A Comparison of Visual and Textual City Portal Designs on Desktop and Mobile Interfaces

Carolyn Pang, Carman Neustaedter, Jason Procyk, Bernhard E. Riecke

School of Interactive Arts & Technology, Simon Fraser University

ABSTRACT

Cities have recently begun to focus on how digital technology can better inform and engage people through an online presence containing web portals for desktop computers and mobile devices. Yet we do not know whether common user interface design strategies apply to government portal design given their vast repositories of information for citizens of varying ages. This mixed-methods study compares the usability of desktop and mobile interfaces for two types of city portals, textual and visual, using the System Usability Scale, a standardized usability questionnaire. Using a set of twelve tasks, we evaluated three usability aspects of two city portals: effectiveness, efficiency, and satisfaction. Our results suggest there was a main effect between textual and visual designs, with users rating the textual design on a mobile device higher than a visual design. From this, we suggest that responsive design may not be the best fit when designing city portals to be experienced for use on desktop and mobile devices.

Keywords: E-government, usability, design, user interfaces.

Index Terms: H.5.2 User Interfaces: User-centered design; H.5.3 Group and Organization Interfaces: Collaborative computing

1 INTRODUCTION

Many city websites in North America are dated and offer an overwhelming amount of information. Even with a search feature, this requires users to exert much effort on information-seeking tasks such as finding information about community recreation centres, parks, and paying taxes [14][30]. As the demand for online services increase, cities are struggling to keep pace with the changing technologies and expected user experience [4][9]. Studying the usability of city websites has seen a recent incline globally as researchers seek to understand the underuse of government sites within their countries [1][9][14][21][28].

For the past nineteen years, the Center for Digital Government (CDG) has annually recognized city portals in North America with 'Best of the Web and Digital Government Achievement Awards', based on innovation, functionality, productivity, and performance [13]. Sites are reviewed by an 'expert panel' who judges these qualities, rather than end users through a formal study or usability evaluation. Our own review of award-winning portals in 2011 [15], 2012 [14], 2013 [13], and 2014 [12] demonstrates that most portals housed similar content (e.g., city news, neighborhood information, parks and leisure, development, etc.) and online services (e.g., 311, pay for parking, pay property taxes, apply for a building permit, etc.). However, the design and layout of these city portals varied considerably, with some relying more on text, while others used visuals more extensively. This raised the question: Should government portals rely on visual or textual interface designs, and in what device situations (e.g., on computers and/or mobile devices)?

carolyn_pang@sfu.ca; carman@sfu.ca; jep4@sfu.ca; ber1@sfu.ca

As the use of mobile devices continue to increase, cities should consider how such portal designs are made available on both large and small screened-devices. There is certainly a wealth of user interface literature that explores how to design for the web and mobile devices [18][19], yet what is not clear is if and how this knowledge applies to government websites that are often information rich with large repositories of materials and services being posted for users. Instead, web design principles are typically presented as 'catch all' suggestions for web design in general [8]. Past research on government web design focused on uncovering usability challenges with government web portals where most rely on expert review or heuristic inspection rather than utilizing reactions from real end users (e.g., [1][9][28]). None have investigated the differences between visual and textual site designs, in particular when applied to interactions on mobile devices.

In this paper, we explore how users interact and experience different interfaces for city portals. Because desktop and mobile interfaces vary in content and layout, we wanted to determine whether users preferred desktop or mobile interfaces for two contrasting design paradigms, textual or visual. We began with a comparative assessment of fifty government portals in North America. Based on this assessment, we chose two representative examples that were also award-winning (as a means to test potential 'best cases'). We then evaluated their designs by having users complete a set of information-seeking, service-oriented, and community-focused tasks on both a desktop and mobile device. Users rated the designs using a standardized usability questionnaire and completed follow-up qualitative interviews.

Our results show that users preferred the more visual components on a desktop and cleaner, textual components on a mobile interface. We discuss the challenges users faced with completing tasks using the desktop interface and the responsive mobile interface, for both award-winning city portals. This includes concerns with the amount of information available to them via both interfaces, and the heavy expectation to scroll and navigate poorly defined groupings of information and tasks. Finally, we describe how our results suggest that responsive design—where images are resized and content is rearranged to fit screen sizes on varying devices—may not be the best solution when designing for an optimum user experience with government city portals. Instead, we suggest that city portals should be designed to consider how to surface information selectively to a user at a contextually-relevant time and place based on patterns of use and location. This would enable users to leverage desired information on desktop and mobile devices at the right time and place.

