Comparing the Usability of Visual and Textual Government Portals using Desktop and Mobile Interfaces

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ABSTRACT
Government agencies have more recently begun to consider how digital technology can improve public sector administration and engage citizens to maintain a sense of interest in their communities. This mixed-method study compares the usability of desktop and mobile interfaces for two types of government portals, textual and visual, using a standardized usability questionnaire, the System Usability Scale. Using a set of 12 tasks, we evaluated which interface and type of government portal (textual-desktop, visual-desktop, textual-mobile, visual-mobile) had a high usability score from a citizen's perspective. Three usability aspects of the desktop and mobile portals were analyzed: effectiveness (whether people can complete their tasks and achieve their goals), efficiency (the effort people use to achieve their goals), and satisfaction (the level of comfort people experience in achieving those goals). 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. Our findings inform the design of a government portal that enables citizens to access information, complete services online, and engage with others in the community, while using a desktop or a mobile device.

INTRODUCTION
Many government agencies' websites are dated and information-heavy. Often times, these sites provide citizens with an overwhelming amount of information on thousands of web pages. This requires users to exert much effort on information-seeking tasks such as retrieving information about paying taxes and fees in person, or searching for forms that they must download, fill out manually, and submit in person for processing at city hall (Sharit et al., 2011). As the demand for online services increase, cities are struggling to keep pace with the changing technologies (Bertot et al., 2008, Dwivedi et al., 2012). The constraints of public sector budgets and internal resource skills are hindering the deployment of online services to citizens (Mishra & Mishra, 2012). Such services include payment of property taxes, permit applications, and licence renewals. Citizens also have the ability to engage with the city by reporting real-time incidents, such as road potholes, or graffiti (Ganoe et al., 2010, Kim & Kleinschmit, 2012), but do not always have the channels to do so with dated government sites. Government agencies are beginning to address such issues of offering online services with the deployment of centralized portals to serve as a gateway to multiple back-end applications that support such online capabilities. Additionally, government agencies are recognizing the need to use social media tools, such as Facebook, Twitter, Foursquare, and Instagram to encourage citizens to engage and communicate with the city online.

e-Government Usability
Prior work by Rosenthal (2007) involved a scenario-based usability study of the CivicInfo BC website, 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 concluded the requirement to redesign the Search user interface to enable users to search for multiple types of information (e.g. document, organizations, careers). Our study expands on this by focusing on the overall design and navigation of a government portal, consciously restricting participants from using the Search feature so as to ensure sufficient exploration of the categorization of information and navigation structure.

Al-Hassan et al. (2009) suggest a framework (Pe-Gov) 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 seeks to validate 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.

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 (2010) studied 14 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 concluded the necessity to conduct usability testing with real users to understand key usability problems with government sites

(Al-Khalifa, 2010). Golubeva (2007) evaluated 11 Russian government websites on the basis of its public value concept, comprised of public services, public policy outcomes, and public trust. The study revealed that the portals needed to improve in its public value offering according to a number of indicators, including transparency and interactivity (Golubeva, 2007). Additionally, Golubeva notes that the portals suffered from poor accessibility, navigability, and layout, suggesting that portal attractiveness also contributed to the portal's usability.

In North America, Youngblood and Mackiewicz (2012) completed a usability analysis of home pages for 129 city government websites in Alabama, USA. Usability standards, such as providing a breadcrumb trail, linking the city logo to the homepage, or ensuring that no horizontal scrolling was required, were evaluated. The authors recommend usability benchmarks for developers of government sites to help maintain and increase citizen access, satisfaction, and trust (Youngblood & Mackiewicz, 2012). While much prior work has identified the need for government portals to improve its usability, few studies have investigated the actual use of government portals by citizens. Our study extends previous work by offering findings that describe the usability of two award-winning North American government portals, based on actual user interactions and evaluation.

Design and Usage on Desktop and Mobile Devices

For the past 18 years, the Center for Digital Government annually recognizes cities' government portals with 'Best of the Web and Digital Government Achievement Awards', which evaluate innovation, functionality, productivity, and performance (Grenslitt, 2013). A cursory review of award-winning portals in 2013, 2012, and 2011 demonstrates that most portals house similar content (e.g. city news, neighborhood information, parks and leisure, development, etc.) and online services (e.g. pay for parking, pay property taxes, apply for a building permit, etc.). However, the design and layout of these portals are quite different amongst each other. Government portals vary considerably in design, with some relying more on text, while others using visuals more extensively. At times, navigation menus are placed at the top of the screen, while others have menus located at the bottom of the screen.

