Understand and Extend the Compare Years Feature – From an Open Government Data Users’ Perspective.

by

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Abstract
Intermediary run portals provide a convenient single point access for users to use open government data (OGD) at neighborhood level. The online features on such portals help users understand, analyze, and find patterns in large amount of OGD. However, prior studies indicate the current set of features are basic and limited in analyzing data which leads to low user engagement. Features are also designed from technical and data perspective; user’s needs and wants are not part of the solution. This study explores user’s perspective on a comparison feature in an intermediary run portal. The goal of this study was to discover and address any navigational, interface, and interaction design challenges in the compare years feature that limits user’s ability to analyze the data. I used a combination of five user-centered design methodologies. The results indicated that the previous comparison feature was underutilized because of various navigational, interface, and interaction design challenges. A suggested design at the end of the research addressed all the above challenges and provided empirical proof that a combination of customization and visualization of features can improve user insight and engagement. Also, a curated comparison feature has the potential to make the underlying OGD relatable and actionable for users leading to an overall better user experience.
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Chapter 1: Introduction

In the last decade, intermediary run portals have succeeded in reducing many data and technical barriers in accessing open government data (OGD) at community level. This is because of a combination of many favorable forces like interactive internet technology matched by a growing interest from group of users like nonprofits, researchers, journalist, and business managers. However, just providing access to open government data in raw form is not sufficient anymore, considering user participation and engagement is ‘stubbornly low’ and ‘not very user friendly’ (Jurisch, Kautz, & Krcmar, 2015; Wang & Shepherd, 2020; Zhu & Freeman, 2019; Sieber & Johnson, 2015; Attard, Orlandi, Scerri, & Auer, 2015; Martin, C. 2014). There is growing need to understand and extend the portal infrastructure like features, to help users make sense of the growing data and make informed decisions towards their objectives – social or economic. To accomplish this a concerted design effort is necessary to make features more engaging, useful, and usable for all users. Features should help users in extracting the underlying relationships and patterns in open government data tailored to their context in a user-friendly manner. Users should be able to gather insights that are relatable, actionable, and meaningful. These influences guided the researcher in this study, which was done in partnership with an open data intermediary, Baltimore Neighborhood Indicators Alliance (BNIA, 2018a).

The focus of this study was the compare years feature on the BNIA operated portal - bniajfi.org. Compare years feature is a time series display of 150 plus quality-of-life indicators covering data from 55 neighborhoods in Baltimore. The need to understand usage and optimize the capabilities of compare years feature from a users’ perspective was necessary at many levels. There is a growing body of studies to understand open government data at country, national, and state level but little attention is paid to neighborhood level usage (Yoon & Copeland, 2020). The technical and supply side of
OGD is given plenty of attention. (Attard et al., 2015); while scant attention is paid to the user’s perspective and usage of data, which has led to an empirical gap about users and usage (Susha, Gronlund & Janssen, 2015; Safarov et al., 2017). Also, how useful and effective are the features in helping users gather insight remains unclear (Zhu & Freeman, 2019). What’s missing is a firm understanding of users’ needs and wants from features which is possible by following a sequence of robust user centered design (UCD) methodology.

The essence of user centered design methods lies in embedding oneself with users, observing interface, and interaction design challenges in user’s natural environment and using the feedback to design, test, and deliver a solution that matches user’s needs and wants. UCD methods like contextual inquiry can help understand the goals of users and context of use. Usability Testing can help define user requirements; while prototyping can assist in developing and evaluating design solutions. Together these methods will provide the missing empirical proof of both opportunities and challenges specific to the usage of compare years feature.

This project begins with a literature review surveying the broader open data landscape, relevant users, and their motivation. This helped understand usage and knowledge gaps in features. The methods section describes the five user centric methods and their implementation. The results section outlines the outcomes from each UCD method and concludes with a suggested design of comparison feature. The discussion section is a reflection on the consistent challenge’s users faced and the implications of the suggested feature design. The conclusion section covers lessons learned from a project perspective and outlines some next steps.
Chapter 2: Open Data Landscape

**Define.** Open government data (OGD) refers to any data or information generated by the government, and made available to the public to access, reuse, and redistribute without restrictions (Kassen, 2014; Ubaldi, 2013). OGD can be viewed as a confluence of two broader movements – open data and open government. (Gonzalez-Zapata & Heeks, 2015). In understanding OGD, many principles like completeness, primacy, timeliness, ease of obtaining information, use of widely used formats, free access to data, use of commonly owned standards, licensing, capability to find information at all times and usage costs can be traced to the larger open data movement (Sunlight Foundation, 2017). On the other hand, core principles like transparency, accountability, and importance on user participation and engagement can be linked to the open government movement (Organization for Economic Cooperation and Development [OECD], n.d.).