2 RELATED WORK

2.1 Government Portal Usability Testing

Studying the usability of government websites has seen a recent incline globally as researchers seek to understand the underuse of government sites within their countries. Al-Khalifa [1] studied fourteen Saudi government websites using a heuristic evaluation based on ISO 9241-151:2008 (Ergonomics of human-system interaction – Part 151: Guidance on World Wide Web user

interfaces) and Travis' 247 web usability guidelines. His findings note the importance of conducting usability testing with real users to understand key usability problems with their sites, a phase often overlooked by government organizations. Golubeva [9] evaluated eleven Russian government websites, revealing that the portals suffered from poor accessibility, navigability, and layout. In North America, Youngblood and Mackiewicz [28] completed a usability analysis of home pages for 129 city websites in Alabama, USA. Ten usability standards, such as providing a breadcrumb trail, linking the city logo to the homepage, or ensuring that no horizontal scrolling was required, were all evaluated. The authors found no correlation between usability and a municipality's population or per capita income. They also recommend usability benchmarks, such as leveraging W3C's validation services, building a usability-testing plan, and including users with disabilities, for government portals to help maintain and increase citizen access, satisfaction, and trust. While much prior work has identified the need for city portals to improve their usability, few studies have investigated the actual use of such portals by people. Our study extends previous work by taking a closer look at the usability of two award-winning North American government portals, based on actual user interactions and evaluation.

There is a small amount of notable work that explores government web design with end user involvement. Rosenthal [14] conducted a scenario-based usability study of the CivicInfo BC website from Canada, where users were asked to talk aloud as they completed their tasks. This study focused heavily on the Search feature of one particular government portal, where Rosenthal suggested a redesign of the search user interface to enable users to search for multiple types of information (e.g., document, organizations, careers) [14]. Our study expands on this by focusing on the overall structure, design, and navigation of a city portal while exploring a broader set of navigational features.

Al-Hassan et al. [1] suggest a framework for delivering personalized services to design with a citizen-centric approach. Specifically, such an approach would extend existing personalized services that require static customization to a more intelligent system that would automatically provide users with services relevant to their needs. Our study validates the need for personalized services by presenting users with an all-encompassing portal and understanding what features they like (and dislike), along with what information and services they currently access within their own government portal.

2.2 Location-Based System Design

One of the main findings from our study points to the need to surface contextually-relevant information within government portal design. As such, we reviewed systems that provide similar functionality for non-governmental services.

Mettouris and Papadopoulos [20] note that location-based systems provide users with the ability to produce and access information that is related to a location. The *Whereabouts Clock* was a location-based application that supported awareness of family members' current locations to contribute to a sense of identity as a family [7]. *Place-Its* provided location-based reminders for family members as they moved to various places throughout their day [27]. *CityFlocks* offered people the ability to stay informed and explore a new environment by accessing local residents' comments about a place within a city [5]. *Sindbad* enhanced traditional social networking services by offering location-aware news feed, location-aware recommender, and location-aware ranking [24]. Studies of these systems revealed that location-based reminders are useful, wherein location often provided indirect cues for other information. *GeoNotes* explored how location-based information systems created user experiences similar to that of post-its, graffiti, and public signs and posters and provided a channel to express one's views in public spaces [21].

3 Comparative Assessment of City Portals

As a basis for our user study, we wanted to understand what types of municipal government portal designs currently exist and what range of information and functionality are offered. To do this, we conducted a comprehensive review of fifty city portals from across North America. Our review consisted of looking at all of the main pages for each city's portal and interacting within each site on desktop computers and mobile devices. Twenty-four portals had been recognized as either a winner or a finalist of a Best of the Web and Digital Government Achievement Award between 2011 and 2014 [12][13][14][15]; the remaining 26 portals were sampled from major capital cities within North America, including New York City, Boston, Vancouver, and Toronto. Table 1 presents details of the comparative assessment.

Of the fifty city portals studied, 50% of the *award-winning* portals offered a responsive design (two had separate, mobile-friendly sites), while 58% of the *non-award-winning* portals offered a responsive design, resulting in 56% of cities offering mobile-friendly sites. 42% of the portals represented a ***visual design,*** which contained prominent visual images (including large background images). The remaining 48% of portals leveraged a ***textual design***, which we define as a site including textual links without thumbnail images. Upon taking a closer look at the information and functionality within the portals, 60% offered direct access to a compilation of online services, twenty-two offered the 311 service (a number citizens could call to obtain information and reach a non-emergency line), and 64% offered an open data catalogue. Nearly all (88%) displayed an events calendar on their home pages while 94% of the cities had a social media presence. Only 18% of the portals offered citizens the ability to personalize content and services to a user-created account.

Table 1: Comparative assessment of city portals.

