cities, nudging can help make better and more informed decisions that align with long-term goals of the individual but also of the environment. The thematic analysis conducted in this study documented a frequent number of entries that related to the resource management of food and energy while reducing their waste, the providing improving of better health care systems and citizens' health, as well as practices to improve safety in a number of different context; moreover, citizens' satisfaction may be aided by personalized, timely, and relevant information or feedback regarding behavior and external factors. Although nudging in data-rich environments may improve participation and engagement by providing opportunities, incentives, or recognition for certain contributions, it can also be seen as a form of unwanted behavioral manipulation that runs the risk of exploiting provided data and technology to redirect behavior in ways that are not transparent not accountable for. It is the most dangerous drawback for such practices to start hindering the citizens' freedom of choice through a system of algorithmic blackbox that may not be easily seen nor perceived; this and other ethical dilemmas are to be considered potentially hazardous given their ability to affect the essence of conscious freedom of choice into becoming a path of decisions previously set in stone. Moreover, if not employed in an ethical and human-centric way, these

practices may further reinforce social divisions and inequalities by favoring certain groups or individuals over others based on their access to or affordability of smart city services or policies.

HOW DO CITIZENS PERCEIVE AND FEEL ABOUT THE USE OF SMART GOVERNANCE-AIDED *NUDGES* THAT ENCOURAGE THEM TO ENGAGE IN PARTICULAR BEHAVIORS?

On of the drawbacks of nudging practices is the challenge of measuring their effectiveness due to their theoretical definition of subtle interventions, as opposed to drastic manipulations of one's behavior. Similarly, perception and feel are hard metrics to measure and, in turn, they differ in sentiment and complexity across the collected data. One of the themes that emerged from the conducted thematic analysis was one concerned with public opinion which revealed that the level of awareness and of trust, as well the attitude that citizens may have towards smart-governance strongly varied based on background knowledge and personal experiences. Although some of the Reddit commenters demonstrated great knowledge and even recommended literature regarding the topic, some others expressed lower levels of awareness and critically questioned the validity and legitimacy of existing nudging practices by implying strong mistrust in the actors behind them; this seemed to be a common recurrence that affected most of the comments representing any form of personal sentiment. Whenever the sentiment of a comment was of positive nature, the analysis of the data seemed to document how feeling and perception was mostly affected by claims of efficacy and purpose of the practices that were being discussed; on the other hand, whenever comments were of more negative attitude, the reasoning behind such sentiment was often originated by feels of mistrust and skepticism regarding those that designed, implemented or funded the practice at hand. Although perception and feel of potential citizens may vary from positive or negative sentiment, as one would expect it to, it is important to note that positive attitude often originates from efficacy of the practices while negative attitude often originates from current and past experiences of the individuals.

WHAT ARE THE OPINIONS AND CONCERNS OF CITIZENS ON TOPICS OF *SURVEILLANCE*, *PRIVACY*, AND *FREEDOM OF CHOICE* IN RELATION TO *NUDGES* IN *SMART CITIES*?

As previously mentioned in some of the sections above, the analysis of the reddit comments revealed how strongly opinions and experiences varied depending on different jurisdictions and contexts. Although the analysis was conducted on modern and actual content, thus better representing the state of today's discourse, surveillance, privacy and freedom of choice were already significant concerns; in relation to smart cities, these issues have the potential to become much more prominent due to their ability of being facilitated, negatively, by the aid of users' data. While modern data-rich environments are mostly the result of retrofitting technological

infrastructure to existing systems, the ideology of smart cities is for them to be built with flows of data in mind, aiding and assisting the governance to be smart and efficient. In order for this aspect to become true, as many variables as possible ought to become measurable and collectable in a city, and this data is often that of its citizens which then become the data themselves. The residents of smart cities would likely be right in being concerned about the extent and purpose of the surveillance that may be conducted in order to aid certain nudging practices; they may also be right to fear for their own security as once digital, any personal information can be lost, misplaced or even retrieved by a malicious party. This issue is extensively discussed by Beckwith et al. (2018) in their chapter regarding flows of data in smart cities in which they explore the complex relationship between the cities and the data, as well as the way that the citizens of a city want data about their community to be managed. The argument made is that there is no perfect answer to handling such large amount of data, and whether it is to be made private or openly available leads to concerns that would still support those discussed in this research. It is a similar issue for one's freedom of choice, arguing that it should be completely up to the individuals to decide their own actions whereas giving up on some of that freedom might potentially not only help said individuals, but may also greatly help the community and the future of our kind.