Furthermore, as the use of mobile devices continue to increase, government agencies must not only consider how such portal designs behave on a desktop interface that offers a large screen real estate, but also, how such designs render on a mobile interface that is restricted to a smaller screen size. Responsive design, where websites automatically adjust the layout, content, and images to accommodate the screen size of any device, allows government agencies to deploy a flexible website that renders on a wide range of desktop and mobile devices. However, effective responsive design still should consider whether content is actually valuable rendered on a mobile device.

System Usability Scale

Because user experience on a desktop interface is different from the user experience on a mobile interface, it is important to investigate how the user interacts with the system on each. The objective of this study was to determine which interface was preferred (desktop or mobile) for two contrasting designs (textual or visual). This was studied by having users complete a set of information-seeking, service-oriented, and community-focused tasks for two government agencies' portals using both a desktop and mobile device. Using the System Usability Scale (SUS) questionnaire, participants provided independent evaluations of each government portal for each interface (total of four), and reported results with a SUS score for each.

The SUS is a standardized, validated questionnaire used to evaluate the effectiveness, efficiency, and satisfaction of a system after a participant has used it but prior to a follow-up interview (Sauro and Lewis, 2012). Though there exist alternative tools to assess a system's usability (e.g. Poststudy System Usability Questionnaire, Website Analysis and Measurement Inventory, etc.), the SUS questionnaire can be used to assess a range of interface technologies and is relatively quick and easy to use (Bangor et al., 2008). The results of this study provide government agencies with a broader view of desirable services from citizens, which can then guide the design of a portal that will provide such services. Specifically, government agencies can then follow these design guidelines when developing a system consumed on a desktop device, with consideration to how such services and information are displayed on a mobile device.

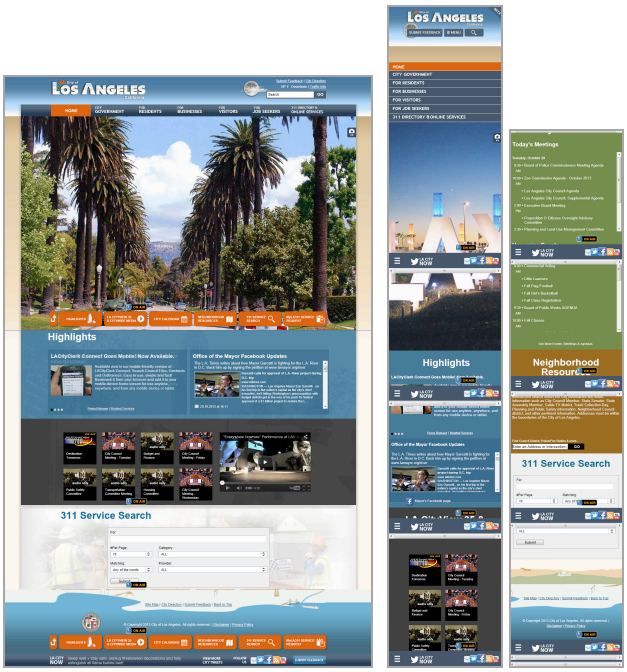
Hypotheses

With the majority of screen resolutions set above 1280x1024 and screen dimensions of at least 15", desktops provide the screen real estate for users to navigate a website and seek 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 hypothesize that citizens will prefer the textual interface (T_D) to a visual interface (V_D) on a desktop device, resulting in higher scores in usability.

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) and smaller screen sizes (less than 5" diameter), 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 hypothesize that citizens will prefer the visual interface (V_M) to a textual interface (T_M) on a mobile device, resulting in higher scores in usability.

(a) (b)

Figure 1: The City of Austin portal; (a) Desktop Interface T_D, (b) Mobile Interface T_M



(a) (b)

Figure 2: The City of Los Angeles portal; (a) Desktop Interface V_D, (b) Mobile Interface V_M

METHOD

This study was carried out with a sample population of 44 residents in the Greater Vancouver Regional District, located in British Columbia, Canada. Data was gathered through a two-staged study (System Usability Scale followed by a short debriefing interview) to allow participants to review desktop and mobile interface designs for two types of government portals: visual and textual.

The City of Austin, Texas (Figure 1) represented a textual government portal in both desktop (T_D) and mobile (T_M) interfaces. The portal used a tan background color, and muted, earthy colors as navigation menus at the top of the screen and for headline text. A single image (954 x 257 px) was used on the home page, with the remainder of the page comprised of textual links to other areas of the portal.