	Award-Winning (*n*=24)	**Non-Award-Winning** (*n*=26)
Textual	10	13
Visual	14	11
Responsive Design	12	14
Access to 311	9	13
Open Data Catalogue	14	18
Events Calendar	24	20
Social Media	23	24
Personalized Portal	7	2

During this review, we also found that two distinct styles of design were being used: a top-down, government-centric view and a citizen-focused, task-centric view. In the case of the former, large amounts of information were being presented around governments' organizational structures and policies. In the latter, information was structured around citizen information and services, grouped according to tasks that were perceived to be common for citizens. The more recently designed sites were taking on the task-centric design paradigm, which suggests this is the design paradigm that most government portals will shift towards in the near future.

Next we describe our user study method and the government sites we selected to evaluate based on the above assessment.

4 User Study Method

The goal of our user study was to understand how desktop and mobile interfaces rated in effectiveness (e.g., task completion),

efficiency (e.g., effort for task completion), and satisfaction. Based on our comparative assessment, we selected two portals to study as representative samples of the majority of sites that we assessed: the City of Austin and the City of Los Angeles. These sites contained *visual* and *textual* designs, followed the 'trending' task-centric design, and supported the same features that were found to be most popular in our comparative assessment. This included the inclusion of a 311 service, an open data catalogue, an events calendar, and a social media presence on the portal itself. Both portals had also won awards from the Center for Digital Government as we wanted potential 'best cases' to evaluate.

The City of Austin, Texas represented a textual city portal in both desktop (T_D) (Figure 1) and mobile (T_M) interfaces (Figure 3a). The City of Los Angeles, California represented a visual city portal in both desktop (V_D) (Figure 2) and mobile (V_M) interfaces (Figure 3b). We chose portals for urban, metropolitan cities with large populations because they contained the most range of site functionality. Cities of a smaller size may include a subset of such features and may have less issue with information presentation.

To avoid potential bias, we did not disclose to participants that both city portals were recognized by CDG's Best of the Web and Digital Government Achievement Awards in 2013 [13].

4.1 Participants

The study was conducted with 44 participants (22 female) in a major urban center in Canada. Participants were recruited via snowball sampling, social media, and Craigslist and included 22 university students and 22 adults employed full-time between the ages of 19 and 58 (M = 33.46, SD = 11.94). All participants had basic knowledge of technology (23 participants owned an iPhone, 13 owned an Android phone, and 8 owned another type of smartphone). Participants' noted that they used both a desktop computer and a mobile device in their daily routines, with 13 participants owning an Android device, 23 owning an iPhone, and 8 owning another type of mobile phone (BlackBerry or Windows). Location-based services were also often used on a mobile device, with 22 participants noting that they had this feature turned on and 14 participants saying they used it for specific apps (e.g. directions, maps, Facebook).

4.2 Hypotheses

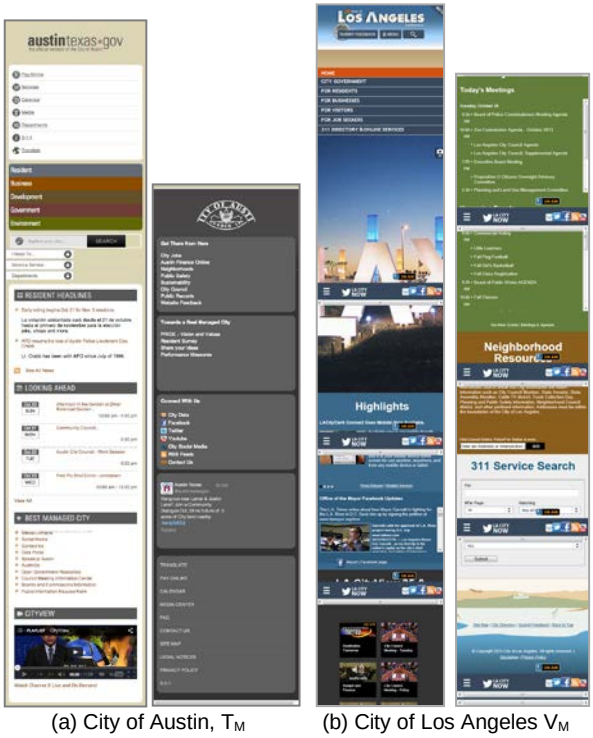
With typical screen resolutions set at or above 1280x1024 pixels and display dimensions of at least 15" across the diagonal, desktop computers provide the screen real estate that is often needed for users to navigate a website and search for information. Often times, users are stationary and have the time to scan text before deciding to click to another page. Clicks that lead to incorrect pages can easily be remedied with the Backspace button on a keyboard, or the Back button in a browser window. For this reason, we hypothesized that:

H1: Citizens will prefer a textual interface (T_D) over a visual interface (V_D) on a desktop device, resulting in higher scores in usability for a *textual* desktop interface compared to a *visual* desktop interface.

