

Perceptions, motivators and barriers of using city management applications among citizens: a focus group approach

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Abstract

Purpose – The purpose of this paper is to understand citizens' perceptions of smartphone-based city management apps and to identify facilitators and barriers that influence app adoption and use. An aim is to identify how current technology adoption theories might be expanded and enriched for studying citizen adoption of city apps in the US.

Design/methodology/approach – This paper presents a qualitative exploratory case study of citizen perceptions of city management apps in Tallahassee, a top-ranked digital city in the southeastern United States. The authors derive empirical data from focus group discussions with citizens using thematic analysis.

Findings – Overall, the findings suggest that city management apps are primarily perceived and used by citizens as handy and efficient tools for the provision of information and public services. The findings suggest that current technology adoption and use models applied to citizen adoption of m-government may benefit by being expanded for the US context.

Originality/value – This paper highlights what factors of m-government technology are effective, useful or inhibiting in citizens' lives from the perspective of a group of citizens in the southeastern US. Implications that might be learned for researchers and practitioners are discussed.

Keywords Mobile communication, E-Government, User generated content system, Service innovation, E-service, Service operation and management

Paper type Research paper

1. Introduction

Over the past two decades, the rapidly increasing trends of population growth and urbanization have raised problems that challenge urban sustainability around the world. In this context, governments of leading cities in Europe, the United States and Asia have begun to adopt a variety of “smart city” initiatives and smart technologies to facilitate urban transformation and sustainable socio-economic growth (e.g. Harrison and Donnelly, 2011; Lee *et al.*, 2014). An emerging technological paradigm that smart cities are adopting is e-government, where various urban domains and citizens are connected through the massive deployment of information communication technologies (ICTs). E-government is defined as



the production and delivery of government services through information technology, and the term encompasses the way information technologies are used to simplify and improve transactions between governments and other actors (Sprecher, 2000). M-government is a subcategory of e-government that is emerging as a new solution for accessing government information via mobile devices (Liu *et al.*, 2014).

In this paper, we focus on one smart city ICT for m-government: the mobile applications (apps) for city management (*thereafter* city apps). City apps are citizen-oriented municipal government programs or software that are designed to run on mobile phones which are accessible to anyone who seeks to use government services (Ganapati, 2015). In recent years, municipalities began adopting city apps as a major component of their smart city initiatives to foster real-time engagement for public service delivery (Ganapati, 2015; Pak *et al.*, 2017; Tang *et al.*, 2019).

We explore city app use in Tallahassee, Florida, a southeastern US city that serves as an extreme case for app adoption and is interestingly situated in a hurricane-prone area. We argue that it serves as a best-case scenario because Tallahassee has a population that is relatively young, well-educated and well-connected to online providers. It is a city where a high percentage of the population favors new ICTs. If some barriers are found in this best-case scenario, we can expect that they are very likely to appear in other cities which do not have such an ideal environment for app adoption and m-government. Thus, our findings can have broad implications for many US cities that have adopted or are considering adopting these apps.

We examine what drives or hinders adoption and use. While city apps are an emerging trend to improve city connectivity and empower communities to tackle new challenges of urbanization, they have not been subject to significant scholarly investigation. We contribute to the m-government adoption literature by being among the first to listen to citizens and gain a perspective on what they think about the city apps that smart cities are deploying. This study aims to fill this gap by addressing two questions:

RQ1. What are citizens' perceptions of smart city apps?

RQ2. What are the facilitators and barriers for citizens to adopt and use smart city apps?

Our study hosts both theoretical and practical significance. From a theoretical perspective, it highlights the ways current theories testing citizen adoption of m-government can be extended for the US context by providing insights into new or understudied variables and constructs. From a practitioner perspective, our findings can be useful for decision-makers responsible for encouraging citizens to download and use city apps in the US, such as government departments and individuals tasked with app design. The findings can suggest more context-relevant and actionable strategies to m-government practice.

2. Literature review: m-government and adoption of city apps

M-government is viewed as a sub-class of e-government that has given citizens more flexible access (e.g. via mobile devices) to their government's public services (Shareef *et al.*, 2012). There is limited research on user intention to use and adopt m-government technologies and even fewer studies that focus on government apps (for exceptions see Sharma *et al.*, 2018; Hu *et al.*, 2011; Park and Lee, 2018; Saxena, 2017, 2018). Most studies ask citizens about their intention to adopt m-government generally, and city apps remain understudied in the literature, especially in the US context.

There are several validated models for understanding user intention to adopt and use ICTs. In the information systems literature, popular models include the unified theory of acceptance and use of technology (UTAUT; Venkatesh *et al.*, 2003) and the technology acceptance model (TAM; Davis, 1989). In the technology diffusion literature, diffusion of

innovation (DOI) theory has been used to discuss technology adoption (Rogers, 1995). The decomposed theory of planned behavior (DTPB; Taylor and Todd, 1995) has been tested to uncover factors which predict individual adoption.

Traditional models were formulated to understand what leads to intention behavior around private sector ICTs, limiting their ability to predict citizen adoption of government ICTs. To address this issue, authors test new variables alongside traditional models (e.g. Naranjo Zolotov *et al.*, 2018) or develop new models, such as the unified model of electronic government adoption (UMEGA; Dwivedi *et al.*, 2017) and the e-government adoption model (GAM; Shareef *et al.*, 2011). In line with the e-government literature, studies find m-government adoption or use as being influenced by citizen's perceived security (Shareef *et al.*, 2012; Almaiah *et al.*, 2020) and trust (Mansoori *et al.*, 2018; Sharma *et al.*, 2018; Shareef *et al.*, 2011; Saxena, 2017). Commonly tested variables provided by these theories for understanding citizen adoption of m-government are provided in Table 1.