The City of Los Angeles, California (Figure 2) represented a visual government portal in both desktop (V_D) and mobile (V_M) interfaces. The portal used vibrant images (1100 x 746 px) as their background; bright colors and images were also included within their mega-menus. Additional visual elements linked to city council meetings and news highlights.

Though both government portals were recognized by the Center for Digital Government's Best of the Web and Digital Government Achievement Awards in 2013 (Grenslitt, 2013), to avoid potential biases, this was not shared with participants beforehand. Participants also provided demographic information and described their current use of government portals.

Participants

Forty-four participants (22 female) were recruited for this study using word-of-mouth, social media postings, Simon Fraser University's SONA system, and free online community billboards (e.g. Craigslist). Participants included 22 university students (undergraduate and graduate) and 22 adults employed full-time between the ages of 19 and 58 (M = 33.46, SD = 11.94). All participants resided within the Greater Vancouver Regional District and had basic knowledge of technology, such as navigating the Internet and using a mobile smartphone (23 participants owned an iPhone, 13 owned an Android phone, and 8 owned another type of smartphone). Twenty-two participants were compensated with university course credit while the remaining participants were compensated with a $5 Starbucks gift card. Ethics approval for the study was received from SFU's Office of Research Ethics.

Setup and Equipment

A Dell laptop computer running Windows 7 was set up with the desktop interfaces (screen resolution of 1920x1080, with a screen size of 15") for both government portals. In addition, a Galaxy Nexus 4 mobile phone running Android 4.2 was set up with the mobile interfaces (screen resolution of 1280x768, with a screen size of 4.7") for both government portals. This ensured that the screen resolutions for each interface were consistent for each participant. Both devices (laptop and mobile phone) were used by each participant in their most natural environment (e.g. school, home, office).

Experimental Design

This is a 2x2 factorial within-subjects study (Table 1) 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).

		Textual Design **(T)**	Visual Design **(V)**
Desktop Interface	**(D)**	$n = 44$	$n = 44$
Mobile Interface	**(M)**	$n = 44$	$n = 44$

Table 1: Factorial within-subjects design of the study with four interfaces and *n* = 44.

Twelve tasks were grouped into three categories and participants' SUS scores for each interface were dependent variables. Quantitative data included interval data from the SUS questionnaire (based on a 7-point Likert scale). Qualitative data included participants' responses to our questions at the end of the study. The study lasted between 40-90 minutes.

Procedure

The study involved participants performing a set of six tasks (Table 2) on each device. Tasks were categorized into three groups (information-seeking tasks, service-oriented tasks, community-focused tasks) to ensure fair distribution of similar tasks across both desktop and mobile interfaces.

	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 community calendar
M	Find city officials (city council)	Apply for a filming permit	Find the City's Facebook page

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

Participants completed two tasks from each category for both the desktop and mobile interfaces for each of the government portals (**City of Austin** = T_D and T_M (Figure 1), **City of Los Angeles** = V_D and V_M (Figure 2). The same six tasks were used for both desktop interfaces and the same six tasks were used for both mobile interfaces. 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.

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).

Group	Order 1	2	3	4
[1] $n = 11$	$\mathbf{T_D}$	$\mathbf{V_D}$	$\mathbf{T_M}$	$\mathbf{V_M}$
[2] $n = 11$	$\mathbf{T_M}$	$\mathbf{V_M}$	$\mathbf{T_D}$	$\mathbf{V_D}$
[3] $n = 11$	$\mathbf{V_D}$	$\mathbf{T_D}$	$\mathbf{V_M}$	$\mathbf{T_M}$
[4] $n = 11$	$\mathbf{V_M}$	$\mathbf{T_M}$	$\mathbf{V_D}$	$\mathbf{T_D}$

Table 3: The order in which the interfaces was presented to each group (*n* = 11) of participants

After each set of six tasks for each interface, participants completed an online questionnaire comprised of the 10 questions in the System Usability Scale (SUS) to provide their usability ratings for the interfaces (Table 4). We used a 7-point Likert scale (1-Strongly Disagree to 7-Strongly Agree).

	System Usability Scale (Brooke, 1996)
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.

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

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.

The second stage of the study involved open-ended questions surrounding participants' experiences using each interface and features they liked and disliked about each. We also asked about their existing use of government portals and basic demographic questions about their housing situation (e.g. homeowners, renters, shared rental, living with family) and length of time living in their current city.