On the other hand, while on the go, users often turn to their mobile devices, typically set at lower screen resolutions (e.g., Apple's iPhone 4S is 960x640 pixels) and smaller screen sizes (less than 5" diagonal), to seek information. Often times, users are mobile and need to access information quickly. Screen real estate is much smaller and users can quickly scan images before deciding to click to another page, though the standard 'Back' button is not always readily in view. For this reason, we hypothesized that:

Figure 1: City of Austin's portal on a desktop computer, T_D

Figure 2: City of Los Angeles's portal on a desktop computer, V_D



(a) City of Austin, T_M (b) City of Los Angeles V_M

Figure 3: Mobile portals for each city

H2: Citizens will prefer a visual interface (V_M) over a textual interface (T_M) on a mobile device, resulting in higher scores in usability for a *visual* mobile interface compared to a *textual* mobile interface.

4.3 System Usability Scale

Our study used the System Usability Scale (SUS) to evaluate each of the web portals. SUS is a standardized, validated questionnaire used to evaluate effectiveness, efficiency, and user satisfaction after a participant has used a system but prior to a follow-up interview [3][6][25]. Though there exist alternative tools to assess a system's usability (e.g., Poststudy System Usability Questionnaire, Website Analysis and Measurement Inventory), the SUS questionnaire can be used to assess a range of interface technologies and is relatively quick and easy to use [3].

4.4 Procedure

This is a 2x2 factorial within-subjects study with four interfaces as independent variables: Textual Design on Desktop Interface (T_D), Textual Design on Mobile Interface (T_M), Visual Design on Desktop Interface (V_D), and Visual Design on Mobile Interface (V_M).

Twelve tasks were grouped into three categories and participants' SUS scores for each interface were dependent variables. The study involved participants performing a set of six tasks on each device. Basic task descriptions are shown in Table 2, where "D" denotes tasks performed on the desktop interfaces and "M" denotes tasks performed on the mobile interfaces.

Tasks were categorized into three groups—information-seeking tasks, service-oriented tasks, and community-focused tasks—to ensure fair distribution of similar tasks across both desktop and mobile interfaces. Information seeking tasks focused on users looking for specific information about their city's services, organization, and regulations (Table 2, Column 1). Service-oriented tasks involved users completing a series of online services (Table 2, Column 2). Community-focused tasks provided users with ways to become engaged within their community (Table 2, Column 3).

Table 2: Twelve tasks grouped into three categories: (1) Information-seeking, (2) Service-oriented, (3) Community-focused

	Information-Seeking Tasks	Service-Oriented Tasks	Community-Focused Tasks
D	Search for a job	Apply for a dog license	Report graffiti
D	Find city building codes	Pay property taxes	Volunteer for community service
M	Locate an elementary school	Pay a parking ticket	Search events on calendar
M	Find city officials (city council)	Apply for a filming permit	Find the City's Facebook page

Tasks were categorized into three groups to ensure fair distribution of similar tasks across both desktop and mobile interfaces. To mitigate confounding order effects, participants were randomly assigned to one of four groups to determine the order in which the government portals were presented (Table 3). We counterbalanced the order in which the portals were presented to mitigate confounding order effects by randomly assigning participants to one of four groups; each group had a pre-determined order in which the city portals were presented.

Table 3: Order in which interfaces were presented to each group (*n*=11) of participants

	Order			
Group	**1**	**2**	**3**	**4**
[1] *n*=11	T_D	V_D	T_M	V_M
[2] *n*=11	T_M	V_M	T_D	V_D
[3] *n*=11	V_D	T_D	V_M	T_M
[4] *n*=11	V_M	T_M	V_D	T_D

Participants completed two tasks from each category for each of the government portals. The same six tasks were used for both desktop interfaces and the same six tasks were used for both mobile interfaces. After each set of six tasks for each interface, participants completed an online questionnaire comprised of the ten questions in the SUS (Table 4) to provide their usability ratings for the interfaces [3][6][25]. We restricted participants from using the search functionality on any of the interfaces to ensure they moved through the portal using the main navigation and content structure.

Table 4: Ten questions of the System Usability Scale (SUS)

System Usability Scale (SUS)
1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Quantitative data included interval data from the SUS questionnaire based on a 7-point Likert scale (1-Strongly Disagree to 7-Strongly Agree). While the SUS is more commonly administered with a 5-point Likert scale, we used a 7-point scale to allow for a more fine-grained response. Note that both the 7- and 5-point scales have a clearly defined mid-point, as well as the same labels at the extreme values. After each set of six tasks for each interface, participants completed an online questionnaire comprised of the ten questions in the SUS to provide their usability ratings for the interfaces.