Three empirical studies focus on m-government adoption, use, or intention in the US Hu *et al.* (2011) study the factors that influence US field police officer intention to adopt m-government apps using constructs from TAM and UTAUT, finding that perceived usefulness was a strong predictor of adoption intention. However, unlike other m-government studies, their findings did not support perceived ease-of-use (Shareef *et al.*, 2016a, b; Liu *et al.*, 2014; Abu-Shanab and Haider, 2015; Saxena, 2017) or facilitating conditions (Sharma *et al.*, 2018; Hobolo and Mawela, 2017) as drivers for intention behaviors. Reddick (2016) finds that American citizen intention to adopt was predicted by cellphone use and social factors in the US. However, demographic factors were not highly correlated with m-government adoption unlike in other studies (e.g. Hobolo and Mawela, 2017). Shareef *et al.* (2016a) find that perceived usefulness, perceived security and perceived compatibility positively predict intention toward m-government apps. Their significant results around perceived ease-of-use contradict Hu *et al.* (2011) in the US context.

Variable name	Description	Adapted from
Perceived security/perceived risk	User perceptions that their information will not be wrongfully distributed or intercepted and that the technology includes necessary protections against user abuse	GAM, UMEGA
Perceived trust	The degree to which transactions and use are perceived to be safe, private, reliable and secure and that services are credible, trustworthy and satisfactory	GAM, UMEGA
Perceived usefulness	The degree to which a user believes that using a technology will satisfy their needs	DTPB, TAM, UTAUT
Relative advantage	The degree to which a technology is perceived to provide benefits better than its precursor, including economic benefits, image enhancement, convenience, or satisfaction	DOI
Perceived ease-of-use/effort expectancy/self-efficacy	The degree to which an individual expects using a technology will be free of effort	DOI, DTPB, GAM, TAM, UMEGA, UTAUT
Facilitating conditions/availability of resources	The extent to which an individual perceives there to be organizational and technical infrastructure to support the technology of interest	DTPB, GAM, UMEGA, UTAUT
Perceived compatibility	The degree to which a user perceives a technology aligns with their behavioral, social and psychological beliefs	DOI, GAM

Table 1.
Commonly tested variables in the citizen adoption of m-government

Given city app novelty, current adoption models may not be considering important drivers or barriers to app adoption. The notion that city apps can benefit a user compared to traditional ways of receiving government services, meaning apps provide a relative advantage, may facilitate adoption and use. Relative advantage is the extent to which an innovation is improved or perceived better compared to prior ones and is theorized to lead to greater adoption (Rogers, 1995), yet is rarely measured in current m-government adoption studies (an exception is Shareef *et al.*, 2012). Another consideration is that citizen motivations for using the reporting function may affect adoption. For example, reciprocal altruism (Trivers, 1971) is when altruistic behavior is performed in expectation of repayment. Some citizens may use apps to enhance their communities, simply because such action is compatible with their personal values, while others may need something in return. Perceived responsiveness is the degree an individual perceives services are reliable 24/7 and that communications will be responded to quickly and satisfactorily. Responsiveness may increase government transparency. Transparency relates to open access to government information and may be important for facilitating trust in government. Additionally, special attention may need to be paid to situational factors that drive citizen use of city apps, such as how disaster-prone an area is (Xu and Tang, 2020).

More than 590 US cities have adopted apps (Ganapati, 2015). However, cities face issues related to low citizen awareness, adoption and usage (Pak *et al.*, 2017). While there are studies of intention to adopt e-government technologies in the US (e.g. Bélanger and Carter, 2009) there is limited literature on US m-government adoption. Importantly, m-government technologies are made for and run by a specific local government. The government takes responsibility for its operations, affordances and communications. The adoption decisions, including barriers and drivers, are driven, to a large extent, by factors beyond the individual level. In other words, factors related to government characteristics, local situations, citizen and resident characteristics, neighborhood and community features, and other contextual considerations are highly important; they are inextricably linked with adoption decisions and practices. Therefore, it is important that we obtain a thorough understanding of the context, including government characteristics and local situations. Previous work has rarely formulated these complex and intertwined factors in empirical tests, and some of the existing findings have been largely inconsistent. Against these considerations, we take a qualitative approach, which has the advantage of gaining a deep understanding of the specific context. Furthermore, a qualitative approach could provide us with insights that can be used to improve the technology (George and Bennett, 2005).

3. Methods

This study took place in Tallahassee, Florida, the 7th largest city in Florida and the 131st largest city in the US, with an estimated population of 194,000 (US Census Bureau, 2019). In 2007, the city began emphasizing technology for public service delivery in response to the Great Recession, making Tallahassee one of the first American medium-sized cities in the smart city movement. In 2013, Tallahassee launched its own city app, DigiTally, which has had over 71,500 downloads so far and approximately 6,000 active monthly users by 2017. Tallahassee was one of the top-ranked digital cities in the US for being a pioneer in employing emerging technologies in its governments (Center for Digital Government, 2015). As a college town and the capital city of Florida, Tallahassee is well connected digitally and 85.9% of households have Internet access. Thus, Tallahassee can serve as a best-case scenario for app-facilitated management due to the city's relatively young and well-educated population and digitally progressive government. This site provided the opportunity to study varied perspectives from citizens at different stages in the app adoption process.