HOW CAN THESE CONSIDERATIONS GUIDE THE CREATION OF INCLUSIVE AND HUMAN-CENTERED GOVERNANCE PRACTICES SUCCESSFULLY EMPLOYING *NUDGES* TO PROMOTE DESIRED BEHAVIORS?

Based on the analysis and conclusions drawn prior, it seems like there exists no exact nor correct way to answer such complex question; one plausible way, although incomplete and insufficient, is to incentivize the creation of smart city frameworks that are themselves inclusive and human-centered. Smart cities should not be places where technology is solely used as a mean to improve urban services and infrastructure, such as some of the mega projects by the likes of Saudi Arabia's NEOM, but rather environments where citizens, governments, and businesses collaborate to co-create solutions for the common good. This is a vision of smart city development often recognized as Smart City 2.0, as mentioned in a prior section quoting an article by Deloitte Insights (2018); this model emphasizes the importance of engagement by residents and stakeholders alike. It is exactly this and similar frameworks that help consider how to guide the creation of human-centered governance practices that successfully promote desired behaviors among citizens. Nudges should be employed and treated for what they are, subtle interventions that influence people's choices without restricting their freedom, and should use make use of useful data, such as feedback, incentives, or social norms, that appeal to the individuals' cognitive biases or heuristics; they could greatly

improve various domains such as those of health, education, safety, accessibility, environment and sustainability just to name a few. The Smart City 2.0 framework implies some factors to be included when considering smart city initiatives and the development of smart governance projects. Smart cities should empower the citizens to participate in the co-creation of solutions for urban challenges rather than subduing to an imposed top-down approach that should supposedly be widely adaptable to every instance. Although it is not quite yet the ultimate goal, the city of Boston in Massachusetts utilizes a mobile app called Street Bump to collect real time data and allows the citizens to report potholes in the road through their smartphones' sensors (Ranchordás, 2019) and the collected data is used to prioritize and fix certain roads. Another implied factor is that of balance, as smart cities should carefully balance the benefits and risks of data-driven nudges, rather than exploiting or ignoring them; this could be theoretically achieved by ensuring data privacy, security, and trust; while also avoiding manipulation and coercion, and respecting citizens' autonomy. The city of Eindhoven in the Netherlands, for example, uses light sensors to monitor nightlife activity and adjust the lighting accordingly, with the aim of reducing crime and disturbance; however, the project respects the privacy and consent of the visitors by anonymizing and aggregating the data collected by the sensors (Ranchordás, 2019). Another two factors are of adaptations and of alignment, as smart cities should adapt nudges to the local context and culture, rather than applying generic or universal nudges while also evaluating and aligning such nudges with the broader goals and values of the smart city, rather than pursuing narrow or conflicting interests. Examples are Singapore's gamification program to motivate citizens to walk more and improve their health, based on their age, gender, lifestyle, and preferences or Stockholm's congestion charge system which varies pricing in order to nudge drivers to reduce car usage during peak hours while also investing the generated revenue back into public transportation projects. It is only by considering these and similar factors, that more inclusive and human-centered governance practices are successfully created and respectively able to employ nudges to promote desired behaviors.

[5] Conclusion

In order to inform a human-centered smart governance, this study sought to investigate how ordinary people perceive and respond to nudging in smart cities, as well as how such nudging is influenced by smart governance structures that use digital flows of information. In doing so, it was explored how these practices may affect people's well-being in various domains, such as the ones proposed by Maslow's hierarchy of needs (1943). To achieve this purpose, a qualitative thematic analysis of Reddit comments was conducted from a selection of five subreddits and twenty-five total posts; the analysis documented the extraction of five main themes: *1) types of nudges*, *2) public opinion*, *3) government policing*, *4) smart city initiatives and goals*, and *5) implications and opportunities*. Indeed, these themes turned out to support Maslow's pyramid of needs as *[1]* showed how nudging could help people to pursue their physiological and safety needs by providing them with information, feedback, incentives, or reminders; *[2]* could affect people's belongingness and love needs by fostering social interaction, cooperation, and trust among citizens; *[3]* highlighted how nudging can challenge people's esteem and self-actualization by undermining their autonomy and freedom of choice, while *[4]* could support those same needs by providing recognition, rewards, feedback, or opportunities for learning and for personal development; *[5]* may have balanced people's different levels of needs by ensuring transparency, accountability, and ethical development. Based on the collected data and discovered themes, this study answered five research questions; the main one explored how nudging practices, aided by smart governance tools and opportunities, may influence the development of inclusive and human-centered governance in the future in an attempt to promote desired behavior.