Additionally for each interface, following each SUS questionnaire, participants were asked to rate (on a scale of 0-10) their ability to find required information, complete their tasks, register for online services, and the overall usability for the portal.

Following the questionnaire, we asked participants open-ended questions surrounding their experiences using each interface. We asked about the features they liked and disliked in each site. We also explored participants' usage and experiences with their own city portals, asking them to describe how often they visited their government portal and the reasons for visiting. Basic demographic data was also collected to better understand the family structure and community involvement (newcomer to the city vs. vested, long-term resident). The study lasted between 40-90 minutes per participant.

4.5 Data and Statistical Analysis

SUS scores are single numbers (with a range of 0 to 100) that represent a measure of the overall usability of the interface. To calculate a SUS score, each of the ten questions' contributions was determined, which ranged from 0 to 6 [odd number questions' score contribution was the scale position minus 1 $(x_i - 1)$; even number questions' score contribution was 7 minus the scale position $(5 - x_i)$] [25]. To calculate the overall SUS score, we multiplied the sum of the score contributions by 1.666, resulting in an overall score range from 0 to 100. This was calculated for each of the four interfaces per participant.

Because the same participants were used to complete tasks for the SUS assessments of both city portals, a two-way, repeated measures ANOVA was used to determine whether there was a significant effect or interaction between interface type and device. Post-hoc t-tests were used to determine any significance between each of the four interfaces.

Qualitative data from our interviews was collected using handwritten notes. We analysed this data using a thematic analysis to draw out the rationale for the quantitative ratings, as well as the main concerns and benefits found for each portal. Representative participant quotes are included anonymously in our results with a participant number (P#).

5 Results

We first present our quantitative results to show participant usability ratings for each portal along with the results of our statistical testing. We follow this with details of our qualitative results which illustrate the reasons behind the usability ratings.

5.1 Quantitative Results

Median and mean System Usability Scale (SUS) scores were calculated for each interface and are summarized in Figure 4; Visual-Desktop (City of LA-Desktop) had the highest mean score and Visual-Mobile (City of LA-Mobile) had the lowest median and mean SUS scores (Table 5).

Table 5: Median and mean SUS scores for each design and interface

	Desktop	**Mobile**
Textual	*Median* = 50.83, *Mean* = 52.54, *SD* = 19.69	*Median* = 48.33, *Mean* = 47.54, *SD* = 22.42
Visual	*Median* = 57.50, *Mean* = 61.21, *SD* = 21.61	*Median* = 30.00, *Mean* = 33.41, *SD* = 18.93

While there was no significant main effect of design (textual vs. visual) on SUS usability scores, $F(1,43) = .61$, $p = .44$, $\eta_p^2 = .014$, there was a clear effect of interface, with the desktop interface yielding overall higher usability scores than the mobile interface, $F(1,43) = 52.42$, $p < .0001$, $\eta_p^2 = .549$. The effect size of $\eta_p^2 = .549$ is considered a large effect size and indicates that 55% of the variability in the data is accounted for by the interface factor. This main effect was qualified by a significant interaction between design type (TV) and interface (DM), $F(1,43) = 20.53$, $p < .0001$ $\eta_p^2 = .323$. As illustrated in Figure 4, this indicates that the influence of the interface on usability scores depended on the design. Switching from a textual to a visual design increased usability scores for the desktop interfaces, but it decreased usability scores for the mobile interface.

We conducted post-hoc tests with Tukey-HSD between all dependent variables to understand the interaction between design and interface (TV*DM). For the visual design, the desktop interface resulted in a higher usability score (61.21) compared to the mobile interface (33.41), $F(1,43) = 27.80$, $p < .0001$; $d = .48$.

Mean usability scores for the textual design on the desktop interface were higher when compared to the visual design on the mobile interface, T_D and V_M, $F(1,43) = 19.13$, $p = .0001$; $d = 0.30$. When comparing both the textual and visual designs on a mobile interface, usability scores for the textual design were higher, T_M and V_M, $F(1,43) = 14.13$, $p = .0088$; $d = 0.19$. Additionally, the visual design on a desktop interface received significantly higher usability scores when compared to the textual design on a mobile interface, V_D and T_M, $F(1,43) = 13.67$, $p = .0.012$; $d = 0.18$. All other comparisons were not significant.

As previously mentioned, the visual design on the desktop received higher usability scores compared to its mobile interface; however, there was no significant difference between the textual design on the desktop or mobile interface [T_D and T_M, $F(1,43) = 5.00$, $p = .067$], indicating that participants rated the textual design on either device quite similarly.