The study obtained human subjects approval from the Institutional Review Board. Data collection consisted of background questionnaires and focus groups. Five citizen focus

groups were conducted in different communities within Tallahassee from March to May in 2017. We used a purposive sampling method to recruit via email and a subject pool system. To participate, citizens had to be at least 18 years of age, English speaking, living in the study city and own or have owned a smartphone. To gain a holistic view on app adoption, both citizens with and without prior knowledge or usage of city apps were included. Recruitment was based on data saturation when no new themes related to our research questions emerged from group discussions. To achieve thematic saturation, we recruited homogenous groups from Tallahassee's four city quadrants and focus groups were conducted until no new themes related to our research questions emerged from group discussions.

The final sample consisted of 35 citizens – 17 females and 18 males with age ranging from 20 to 68 years ($M = 37.1$, $SD = 14.8$). Participants self-identified as Caucasian ($n = 17$, 46%), African American ($n = 8$, 22.9%), Latino and Latino mixed ethnicity ($n = 5$, 14.3%) and Asian/Pacific Islanders ($n = 5$, 14.3%). Education level ranged from high school graduate ($n = 4$, 11.4%) to Master's degree ($n = 5$, 14.3%). Participants reported living in the city between 1 and 46 years ($M = 13.6$, $SD = 15.4$), with 51.4% ($n = 18$) identifying themselves as homeowners. Household income covered all brackets from less than 10,000 ($n = 2$, 5.7%) to 150,000 and more ($n = 2$, 5.7%). Median household income fell between \$50,000 and \$59,999. Table 2 compares the focus groups with the city population of which this study took place.

After consenting, citizens completed a brief questionnaire on demographics and app usage. Next, they took part in 60 to 90-min-long focus groups. Prior to discussion, they were shown trigger materials that included example screenshots of city apps from different three municipalities (the DigiTally, AskElkGrove and MyColumbUS apps). The screenshots presented interfaces of the main menus that show a list of the app functions, as well as examples of how app interfaces look when submitting service requests and finding information about trash collection, traffic, city buses, parking, municipal news and notifications, events sign up and tourism. Citizens were compensated \$20 for study participation.

3.1 Focus groups

Focus groups were conducted at locations throughout the city, including the university campus, community centers and non-profit agencies. To get a depth of knowledge from

	Focus group	Total population (U.S. Census Bureau, 2016)
<i>Gender</i>		
Male	51.4%	47.3%
Female	48.6%	52.7%
<i>Race</i>		
White	46%	51.8%
African American	22.9%	34.8%
Latino and Latino mixed	14.3%	6.9%
Asian/Pacific Islanders	14.3%	4.1%
<i>Age</i>		
20–34	57.1%	46.8%
35–44	11.4%	12.0%
45–54	11.4%	10.4%
55–74	20.1%	17.1%
<i>Education</i> (high school graduate +)	100%	92.6%
Median household income	Income group: \$50,000–\$59,999	\$50,654

Table 2.
Comparison between
the focus group sample
and the city population

homogenous groups, we chose to assign participants to focus groups based on the location of the city by which they reside. Tallahassee consists of four key quadrants: northeast (includes downtown), southeast, northwest and southwest. We recruited from and held a focus group in one of the biggest suburban areas in the southeast quadrant and one in downtown Tallahassee for the northeast quadrant. Two focus groups were held at the main university campus in the northwest, which included students and government employee participants, as they account for a large percentage of the population in Tallahassee. Another focus group was held at a community room in the southwest, where most low-income and minority citizens reside. Every quadrant of the city had at least one focus group of respondents of a similar characteristic. The focus group method utilizes group discussion to solicit ideas about a concept or product (Morgan *et al.*, 1998); participants interact with new technologies, articulate their opinions and feed off each other's perspectives. This can encourage deeper reflection about a topic and provide researchers with insights that can be used to understand and improve the technology (Lindlof and Taylor, 2017).

A trained moderator (male) conducted focus groups following a semi-structured discussion guide (see Appendix). After an introduction about the purpose of the study, trigger materials were presented to educate citizens with no prior app usage and enlighten others about the wide variety of city apps. Citizens were asked about their perceptions and attitudes toward city apps and various app features. They were also directed to discuss reasons for liking or disliking apps and app features and circumstances that would lead to app adoption and continued or discontinued use. Citizens who have used city apps were asked to describe their own experiences of app use. The semi-structured discussion guide was designed such that the questions were sufficiently broad to allow for open conversation, deviation and extensive discussion to facilitate the generation of rich perspectives. The moderator directly asked respondents in all focus groups to discuss two key topics: (1) the greater good influencing their decision to download and use a city app and (2) whether city apps would change the way they reached out to their local governments. Other topics were brought in by the moderator only if they had not been touched on prior in the focus group.

3.2 Data analysis

Survey data were analyzed using descriptive statistics. Data from focus groups were audio recorded, transcribed verbatim and analyzed using inductive thematic analysis (Braun and Clarke, 2006) and an open-coding approach which allowed themes to emerge that illuminate the key aims of this study: (1) to understand how citizens in the US perceive city apps; and (2) to understand the facilitators and barriers in the app adoption and use process. The data analysis process involved repeated rounds of reading and coding of data and developing and refining thematic categories with each round that are conceptually related to the research questions. Here we include quotes from the clean transcript report to present the fundamental meaning of what was said, eliminating repetition and fillers, to provide a clearer account of the answers provided.