In terms of contribution to the existing literature, this study provided a novel perspective that was based on the discourse supported by ordinary people and by everyday discussions, as opposed to the more common approaches that are more interested in the opinion of experts and policymakers involved in the designing and implementing of nudging practices. Moreover, the research still provided plausible insights and recommendations for said policymakers, but from the perspective and experiences of Reddit users; by highlighting their diversity and complexity, as well as the diversity and complexity of their viewpoints, the study discussed some of the ethical questions and dilemmas regarding the legitimacy and desirability of nudging practices that may influence or manipulate citizens' behavior in subtle, complex, and data-driven ways.

Given the nature and original purpose of this study, many limitations have been encountered, such as the content of the platform itself and the frequent disinterest of users to bring forward a

serious discussion, or the sheer amount of required data necessary to truly resolve some existential concerns, as well as the fundamental difficulty of measuring nudging's efficiency. This study recognized that the data source, the data collection, the analysis methods, and the scope and depth of the research may have limited the development of a more in-depth outcome. Despite such limitations though, future research should more frequently focus of the opinion and experiences of ordinary people when documenting the development and creation of smart city frameworks that use smart governance in order to nudge citizens towards behaving a certain way; with the gain in popularity of modern smart city concepts, data management and human-centered infrastructure should be carefully evaluated so to not let data and technology being the sole drivers of *smart city* development, but rather the enablers.

According to the findings and answerers provided to the posed research questions, it was concluded that nudges, although a prevalent and controversial phenomenon in smart cities, elicit diverse and complex views and feelings from citizens; yet, the process of understanding and considering such views is essential for the future development of such cities. The findings revealed that, although different and complex preferences and opinions exist across a population, people generally had a positive sentiment and expectation about the role of nudging practices whenever they aligned with themes of greater good; oppositely, the sentiment was much more critical when the discourse more directly addressed futile outcomes and governmental policing that hindered people's freedom of choice. Considering once again Maslow's hierarchy of needs, this study offered a novel perspective that was mainly based on the discourse supported by ordinary people and by everyday discussions; this more nuanced approach to developing smart governance can also help to identify potential gaps, trade-offs and conflicts between the different levels of needs of the citizens. Overall, it it the citizens that would be most affected by the workings of smart governance, and nudging should be developed to satisfy the creation of smart city environments that are not only smart but also human-centric.

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Appendix

Open codes	Occurrence	Open codes	Occurrence	Open codes	Occurrence
Environmental impact	16	Google Cloud IoT Core	2	Suburban retrofitting	2
Government policies and regulations	16	Cloud computing and services	2	Infrastructure investment and maintenance	2
Smart city initiatives and goals	16	Business strategies and decisions	2	Urban sprawl	2
Challenges and barriers	16	IoT devices in healthcare	5	Tactical urbanism	2
Benefits and opportunities	16	Healthcare services and quality	3	Building form and function	1
Community engagement and participation	12	Cost and affordability	7	Behavioral economics books	1
Social equity and justice	12	Infrastructure and availability	7	Setting prices for a single-item restaurant	1
Urban design and planning	9	Consumer preferences and behavior	6	COVID-19 pandemic impact on human behavior	1
Accessibility and walkability	7	Health outcomes and benefits	3	Company swag	1
Transportation and mobility	6	Battery-powered cars	2	Behavioral economics experiments	1
Land use and density	5	Plant-based diets	2	NIMBYism	1
Housing diversity and affordability	4	Food waste	2	Housing crisis	1
Quality of life and well-being	4	Red meat consumption	1	Federal funding	1
Public safety and security	3	Chickpeas and lentils consumption	1		
Aesthetics and creativity	2	Biodiversity	2		

Initial open codes, deduplicated and sorted by their amount of occurrences across the dataset.

Axial themes	Axial sub-themes
Nudges	Economic nudges; Social nudges; Physical nudges; Benefits of nudges; Drawbacks of nudges.
Public opinion of nudges	Awareness of nudges; Attitudes towards nudges; Trust in nudges.
Government policing on nudges	Legislation; Regulation; Funding.
Smart city initiatives and goals	Sustainability; Resilience; Efficiency; Accessibility; Affordability.
Challenges and barriers to using nudges in smart cities	Technical challenges; Economic challenges; Socio-Political challenges.
Opportunities for using nudges in smart cities	Improved efficiency; Reduced costs; Increased sustainability; Enhanced quality of life.