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. In previous studies, the average SUS score was 68 (Sauro & Lewis, 2012). 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 $(5 - x_i)$] (Sauro & Lewis, 2012). 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 government portals, a two-way, repeated measures ANOVA was used to determine whether there was a significant difference between the means of overall SUS scores. Post-hoc t-tests were used to determine any significance between each of the four interfaces.

RESULTS

Quantitative Results

Mean System Usability Scale scores were calculated for each interface; Visual-Desktop had the highest mean score:

- Textual-Desktop T_D : $M = 52.54$, $SD = 19.69$
- Textual-Mobile T_M : $M = 47.54$, $SD = 22.42$
- Visual-Desktop V_D : $M = 61.21$, $SD = 21.61$
- Visual-Mobile V_M : $M = 33.41$, $SD = 18.93$

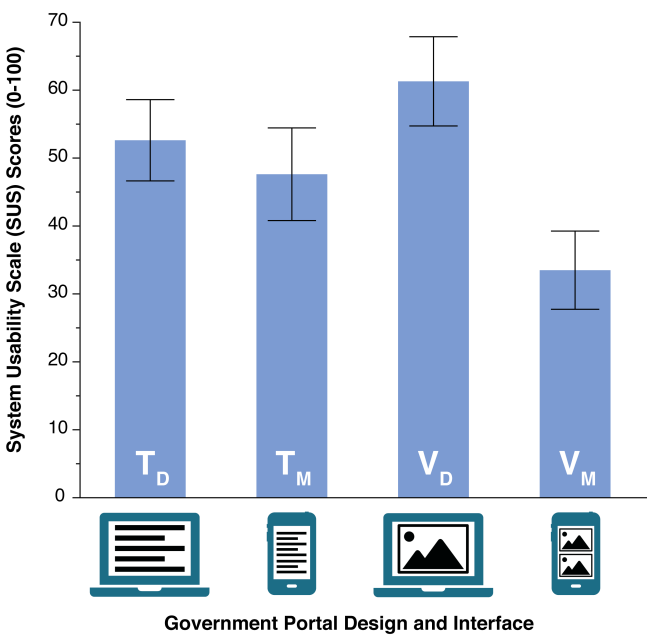


Figure 3: Mean scores, represented by bars, of SUS scores for each interface with error bars representing the confidence intervals.

The ANOVA results show that the main effect of the type of interface used significantly affected the SUS usability scores for textual and visual interfaces, $F(1,43) = 52.42$, $p < .0001$; there was also a significant interaction between TV*DM, $F(1,43) = 20.53$, $p < .0001$. Though there was no overall effect between desktop and mobile, there was a main effect between textual and visual designs, with a clear preference for the visual (desktop) interface.

Post-hoc tests with Tukey-HSD between all dependent variables sought to understand the significant interaction between design and device (TV*DM), specifically between visual designs on desktop and mobile [V_D and V_M, $F(1,43) = 27.80$, $p < .0001$; $d = .48$], where participants preferred the desktop interface of the visual design.

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 device, 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 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 was also calculated. Figure 4 demonstrates the mean ratings for each interface as participants rated their ability to find information, to complete their tasks, to register for online services, and the portals' overall usability.

Participants' mean ratings for the visual design on the desktop interface (V_D) was highest in their ability to find the required information ($M = 7$, $SD = 2.12$).

When evaluating participants' ability to complete their tasks, the visual design on the desktop interface (V_D) was rated highest ($M = 7$, $SD = 2.28$).

Participants rated both the textual (T_D) and visual (V_D) designs on a desktop interface equally when asked about their ability to register for online services ($M = 7$, $SD = 2.02$ and $M = 7$, $SD = 2.05$, respectively).

Finally, participants rated the visual design on a desktop interface highest with respect to its overall usability, $M = 7$, $SD = 2.04$, though the textual design on a desktop interface was close ($M = 6.5$, $SD = 2.12$).