4. Findings

In the sample, only 13 (37.1%) had used city apps, ranging in usage duration from 1 month to 4 years. Overall, citizens were not familiar with the smart city concept, but many ventured guesses that a smart city "is more advanced in technology" (Female (F) 12, Focus Group (FG) 2). After the trigger materials, citizens unanimously expressed a favorable attitude toward the idea of the smart city and were positive about city apps in improving citizens' lives and communities. Across focus group participants, we identify the following themes (as summarized in Table 3) on citizen perception of city apps and the factors that facilitate the adoption of these apps.

4.1 Perceptions of smart city apps

4.1.1 Perceived advantageous affordance of smartphone apps. Among the app features introduced in the trigger materials, citizens rated service request, events calendar, utility bill payment and emergency-management information as particularly useful, and many considered at least one to be a reason to adopt the app. The overwhelming majority of the participants believed that apps held a relative advantage over to traditional means. For example, the service request tool was the most liked feature among participants. They explained that the photo-taking function of smartphone apps allows citizens to communicate faster, more detailed and accurate messages.

We had a neighbor that piled multiple items of garbage and recycling out in front of their home right by the stop sign. We had to call the city because, after almost getting hit three or four times, nobody was picking anything up. But, if we could have clicked a picture and sent it to the city, it would have taken couple of minutes maybe versus two or three phone calls and getting transferred (F15, FG3).

In some situations, such as reporting crimes to the police, the photo-taking function could be extremely helpful. A participant told the story:

Last night, we had somebody that took out our neighbor's whole entire front fence at about 2 a.m. Reporting a crime, I guess in this case, would have been to do a screenshot or something of the vehicle that was actually committing the crime before they were gone and have that to submit for the police (F15, FG3).

Overarching Categories	Level 1 Subcategories	Level 2 Subcategories	Freq	% Of participants
Perception of smart city apps	Perceived advantageous affordance of city apps	Service request function (especially power outage reporting in hurricanes)	25	71%
		Utility bill payment	14	40%
		Emergency preparedness and response information	10	29%
		Events calendar	8	23%
		Government responsiveness and transparency	16	46%
	Privacy and data security	16	46%	
Facilitator/barriers of app adoption and use	Greater good for community and recognition		15	42.8%
	Community and neighborhood connection		21	60%
	Personalization	Being able to customize the app (such as push notifications) to serve a citizen's specific needs	20	57%
	Digital divide	Citizens do not have smartphones or have technology/language barriers (esp. aging population)	19	54%
	Storage space taken up by the app		15	42.8%

Table 3.
Code Frame and Node
Frequency

Note(s): (1) The frequency is calculated as the number of focus group participants who mentioned a specific theme. (2) % of participants = # of participants who mentioned a specific node/35 (i.e. total # of participants). (3) Nodes with a frequency of less than 20% are not reported here

Consistent with the industry claim that city apps can efficiently streamline workflow management and service delivery, some participants who used the app found increased operational efficiency of services. One participant used the app to report water leaking in his neighborhood and was surprised that the request got resolved much faster than expected, highlighting the importance of perceived responsiveness of the city app.

I was pleasantly surprised. Not only did it work, but it was way faster than I thought. I thought, okay, I will go back on here in a week, and I will see that they finally looked at it and then maybe in another week they will have considered addressing it. Then, maybe in another week they will have actually addressed it. For me, that would have been the way to go. I am glad that I used the app and it worked. It was in a day or two. It said “reviewed”, and then a day or two later it was fixed (M21, FG3).

As our study site is in a Hurricane/storm-prone area, another commonly shared perception was that app features related to emergency management, Hurricane preparedness, and power outage reporting and tracking are salient motivators for app adoption.

I think just being able to communicate with the city when there is a storm, Hurricane, or something like that. I think that would be a useful feature (F3, FG1).

Some participants felt apps can be especially effective communication platforms during city-wide emergencies, which may be partly because many people have their phones on 24/7, as one participant explained:

You know [the university] has the alert system. If there is something going on, [such as] when there was an active shooter incident or when we had weather, my phone would ring at 2 o'clock telling me there is a thunderstorm. It helps to know. I think if the city did have something like that, it would be beneficial (F15, FG3).

Another common advantageous affordance of a city app was its convenience and inclusiveness. Although alternative city communication channels are available, citizens considered apps to outperform others by affording more interaction with the city with reduced cost.

Before [the app] I was using the website. So, I guess it helps convenience-wise. . .that's what I do because it's in my pocket. I do not open the laptop to do it (M13, FG2).

Another participant shared this perception:

I need something to get access to the website, but it would so much more convenient to use a service like an app (F3, FG1).

Several participants suggested a benefit is that it offers an inclusive “one-stop-shop” of a full array of city affairs rather than specializing to one or a few features. One participant explained:

I can remember when you had to go to [a city] building and pay your bill or drop it in the mail. For a while, they've had the convenience of online bill pay and now they're making an effort to move towards more convenient ways related to utilities. . .I do think that [the city] is an ideal place to implement a lot of these things. It just makes things more available to the community. There's no hub. And I think if [the city] had a hub and utilized what a lot of other places have done, then we can benefit as a community (F15, FG3).