Axial selection of themes and their respective sub-themes.

Appendix 3

Candidate themes	Candidate sub-themes
Types of nudges	Economic; Social; Physical.
Public opinion	Awareness and trust; Attitudes towards nudges.
Government policing	Legislation; Regulation; Funding.
Smart city initiatives and goals	Sustainability; Efficiency; Accessibility.
Implications and opportunities	Technical implications; Economic implications; Ethical implications; Enhanced quality of life and Socio-Political implications.

Final selection of themes and their respective sub-themes.

Appendix 4

Subreddit	Comment
r/Sustainability	Speaking of, the EU commission just accepted an initiative to redirect meat and dairy subsidies to plane based meats and lab meat research. If it gets enough signatures over the upcoming year, the EU commission will actually have to consider it. It's huge! Even cheaper and more accurate plant meats as well as lab meat could be closer than we think. If you have European friends you can share it with them: https://eci.ec.europa.eu/025/public/#/screen/home (It's an official EU site btw I'm not trying to give anyone a virus).

Reddit user' comment

Appendix 5

Subreddit	Comment
r/Sustainability	Try pushing for more plant-based options at restaurants, conferences, and events in your area. People are more likely to choose plant-based foods when it's the default option and not something singled out as "other." It's a tough road but not too long ago it was even harder to convince people.

Reddit user' comment

Appendix 6

Subreddit	Comment
r/UrbanDesign	Public transit is also massively important. The problem we have in North America right now is that the car is favored above everything else. A better city would incorporate solutions from a variety of methods: better biking infrastructure, increased frequency of busses within the city, a larger rail network for inter-city travel, and the construction of more mixed-use zoning and walkable streets. All of these things together make for a livable city. Right now, the scales are tipped so far towards car-centrism that investments into any of these areas would help reduce the problem.

Reddit user' comment

Appendix 7

Subreddit	Comment
r/BehavioralEconomics	Isn't part of good citizenship behavior being skeptical of and questioning the govt? Not taking things at face value, etc.?

Reddit user' comment

Appendix 8

Subreddit	Comment
r/BehavioralEconomics	that's not allowed any more

Reddit user' comment

Appendix 9

Subreddit	Comment
r/IOT	Awesome! Is this a kit that someone can buy and build? How are you accessing the data collected?

Reddit user' comment

Subreddit	Comment
r/BehavioralEconomics	As already mentioned, "Nudge" by Thaler/Sunstein and "Thinking fast & slow" by Kahneman are obvious choices and should give you a basic understanding. And while they do provide a lot of theory, they will not directly tell you how to approach intervention design. Therefore, I would also suggest "Applying Social Psychology: From Problems to Solutions" by Buunk & Van Vugt. They offer a good explanation of how to identify problems, develop possible solutions and implement them. The process will include tons of literature research. Trying to figure out scientific papers on your own can be very challenging, if you don't have the specific background. So, if nobody in your team has the academic training it would make a lot of sense to either hire specialists or team up with a university department near you. Applied problems are in high demand for a lot of courses in (social) psychology.

Reddit user' comment

Subreddit	Comment
r/BehavioralEconomics	Adding to these, Designing for Behaviour Change (Wendel) is a good read, and a handy reference book too