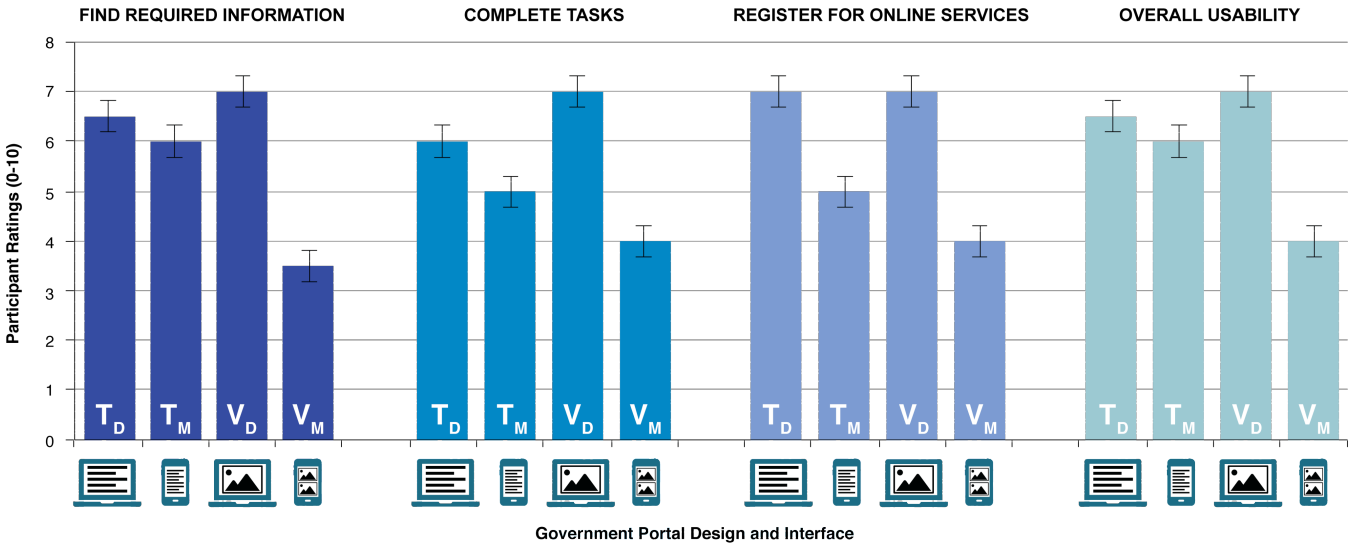


Figure 4: Mean ratings, represented by bars, for each interface, with error bars representing the confidence intervals.

Qualitative Results

Participants were asked to share their impressions of each interface, and to specifically identify features they liked and disliked while navigating through the portals.

V_D: Visual-Desktop (City of LA)

Though the visual design on the desktop interface was consistently rated higher than the other interfaces, there were mixed comments about it. Participants noted that they appreciated the bright colors and that it was organized well, making it easier to find information within this particular interface.

> *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

> *The LA site was more bright and colorful but 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

> *I found the LA one really well organized and easy to navigate.* – P31, Female, Age 49

> *In the desktop LA website, I think it is well constructed and easy to locate the information I need.* – P41, Female, Age 51

However, participants also identified concerns with the amount of information presented within the portal.

> *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

> *The amount of information presented is overwhelming and poorly organized. Unless you have advanced knowledge of the site, it is very difficult to find certain services or information. Breaking down info by resident, business, and government is ineffective.* – P17, Male, Age 23

> *I like the drop down menu of the LA interface. However, I Austin's color scheme is better than the LA one. Also, I'm not sure if the ads on the right bottom side are necessary, they were way too big.* – P23, Female, Age 25

T_D: Textual-Desktop (City of Austin)

Participants consistently remarked that the color scheme was ideal for categorization; however, their navigation menu and content layout resulted in too much scrolling.

> *There was a lot of scrolling and by the time I got to the end, I would forget what I was even looking for.* – P20, Female, Age 52

> *I like how the colors represent each section in the first one to indicate which menu I'm in.* – P23, Female, Age 25

> *The Austin desktop's information architecture was hard to grasp at first, but once you understood how it worked it was the same or better than LA desktop.* – P24, Male, Age 29

> *Their drop-down menus are waaaaay too long to scroll through! I find myself needing to use sitemaps instead of scrolling through a long list of drop-downs that are not very well organized.* – P33, Female, Age 22

V_M: Visual-Mobile (City of LA)

The visual design on a mobile interface received the most negative comments from participants. Users did not like having to scroll on a mobile device as much as they had to in order to find information.

I thought it was going to be better, but it was worse, than Austin's mobile. Many, and I mean many of the pages that I was taken to by links that suggested content, took me to places with navigation, advertisement, and all the other generic every page content. But nothing to do with what I was searching for/link suggested in the first place. – P7, Male, Age 33

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

I had lots of problems scrolling. I'd want to scroll sideways or up and down, but it would get stuck on an embedded section of the site that also incorporated scrolling. – P16, Male, Age 23

The mobile version seems to still want to display as much information as possible even though the screen size is reduced by so much. – P37, Female, Age 19

T_M: Textual-Mobile (City of Austin)

Participants preferred the textual design to the visual design on the mobile interface. However, the primary concern with the textual design on a mobile interface was the amount of information being presented on such a small screen.