In sum, well-liked features included service request, events calendar, utility bill payment, emergency management and the app being a convenient “one-stop-shop” to information and services. Some participants reported time savings, reduced costs and increased efficiency in public services through the app.

4.1.2 Government responsiveness and transparency. Since city apps are managed by the government, citizens also identified government responsiveness and transparency as

important features. Across groups, participants expressed a shared desire to receive feedback and updates on the requests they submitted.

When you report a problem, they should communicate back to you. And that's a plus. I mean, you're getting feedback. Maybe it's going to take two weeks, but if they reply and tell you "we are going to get on it". That's good feedback (M28, FG4).

Some said being able to receive responses from service providers played a strong role in choosing the app over other channels, such as phone calls, email and mail:

I also can track my own issue that I reported, because when you call and report it to the city, a lot of times you do not get a call back (F1, FG1).

Some reported that such updates would lead them to choose the app over other channels. Others thought the transparency afforded by the app could help improve process transparency, government responsiveness and service delivery efficiency. Effective feedback also made participants feel that their voice is being heard, thereby increasing their trust in the government:

I think that increases trust in the government if the citizens know that their voice has been heard and their opinion has been heard. That increases that trust (F1, FG1).

Some citizens said that being able to view fellow citizens' requests would be a valued public service.

When I used it, I thought it was interesting that I can see other people's requests and I really like that because there were things going on near me that I did not know about. Like some other [person] reported that they saw a drug dealer around where I lived, and I thought, for me, someone who's living there, it's nice to know to maybe avoid that area (F1, FG1).

Others felt that there should be platforms in place to hold the government accountable to respond to the requests on city apps. When the problems reported and actions taken in response by government are visible to the public, it becomes possible that citizens can act to influence the government.

I think that will increase the liability to the city and it would require a retooling of their response to incidents. Because if you did have something like a pothole, and someone posted it a week ago, and then I drive through and it knocks my car, then I can show that the city has known that for a week. I do not want to say it's a drawback because it would be a good thing to the citizens of that community, but it would definitely change how the city had to respond (M7, FG2).

4.1.3 Privacy, data security and trust in government. While the majority of the participants gave thoughts to the privacy and data security issues associated with city apps (e.g. "privacy and tracking is always a concern," M24, FG4), opinions split on the levels to which they trust the government in handling the app. A few participants were minimally concerned and justified that the app was perceived as trustworthy because it was run by the government:

I perceive it as credible because it's the city. I trust what they are telling you because it is coming from the city. As for security, I would not have any security concerns (F1, FG1).

Conversely, some citizens reported that they did not want any form of government to have access to their phones, fearing government spying and invasion of privacy:

How many apps do you download to your phone that if you read the fine print, it [says] it's going to have access to your contacts, it is going to have access to your email, to voice settings, etc. You do not want to do that with the government. I would not even feel comfortable (M7, FG 2).

Citizens also referenced hacking incidents that have happened to other apps, and one felt it could be worse for city apps:

If that happened to a city app, I can imagine that would cause even more problems with the city itself being liable for some things (M36, FG5).

One participant perceived government as lacking the controls in place to keep data secure:

That was one of my big concerns. I mean, we live in an NSA world. . . Everything is constantly being collected and it never disappears. So, it's stored somewhere, and someone will have access to it. If someone wanted to use it against you for something, they could, or be hacked into and someone can use that against you (M33, FG5).

Another participant implied that the level of trust in city apps depends on a city's facilitating conditions, such as its resources and capability to manage data. He was more likely to trust an app run by a large municipality because he thought bigger cities have the means to develop better apps.

I feel like smaller cities are more difficult to trust, like their apps and websites, because I notice they do not have as much funding as a large city probably. So, cities like Miami, Orlando, places like that, I would trust their apps a little bit more considering they have more feedback, they have more views, opinions, and more funding, that's probably the most important aspect of it, but a small city, I probably would not trust that much (F12, FG2).

Some participants attributed generational differences to the trust issue, suggesting that the younger population felt more comfortable with providing personal and financial information on an app than the senior population. For example:

It could be an issue for other groups of people, but not for the younger population, we understand what having an app means and kind of what the risks are. I do not think it's something we're going to be concerned about (F3, FG1).

My husband would not be putting payment information in an app. He would be like, "Nope! Not going to happen. I'd rather send a check. I'd rather drive down there and give cash. I am not putting my credit card information in my phone." He will be 37 this year. (F5, FG1)

I am 27 years old. I use the Chick-fil-A app. So, I put my credit card information. I've never considered that an issue (F1, FG1).

Some participants suggested measures to be taken to protect their online privacy, such as making their identity unknown to others or to the government:

For me, I do not want them to be big brother, I want the app to be anonymous with my communications (M10, FG 4).

I also wanted to make anonymous comments on things. I do not want my name stamp on everything (M6, FG1).

There was wide variation in concern, with some stemming from differing levels of trust in governments and other groups attributing this variation to age. An anonymity option was desired by some.

4.1.4 Greater good for community and recognition. In the discussions of using apps to report issues, the moderator asked each focus group whether they would report for the benefit of others rather than only for their own personal interests. Some participants expressed an intrinsic intention to contribute to the greater good of community and that the ability to do so was compatible with their values. They were willing to report to help others even if they would not benefit directly:

Moderator: To what extent does the greater good of community motivate you in downloading or using this app?