Reddit user' comment

Subreddit	Comment
r/IOT	Google is a serial killer

Reddit user' comment

Subreddit	Comment
r/UrbanPlanning	What do you actually do? Are you always stuck inside? What did you do when you were a child and couldn't drive?
	Practically, yes we (my siblings and I) were always stuck inside. Ones parents had to drive us to anywhere. Even if you wanted to get lunch it'd be usually a 3/4 mile drive.
	Regarding biking we tried it once, but on the 40 mph limit roads with people actually driving at 50/60 it wasn't not very pleasant/ conducive to actually making it to adulthood lol.
	Why do you have these sorts of strange regulations? Are your officials so incompetent? Is this due to lobbying from car or oil companies? I don't get it.
	The entire city/urban design is centered around the car first. It is not just due to lobbying from car/oil companies, a lot of it is buy in from the rest of American society. For instance most single family homes around here must have a 2 car garage. Oh and since the road is too dangerous with those high speeds, our homes must be isolated from arterial roads, and we must make our neighborhood roads winding to prevent drivers from using them as shortcuts, but since they are too winding for firetrucks they must be giant neighborhood roads, etc... You'll see a bunch of weird design choices coming from centering heavily around the car.
	Why is there no public transport? It seems like the only thing is the yellow school bus, idk.
	The density is too low to seriously support public transit. Take a look at https://luminocity3d.org/WorldPopDen/#3/37.44/-39.20 and zoom around say Atlanta or the post war suburbs and see how their density is around 1k per square kilometer instead of European's 4k per square kilometer. You'll see more public transit around pre-war suburbs or wherever has more density.
	He says there can be only one family houses. Why? Why can't you have idk a commie block in the middle of such a suburb? Or row houses or whatever.
	Americans' legal system regarding property is a bit weird compared to the rest of the world. There are very weak 'individual property rights' you typically must get permission from the city and your surrounding neighbors to make any change. The other "English" countries of UK/ Australia/Canada etc... also have this very strong neighborhood approval for you to make any changes to your property.
	Why are there no businesses inside these? I mean, he says it's illegal, just why? If I lived in such a place, I'd just buy a house next to mine and turn it into a tavern or a convenience store or whatever. Is that simply not possible and illegal?
	The exclusive zoning means only one thing at a time, this also induces even more driving since if you live in a residential zone there is no way for you to buy/work without driving to the commercial zone.
	These places have front and backyards. But they're mostly empty. Some backyards have a pool maybe, but it's mostly just green grass. Why don't you grow plants in your yards? Like potatoes, cucumbers, tomatoes or whatever. Why do you own this land, if you never use it?
	It is illegal in most cities to grow anything in the front besides grass. (though that has changed in some cities)

Reddit user' comment

Subreddit	Comment
r/UrbanPlanning	Having moved away from Austin last year, this doesn't surprise me. It's a city which is deeply opposed to change, despite the fact that they're a couple decades beyond the point of no return in terms of population. Most legacy landowners are white, and are openly opposed to poor people, or those of other races being able to own property. Despite being the most "progressive" city in Texas, that doesn't make them at all progressive relative to the rest of the country, and their laws are still deeply rooted in a legacy of racism endemic to Texas municipal law. I don't see this changing anytime soon, they can't even get their light rail started, even though it's supposedly been right around the bend for the past 25 years.

Reddit user' comment

Subreddit	Comment
r/Sustainability	Although this infographic is a bit confusing, it's very true. Avoiding meat significantly reduces ones carbon footprint. I would even venture to predict that governments may start to subsidize those who avoid meat because of the supply chain implications.

Reddit user' comment

Subreddit	Comment
r/UrbanPlanning	They are trying to control what other people can do and they will use any argument available whether it makes sense or not

Reddit user' comment

Subreddit	Comment
r/UrbanPlanning	My city: "Best we can do is this painted bike lane."

Reddit user' comment

Subreddit	Comment
r/UrbanPlanning	Los Angeles (my current city): "the best we can do is this pothole that's been here since '86"

Reddit user' comment

Subreddit	Comment
r/UrbanPlanning	LADOT: "Here's .6 miles of unprotected bike lanes on a 6 lane stroad. It only cost $8.3mil. You're welcome."

Reddit user' comment

Appendix 20

Subreddit	Comment
r/Sustainability	I'd probably add that whilst this shows a great amount of plants, ideally you'd want natives not just rows of introduced flower species. A wide range of native plants and reducing grass density for rock features or native ground cover to reduce your water usage is the way. Sustainability should focus on providing habitat and pollination vectors, aswell as food, while promoting propogagation of flora and fauna native to the geographical location to stop select plants and species taking footholds and destroying or outcompeting natives. There's also nothing particularly sustainable about huge watering or fertiliser demands or the repercussions of maintaining them.

Reddit user' comment

Appendix 21

Subreddit	Comment
r/UrbanDesign	It's excellent that you mentioned Finland as an example, because Finland is actually one of the best places for winter biking in the entire world. Finland found that temperatures and snowfall each had almost no effect on biking whatsoever. What did make a difference was the presence of separated bike paths, and the frequency of snow clearing by the city.

Reddit user' comment

Appendix 22

Subreddit	Comment
r/IOT	I've made this enhanced weather station a while ago and I thought you guys might like it. More details and instructions on how to build your own here: https://hackaday.io/project/185377-solar-powered-air-quality-monitoring-station-iot

Reddit user' comment