Participants' ratings following each SUS questionnaire for each interface were also analysed. Participants rated their ability to *find information*, to *complete their tasks*, to *register for online services*, and the portals' *overall usability* (Figure 5). Overall, these ratings mimicked the response pattern observed for the SUS scores. While there was no significant effect of design (textual vs. visual) for any of the four measures (all p's > .11), there were significant main effects of interface on all four measures (all p's < .001, all $\eta_p^2 > .48$) indicating overall higher scores for the desktop interface. This was qualified by significant interactions between design and interface (all p's < .001, all $\eta_p^2 > .25$), indicating that switching from a textual to a visual design tended to increase scores for the desktop interface and decrease scores for the mobile interface (Figure 5).

Our results did not support either of our hypotheses. For H1, we expected that citizens would prefer the textual interface (T_D) to a visual interface (V_D) on a desktop device; our results showed the opposite preference. For H2, we expected that citizens would prefer the visual interface (V_M) to a textual interface (T_M) on a mobile device, and again, our results showed the opposite. Next, we describe the results from our semi-structured interviews.

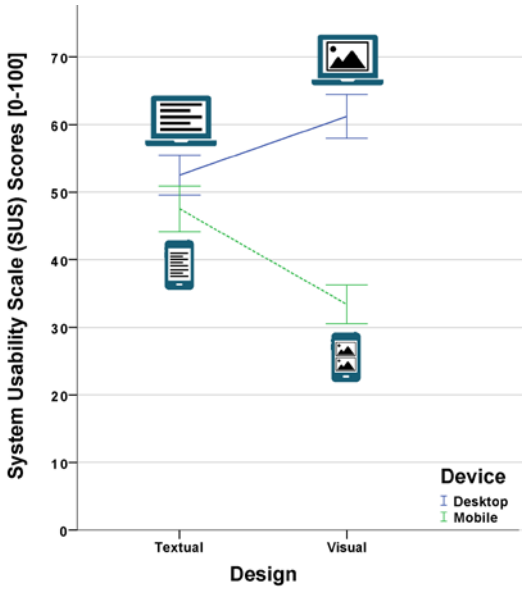


Figure 4: Plotted graph of mean SUS scores for each interface with standard error bars

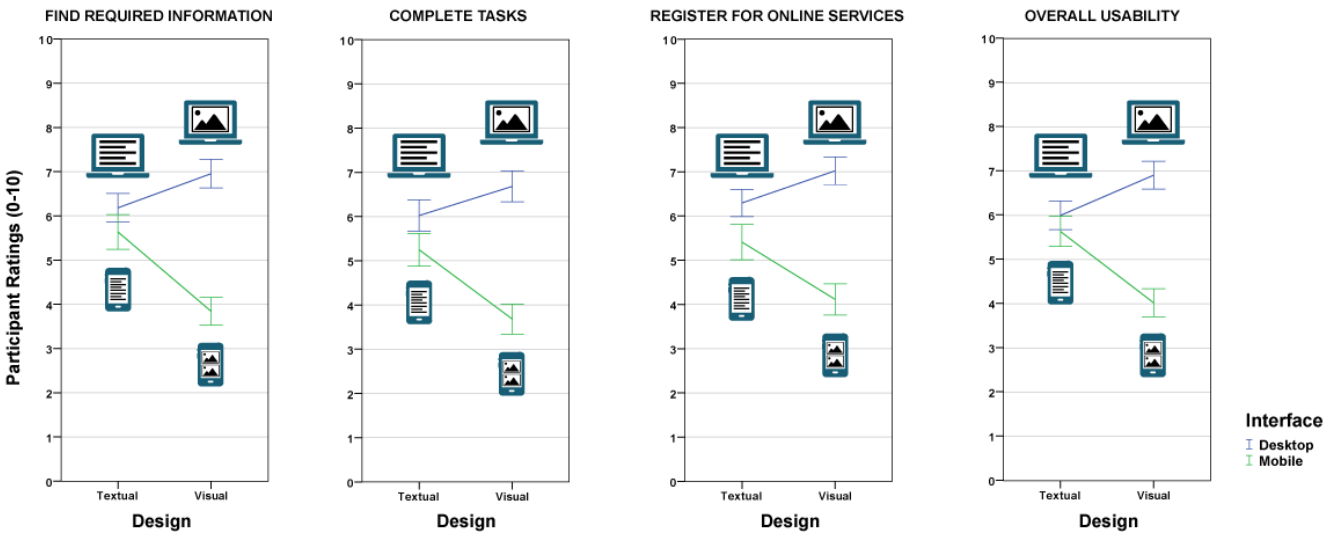


Figure 5: Mean scores for the four dependent measures. Error bars depict standard errors of the mean.