M28 (FG4): I am in the community good. It certainly would motivate me beyond just [using the app] for myself.

M25 (FG4): Still, I am the part of the community, so there is good for me.

F22 (FG4): Yes, I am the part of the community so there is something for me, too.

One participant even felt that being able to benefit others (and not just themselves) was key to the success of city apps:

I feel like when you have an app like this, it will only be successful if people were motivated enough in helping other people. I think I would try to report it for other people so they do not come across it and have to go through what I was going through with traffic or something (F34, FG5).

More participants valued the act of using the app for the greater good but felt that there must be personal benefit from app use.

I think that there needs to be a degree of stuff just for you (M6, FG1).

One participant implied that the altruistic behavior was more likely to occur toward members in related groups (e.g. one's own community) rather than toward members in unrelated groups (e.g. other communities), because there was a higher likelihood of the favor being returned.

If it was solely to benefit the city, probably unlikely, but for benefits to the community, it does not have to benefit me right then. If it's a group and I report a pothole, maybe somebody else will report a pothole that I have not hit yet. So yeah, I might go out of my way to report. Pay it forward (M25, FG4).

This notion aligns with the concept of reciprocal altruism (Trivers, 1971). Some participants agreed with the necessity of app use being mutual beneficial.

I kind of think of it as a mutually beneficial situation that I am reporting something that may help this person. In the future, maybe others will do that so I can avoid issues. I think it's not a matter of well, I'm not going to get anything out of this [app], but I want to help others. We're all selfish to a degree. If there was nothing that benefited you on it, then no, I would not download it (F1, FG1).

I do not think I would download this app just to offer help, but I think the value is that I also could get help (F4, FG1).

A minority of the participants doubted "the greater good" motivation and felt unlikely to use the app for the sake of benefiting others. One participant described that for the "greater good" mechanism to work, citizens' must be rewarded, such as through financial incentives.

To me, it's in human nature to act in your own self-interest and that's kind of the way our life works in the first place. You provide a service to somebody, not because you care how much they like it, but because they'll pay you for it. And so, maybe if there was some sort of reward you could get out of successfully reporting something? If you got something tangible like a discount off of your city utilities or something like that [like] if you consistently gave true reports or something like that (M32, FG5).

Some citizens supported the idea that there should be something to be gained. One participant felt the reward could be intangible, such as recognition or reputation. She discussed using another app, "Waze", where users report traffic issues to warn others of possible delays. She liked that others could see her report and "like" it. This implied that social recognition could be an incentive to motivate her to report in city apps.

Reporting [for the greater good], I do not know if everybody else has seen it but [on] the Waze app, people can like your reporting. And I like being recognized (F12, FG2).

In sum, some participants expressed that contributing to the greater good of their community would intrinsically motivate them to use the app and that this altruistic mindset would be the key to city app success. However, others felt that to be motivated to use the app to enhance their city, there would need to be a form of repayment, whether intangible (e.g. recognition) or tangible (e.g. financial incentives).

4.2 Facilitators and barriers of app adoption and use

The following section discusses four thematic categories of factors which participants acknowledged could facilitate or discourage city app adoption and use: (1) community relevance via neighborhood connection, (2) personal relevance via context-aware prompts, (3) device access and digital literacy and (4) storage space.

4.2.1 Community relevance and neighborhood connection. When asked what features they would like to see or would encourage their adoption, most participants mentioned that city apps could be a hub to facilitate connections to other residents. Some participants talked about how they joined online groups for community issues on Facebook or Twitter. One felt that the app could better serve that purpose.

Our neighborhood. . . has a Facebook page and it's a neat group that gets together a lot. So, if there is push notifications like on the app, then it would be nice [since] a lot of people probably do not check [the Facebook]. I always thought it was kind of nice (F23, FG4).

Participants across groups would like city apps to keep them updated with community issues and events.

I think news notifications, events, and activities that sort of stuff. They [city apps] try to communicate with residents. It's way more convenient (M6, FG1).

I think that as far as the aspect of it being a way to know what is happening in the community outside of trash and garbage and electric, something like that would be very beneficial (F15, FG3).

The neighborhood discussion forums the citizens mentioned are similar to groups on Facebook that also provide information about city management and services. There was consensus that this social nature of city apps could help them be downloaded *in lieu* of similar apps.

4.2.2 Personal relevance via context-aware prompts (or Nuisance). Another uniform belief across groups was that being able to tailor the app to a citizen's own needs would promote app adoption and use.

If you can click things on and off to make it kind of your own, I would find it more useful (F5, FG1).

One citizen suggested that the app could be useful if it tracked and stored her driving routes so that highly personalized alerts would be pushed to her:

If they would have pushed the information to us that there were streets closed downtown, we would know something we never would have checked (M23, FG4).

Participants expressed a desire to be able to personalize what push notifications to be received and when to receive them.

As long as I have the ability to select what type of notifications I receive, it's great, I love it. Also, if there is a possibility to pause for a day, week, month, the ability to pause receiving those notifications. I do not want to know every single thing that happens in the city but like entertainment, I would like to receive entertainment. I would receive traffic. So, it is about the ability to choose (M25, FG4).