The Austin mobile phone site was good, though the problems found on the desktop site are still found in the mobile phone site. 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 site is basically the same site from the desktop. It doesn't follow any fluid or responsive standards that I can feel good about or notice. The site becomes even harder to navigate with the smaller sizes of font and the lack of full screen. – P7, Male, Age 33

The Austin mobile site was the easiest to use, though their desktop site was more difficult. Conversely, I found LA's desktop site easier to use than their convoluted mobile one. – P26, Female, Age 21

Everything on the Austin website was stacked on top of each other. Locating information on this website was similar to playing a game of "Where's Waldo". – P37, Female, Age 19

I couldn't finish some of the tasks in this interface because there was just too much information on the page. – P39, Male, Age 21

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

Current Use of Existing Government Portals

Participants' current use of their own government portal was fairly infrequent, with 6 participants noting they visited a few times a month, 8 participants visiting every few months, 17 visiting only a few times a year, and 13 noting their visits were infrequent or never. 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 tickets, to pay taxes or to search for information about taxes annually, to look up information about owning a dog, or to apply for building permits for home renovations. Some participants noted that they would also search for upcoming events or volunteer opportunities within their city.

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).

DISCUSSION AND CONCLUSIONS

Though we reject the null hypothesis that citizens would prefer the textual interface (T_D) to a visual interface (V_D) on a desktop device, participants seemed to have a preference for the visual design over the textual design. Participants positively identified certain features of the visual design that appealed when using the desktop interface. The visual design categorized and presented the information in a simpler form that required less internal processing from the user. Grouping services by role (e.g. resident, visitor, job seeker, etc.) within the mega-menus helped guide users to subareas of the portal. Participants were drawn and attracted to visual assets as opposed to analyzing and reading lines of text. On the other hand, the textual design employed a useful color scheme that helped cue users to categories of information. However, the multiple horizontal menus were challenging for users as they presented too many choices. Users also noted that both portals contained too much information and was overwhelming, especially when a lot of scrolling was required.

We also reject our hypothesis that citizens would prefer the visual interface (V_M) to a textual interface (T_M) on a mobile device. Though there were some concerns with the textual design on the mobile interface, participants expressed frustration with the amount of scrolling required for the visual design. Participants the amount of scrolling a visual design would require on a mobile device, where lines of text conveys more information and results in less scrolling by the user.

Generally, participants were concerned with the wealth of information contained with both government 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 noted the average SUS score was 68 for over 500 studies that employed the SUS (2012). 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 reflects major concerns with the system's usability.

As seen during our study, participants had very specific reasons for visiting their own city's portal, and would revisit information and services only applicable to them. For example, a dog owner will visit the city's portal to renew their dog's licence on an annual basis, or a home owner will visit the city's portal to pay their property taxes on an annual basis. In line with Al-Hassan et al. (2009), such recurring transactions suggest the potential to design a modular portal in which citizens can create an account with security credentials, and then customize their experience based on their individual needs and interests.

To assist users with information-seeking tasks (Sharit et al., 2011), users can bookmark portal pages and store regularly filled forms and submit them through their personalized portal. To encourage engagement between citizens and governments, cities must find ways for their citizens to more actively use their portals. A personalized portal presents an online space catered to the citizen. This space can also serve as an opportunity to store a history of instances or messages when citizens have reported graffiti or potholes. Supported by Ganoe et al. (2010) and Kim and Kleinschmit (2012), such participatory channels can support active community improvements while encouraging use of online government services.

Responsive designs, 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. Instead, designers should consider developing a mobile app that is more text heavy, making efficient use of the smaller screen real estate. Additionally, there is a need to identify relevant content to be consumed on a mobile device, and further determining its value if consumed on a mobile device.

The findings from this study contribute design implications for government agencies to consider when designing an online portal. While we feel the study was comprehensive with the evaluation of both desktop and mobile interfaces, next steps will include developing a prototype of a government portal for a mobile device and then testing it with users using the same tasks. Such a prototype will include location-based services to facilitate the surfacing of information based on the user's location, further minimizing the amount of user interaction required to retrieve information.

Future work will also consider running additional statistical analysis on data from the study, including determining if there was any impact of frequency of using existing government portals on perceived usability. In addition, data surrounding task completion will be analyzed to understand if incomplete tasks had an effect on the overall system usability ratings.

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