5.2 Qualitative Results

During the interviews, participants were asked to share their own experiences and expectations of their city portals. Participants also described impressions of each interface, and identified features they liked and disliked while navigating through the portals.

5.2.1 Current Use of Existing Government Portals

Participants' current use of their own government portal was fairly infrequent, with six participants noting they visited a few times a month, eight participants visited every few months, seventeen visited only a few times a year, and thirteen noting they visited infrequently or never.

> *I visit my site a few times a year...just to pay taxes, look up information about owning a dog and applying for permits for renos to my house.* – P19, Female, Age 57

However, despite the frequency of visits to the portal, many of the services and information they sought were similar. For example, participants would visit their government portal to pay for parking infractions, pay taxes, search for information about taxes annually, look up information about owning a dog, or apply for building permits for home renovations. Some participants noted that they would also search for upcoming events or volunteer opportunities within their city. Overall, it was described as a tedious process when using their government site.

5.2.2 Desktop Interfaces

Though participants consistently rated the visual design (City of LA) higher than the other interfaces, there were still mixed comments about it on a desktop computer. Participants noted that they appreciated the structure and navigation, making it easier to find information.

> *LA city had a special view to categorize functions under the role of the user to the city, such as a resident or a visitor. That to me is very unique, I've never seen this before.* – P12, Female, Age 21

However, participants also identified concerns with the amount of information presented within the portal, even when they interacted with it on a large screen.

> *The LA site…I was clicking on different areas and it wasn't taking me to where I thought I should be going. That was the frustrating part of the site. They were more streamlined with their navigation, but it didn't seem accurate as it brought me to the wrong places.* – P19, Female, Age 57

> *LA's was better than Austin's but it still wasn't easy to use. It was complex to the point where you feel overwhelmed with the amount information you have to wade through while your eye scans the content.* – P7, Male, Age 33

Grouping services by role (e.g. resident, visitor, job seeker, etc.) within the menus helped guide users to subareas of the portal. Participants were drawn and attracted to visual images and icons as opposed to analysing and reading lines of text. On the other hand, the textual design employed a useful colour scheme that helped cue users to categories of information. However, multiple horizontal menus were challenging for users as they presented too many choices and content layout required a lot of scrolling.

5.2.3 Mobile Interfaces

Participants preferred the textual design (City of Austin) to the visual design on a mobile device as it allowed them to more easily find the required information and complete the tasks in the study. However, the primary concern with the textual design on a mobile interface was the amount of information being presented on such a small screen. Though content appeared to be organized, underlying pages of content were less intuitive and often led to the wrong area.

> *The Austin mobile… It is very complex and a lot of the actual tasks are obscured by over structuring and organization of content.* – P2, Male, Age 28

> *The mobile interface seemed to offer very little real information and the graphical layout didn't seem optimal for mobile devices. Often times the place that seemed obvious to hold the information I was seeking had no such information or did not make it readily accessible.* – P42, Male, Age 26

The visual design (City of LA) on mobile devices received the most negative comments from participants. Users did not like that the navigation menu and content layout resulted in having to

scroll on a mobile device as much as they had to in order to find information.

> *This mobile was the worst – you had to scroll too much and zoom in a lot to try to navigate. I felt like giving up searching for anything.* – P4, Female, Age 33

> *… many of the pages that I was taken to by links that suggested content, took me to places with navigation, advertisements… content. But nothing to do with what I was searching for/link suggested in the first place.* – P7, Male, Age 33

Overall, the findings from our interviews supported the usability scores of mobile devices revealed during our quantitative study. Regardless of the city portal having a visual or textual design, both received SUS scores below 50 (T_M = median 47.54, V_M = median 33.41).

6 Discussion

Generally, participants were concerned with the wealth of information contained with both city portals, on both desktop and mobile interfaces. Participants also expressed concern with the layout and structure of information, and indicated their frustration with the system's design and usability. In prior work, Sauro & Lewis [25] noted the average SUS score was 68 for over 500 studies that employed the SUS. None of the interfaces evaluated during our study met this average, with the highest score of 61 attained by the visual design on the desktop interface. A mean SUS score of 33 for the visual design on the mobile interface suggests major concerns with the system's usability, despite it being an award winning site (as reviewed by an expert panel). While conducting heuristic analysis with usability experts is common practice for present-day usability evaluations, there remains a challenge in applying these types of evaluations to government portals. Government organizations have traditionally operated in a top-down manner, where the focus has been on providing information and a presence online [10][28]. Aside from Jarrett [16] and Walser [28], few studies have explored the user experience or usability of online government services. Our study offers a closer look at the usability of highly regarded portals that have shifted their design paradigm to a more citizen-focused, task-centric view.