Conversely, a shared attitude was discomfort with a high volume of irrelevant messages, notifications, or alerts, which many considered as "annoying" or "nagging". Some participants

complained that one of the main conditions that could lead them to delete the app is when it keeps sending messages that they are not interested in at all.

4.2.3 Device access and digital literacy skills. In discussing potential obstacles to adoption and use, some older participants brought up concerns for citizens who do not possess smartphone devices or the necessary digital literacy skills. This was a concern particularly for the senior population, a group seen by participants to be able to benefit greatly from an app's features but would need a user-friendly interface and opportunities for hands-on assistance to learn digital literacy skills.

Overall, it's a beneficial idea but as we said about the aging population, the older crowd does not have smartphones. They want to keep it simple with flip phones. I know we are looking forward technology-wise but it's not user friendly for them obviously because they do not have that kind of technology, but it seems like a lot of services would involve them, like transporting, utilities for older [people], more so like the grandparents (P13, FG2).

I think it is the fact that most people need hands-on [assistance] and do not have the capability to download the app. I think that you are missing a whole group of people. You are missing senior citizens who cannot download [the app] and cannot follow the directions (P18, FG3).

One participant suggested using video demonstration to remedy this lack of digital literacy.

They [The city] should create some use-case videos. They should just have somebody sitting in front of a camera, and they should show them downloading the app, submitting a picture for a service request (M21, FG3).

The focus groups revealed concern about gaps in digital literacy, which may inhibit access to important information and services compared to traditional means. While only a couple of participants mentioned a cultural or language gap being a problem, most people who shared the digital divide concern were worried about elderly citizens. Participants suggested user-friendly interfaces and opportunities to learn digital literacy skills, suggesting ease-of-use is important to consider.

4.2.4 Storage space used by apps. Interestingly, we found a factor affecting app adoption and use emerge in the discussion that has not received much attention in prior theories or literature: the amount of space taken up by an app. Several participants were conscious about the size of city apps given the limited amounts of memory on their phone. One participant best described this factor:

It depends on how much space it would take. And basically, if it is something I am not using regularly, I would not put it on my phone because of the amount of space it takes up (F18, FG2).

Participant descriptions on how they choose to use or discontinue use of apps imply the need for an application to be both regularly used and *very low burden* (e.g. small in size).

5. Discussion and conclusion

City apps are an emerging trend being used to improve city connectivity. Despite this, they have not been subject to significant scholarly investigation. We derived empirical data from focus group discussions with citizens using thematic analysis to understand citizen perceptions of smart city apps and what drives and hinders citizen adoption in the US context.

This study suggests that city apps are primarily perceived and used by citizens as handy and efficient tools for the provision of information and public services. Our findings are in line with studies that have found perceived usefulness, perceived compatibility, perceived security, facilitating conditions and perceived ease-of-use are drivers for app adoption and use of m-government. However, we find less studied concepts of relative advantage,

perceived responsiveness, message volume and trust in government, as well as the new concept of the storage space of apps, as being important for adoption and use in the US context.

Our findings suggest advantageous features lead city apps to be perceived as more convenient and useful than traditional means. This is in line with DOI theory suggesting relative advantage leads to greater adoption (Rogers, 1995). In addition, our findings around emergency management align with Susanto (2015) who asserts that situational factors may influence m-government adoption and usage. City apps may also improve perceptions of government accountability and transparency by allowing citizens to easily communicate with government, track requests and receive feedback, which may in turn increase trust in government. This suggests that perceived responsiveness may affect adoption through increasing trust in government and m-government technology. Our findings also suggest that the theory of reciprocal altruism may help explain how values can drive or hinder citizen adoption and use, and we suggest the technology adoption construct of perceived compatibility as plausibly appropriate for measuring such value-driven behavior.

In line with the prior literature, privacy and security issues are widely shared concerns toward media and communication channels that collect personal information (Radunovic, 2016). Our findings suggest citizen perceptions around security relate to fears of tracking, data breaches, government spying and invasion of privacy. Citizens hold varying levels of trust toward their local governments, which in turn affect their levels of trust in city apps in such dimensions as security of their personal information and their ability to retain confidentiality. Overall, citizens in our study perceived trust in m-government in three ways: trust in the technology, trust in the government handling of the technology and trust in government in general.

Participants felt digital literacy could be a facilitator or barrier to city app adoption and use. This finding supports Shareef *et al.* (2016a) who find a positive and significant relationship between perceived ease-of-use and behavioral intention. However, it contradicts Reddick (2016), who found that demographic factors associated with the digital divide, such as age, were not found to be highly correlated with m-government adoption in the US. Finally, our data suggests a barrier to app use that has not been documented in previous research: in the circumstance when users need to free up storage space of smartphones, our participants asserted that they tend to delete the apps that are large in size and are less frequently used. We believe the size factor also applies to city apps.

5.1 Implications for researchers

Our findings suggest that researchers should continue to model perceived usefulness, perceived compatibility, perceived security, facilitating conditions and perceived ease-of-use as is done in m-government literature. Scholars may benefit from expanding current models for the US to include more specific measures that gauge relative advantage, situational factors that focus on emergency management, perceived responsiveness, message volume and trust in government. Our results around digital literacy suggest that future work may benefit by considering age as a possible moderator in the relationship between perceived ease-of-use and citizen adoption. In addition, variables related to perceived security and trust are plausibly moderated by age.

Storage space was identified as a new construct not traditionally included in technology adoption models that researchers may want to consider. Existing theories can be extended by adding a construct related to the perceived burden of city apps. Alternatively, researchers may want to adapt existing measures of facilitating conditions (commonly used in DTPB, UTAUT, UMEGA and GAM) to understand the degree to which an individual perceives that their cellphone can support city app storage requirements.

5.2 Implications for practitioners

Given the strong feelings around advantageous affordance, practitioners can continue to make city apps hubs that connect to a multitude of services, while considering their storage burden. Governments may also benefit from giving apps functions that allow citizens to communicate with and receive information from the city in preparation for, during and in recovery from emergency events. Staying in touch with local government and with their local communities was identified as a key driver for app adoption and use.

Although we find that citizens enjoy the thought of city apps sending relevant information, such as updates on service delivery and emergency alerts, our findings suggest tailored messages sent at a low volume are more likely to lead to continued use than messages sent in large quantities. Our focus groups also suggest one strategy to encourage app adoption would be to recognize reporting efforts using tangible rewards, such as gift cards, and intangible rewards, such as by offering a “like” function for others to complement reporting.

We also find support for the notion that facilitating factors relative to the perception of a strong infrastructure around city apps can increase trust in the technology. This may include letting citizens know there is a dedicated budget around the app, that customer service is available 24/7, and what steps are being taken to handle citizen privacy and security of data (such as encryption). An option that would allow anonymity can allow citizens to associate city apps with lower risk, which may lead to increased willingness to adopt. A user-friendly interface, video demonstrations on use and opportunities to learn digital literacy skills may increase perceived ease-of-use and overcome barriers that stem from the US’s digital divide.

5.3 Limitations and future research

We acknowledge the limitations of our study. Being a qualitative exploratory study, our sample is not a representative sample in making statistical inference. Thus, it is possible that our findings may not be generalized to all city app users. The goal of our sampling method was to reach participants from different quadrants of the city to maximize diversity of participant background. We used different city quadrants because in Tallahassee (i.e. the study site), residents tend to have a similar demographic background (e.g. social economic status, professions) within a quadrant, but different background across quadrants. Yet, participants in each focus group may not be representative of all residents in that quadrant. Thus, it is possible that further topics would have arisen in the discussions if we had conducted more focus groups. Overall, we feel confident we were able to reach satisfactory saturation as we included focus groups of ideal size and participants from all the city quadrants. Recognizing these potential limitations, we offer reasons for why believe our study has a satisfactory level of data saturation throughout. The focus groups were led by a skilled moderator; groups were conducted until no new themes emerged, and they generated a richness of data. A second limitation is that the number of questions on the moderator guide may have shaped some discussions’ focus on the interests of the researchers rather than the participants, in particular, the greater good and government credibility in managing the app. We attempted to strike a balance where there was minimal control over the content while attempting to ensure relevant topics were covered in depth. All other topics arose in at least two focus groups without prompting which allowed us to obtain high quality data.

We hope our findings could inform future studies that develop quantifiable scales specifically for city apps’ uses and gratifications and test these scales using deductive methods (e.g. large-scale surveys) to gain more generalizable insights. Another potential research avenue is to combine citizens’ perspective with city apps’ backend user data and city documentation to suggest and test government or policy strategies that could potentially help overcome barriers in the city app adoption process. We believe as cities continue their quest to

become smarter, studies on the citizen adoption and use of city apps in the US will continue to be an opportune field of study.

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Appendix

Focus group discussion guide

Notes:

- (1) The moderator will ask the sub-questions under each general question if no one mentions this issue in the discussion. If someone mentions it, the moderator can follow up on this point.
- (2) *indicates examples of the points that we want to look for in this conversation.

Session 1. (smart city)

Show the background picture. (Talk about the notion of "smart city")

- (1) Please tell us what a smart city is in your mind.
 - Do you think Tallahassee is achieving the goal of "being a smart city"? In what aspects? If not, what are missing?

Session 2. (smart city technology)

Use the trigger materials to introduce examples of smart city apps and their features

- (2) How do you think/how do you feel about these?/What are your favorite features?
 - Is there anything about this you think would be useful for you?
 - Could you tell me about whether you would be interested in using it? Could you explain more about how and when you might use it?
 - What do you dislike about the app? What about any problems or concerns you can see with this?
 - Is there anything you would like to change about it? What else would you like it to do?

- Do you think “enabling interconnectivity within community and across-communities” is an important feature?
- (3) Would you be likely to download and try smart city apps? Why or why not? What factors (would) influence your decision to download and use this kind of app?
(If you already have city apps on your mobile devices, what influenced your decision to download)?
 - Do (would) you evaluate the credibility and ease-of-use of an app before you download it?
 - If someone in your network uses it (example, a friend, your neighbors), would you try?
 - If some city officials suggest it to you, would you try it?
 - *To be a better citizen of Tallahassee or learn about what’s going on about my city.
 - *To influence the services offered by Tallahassee, to improve public service, to contribute to your community/city.
 - *To connect with Tallahassee officials
 - *To connect with others from my neighborhood
 - How about the “appearance/design”?
- (4) After you try it, what would ensure your continued usage of this kind of app?
 - *Timely response to my request / information update

If you could improve something about an app, so as to continue using it. What would that be?
(For those who already have the app, in particular)

Session 3. (technology-based engagement)

- (5) How do you usually interact with the government about public policies, services and programs? What do you think is the best way to interact with government regarding public policy or public services?

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