Our participants also had a preference for the visual design over the textual design on a desktop. The visual design categorized and presented the information in a simpler form that required less internal processing from the user. Participants also rated the textual design on a mobile device higher. Given this, there is an apparent need to consider how to make the user's experience feel familiar across mobile and desktop devices using similar visual cues, such as colours, icons, and categorization of services.

Overall, participants found finding information, completing online services, and the overall usability of city portals better on desktop devices compared to mobile devices. This suggests that future research on government websites needs to closely focus on better design paradigms for mobile device usage, especially as the use of mobile devices continues to grow. It also reflects the state of government website design where mobile designs are newer and designers are still trying to understand how to best design them.

As can be seen with our own comparative assessment of city portals, only 56% of the cities reviewed offered mobile-friendly sites. As municipal governments consider the rapidly growing use of mobile device usage, we suggest they design to provision services to people while on-the-go. Our participants were overwhelmed by the amount of information offered on both city portals and noted this as a reason for their infrequent, visits to their own government portals. Despite their need for regular tasks, such as paying property taxes, registering for a community centre's program, or looking for community events, our participants' visits were very purposeful and revolved around their routines. One way to address this is to offer users a personalized approach (only 18% of the portals reviewed during our assessment offered such a service). Once users have created their profile and select their most common services, recommender engines could better target contextually-relevant tasks.

Surfacing information selectively to a user at a relevant time and place based on patterns of use and location could enable users to find and leverage government information during their daily routines. For example, sending a user a notification of a new development in the neighbourhood based on their route to and from work could provide the user with a heightened awareness of their community. Similarly, a user could be notified of changes to a community centre's programs based on their patterns of frequent visits to the centre.

6.1 Responsive Design

Responsive design, where content is automatically resized to accommodate the screen resolution of any device, may not be optimal for the user experience, as seen when evaluating the City of LA's visual design on a mobile device. Based on our comparative assessment, the portals we evaluated in our study were highly representative of other mobile designs. Thus, it is clear that this is a larger issue beyond just the two portals we evaluated. Other city portals that use similar responsive designs may suffer similar issues reported by our participants. However, this should be confirmed with studies of additional mobile sties.

Our study suggests that responsive design practices for mobile devices may not be suitable for government portals, resulting in the need to rethink such practices. Though responsive design may be easier to maintain for government organizations (as content is only created once and 'responds' automatically based on the user's device), the wealth of information contained with a single city portal (along with the diverse audience of users) challenges this common design practice. Rather than expecting the user to search and find required information, we suggest the expectation is shifted towards the government to deliver information and services to each user based on their personal routines and behaviours. Recognizing the effort and time for information retrieval, government organizations can easily begin to determine historical patterns of routine services, such as paying for property taxes, or renewing dog licences, and offer quick, personalized links to the service.

Designers of government portals and mobile systems should consider implementing a separate mobile experience that leverages an adaptive design approach. However, consideration should be given to not simply adapt the design to the screen size or device, but to also incorporate a user's personal behaviours, patterns, and needs. Additionally, there is a need to identify relevant content to be consumed on a mobile device, and further determining its value and usefulness for such devices.

6.2 Limitations

We recognize that while valuable, our study results come with their limitations. We focused our study on two city portals. Our comparative assessment showed that the portals selected were highly representative of the majority of government portals in our sample. Thus, it is likely that similar problems will exist for these portals as well. This suggests that similar design guidelines to improve the portals we studied would also likely be more broadly

applicable to other city portals more generally. Yet this needs to be confirmed with further studies, in particular as it relates to issues around responsive design. We also did not conduct a fully comprehensive, long-term user experience study, where people could use the portals over a longer time period as part of their everyday activities. Instead, we focused on a first step which is improving the basic usability of government sites. Our hope is that improved usability would lead to longer-term usage by citizens, which would make a user experience study more straightforward to conduct. Indeed, this would be interesting to conduct and is a recommended next step.

7 Conclusion

Our paper contributes a comparative study of visual and textual designs of city portals on both desktop and mobile devices. Following a comparative assessment of fifty city portals across North America, we conducted a mixed-methods study and discovered that people found the information contained in city portals to be overwhelming and difficult to navigate. People preferred to access government information on a desktop device and relied on visual images to help them to complete tasks. City portals that adopted a responsive design for mobile users received poor usability scores. Our study provides researchers with a framework of tasks to use in future studies to assist in better understanding the challenges users face when using city portals to complete tasks on varying devices. To date, research has not articulated what types of tasks are important for such evaluations. We suggest future work explores the design of a government portal for a mobile device and then testing it with users using the same tasks. Such a prototype would benefit from location-based services to facilitate the surfacing of information based on the user's location, further minimizing the amount of user interaction required to navigate government information.

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