Open government data (OGD) can be stored and found online as categories or groups called datasets. They cover different areas, such as: health, transportation, and education to name few (The World Bank, n.d.). There are thousands of datasets which are organized into different levels and often there can be overlap – national, state, city, and neighborhood. OGD can originate from individual governmental agencies on themes or topics. For example, location of local farmer’s market from the U.S. Department of Agriculture (U.S. Department of Agriculture, 2020). City and neighborhood level open government data is the focus of this study and it follows similar design of open data but differs in scope (The World Bank, n.d.). OGD being non-personal, aggregated data, it does not contain information at an individual level (Open Knowledge Foundation, n.d.). This data can be represented in a variety of ways – it can be in the in raw form, available as maps, diagrams and charts, a document, a multimedia file, or an (API) application program interface (Hivon & Titah, 2017).

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**Benefits of OGD.** The premise of free use and reuse of open government data (OGD) is to improve governmental transparency and efficiency and encourage user participation and engagement (Attard et al., 2015). Governments at all levels – national, state, county and city are creators of OGD and themselves benefit from its use and reuse. OGD is channeled to inform planning, job creation, modernization of governmental systems, and pinpoint inefficiencies and inequalities in the delivery of basic services for citizens (Smith, L. 2017).

Besides government, open government data (OGD) has been assigned significant social and economic value from the citizen’s perspective. Access to OGD empowers and motivates ordinary citizens to take part in the larger democratic process, improves decision-making, and reduces information asymmetry (Jetzek, Avital, & Andersen, 2019). OGD also can stimulate innovation and economic growth (McKinsey Digital, 2013). In the long run, the use and reuse of OGD according to Howard, A. 2012 has the potential to generate public good for everybody. However, this can be realized not by one individual, but by the collected efforts of a distributed community that includes governments, nonprofits, academics, civic advocates, and more informed communities of users (Howard, A. 2012). Taking inspiration from this holistic approach, the next section starts with an overview of the technical aspects of portals followed by social aspect – important actors and their interactions.

**Open Government Data Portals**

An open government data (OGD) portal can be defined as “a web-portal launched to make certain types of governmental data publicly accessible via internet” (Kassen, 2014). With the rise in internet technology, portals have become a significant platform to create awareness, promote use, and reuse use of open government data for citizens. (Wirtz, Weyerer, & Rösch, 2017).

There are two kinds of portals – Direct Provision Portals and Aggregator Portals. Direct Provision portals are primary sources of open government data and are operated...
by national, state, county and city governments or any governmental agency. The
providers not only produce and publish data on their portals but also support the whole
life cycle of OGD use - distribution, updating and archiving of OGD (Alexopoulos,
Loukis, & Mouzakitis, 2014). To illustrate, data.gov at national level, maryland.gov at
state level and U.S. Census Bureau portal like census.gov.

Aggregator portals are secondary sources of OGD. Aggregator portals collect,
aggregate, and publish multiple datasets from primary sources and present them on a
single portal making it easy for end users like journalists, business managers, and citizens
to locate, use, and reuse OGD. Aggregator portals are designed and managed by open
data intermediaries like BNIA-JFI, whose goal is to bridge the usage, awareness,
technological, and incentive gaps between open data providers and end users (Attard et
al., 2015). Intermediary run portals serve as a single point access for end users therefore
occupy an important part in the OGD ecosystem (Alexopoulous et al., 2014). The interest
of this study is aggregators portals operated by intermediaries at the neighborhood level
because of such portals form close connections with local organizations, neighborhoods,
and communities. Aggregator portals can have the most direct impact on their daily life
and neighborhood (Xiao, Jeng, & He, 2018).

Portal Features.

Features act as an important resource on OGD portals that allows users to access,
use and reuse open government data. An OGD feature can be understood as a grouped
layer of functionality above the data layer that allows users to access, use, and reuse data
(ArcGIS Enterprise, n.d.). Some examples of features are data manipulation, information
visualization, navigational and analysis features. Data manipulating features include
filtering and sorting which enables users to compare between multiple data alternatives
(Sayogo, Pardo, & Cook, 2014; Zhu & Freeman, 2019; Nov & Su, 2018). Sorting and
filtering features protect users from information overload by reducing their choice set
(Nov & Su 2018). Some features focus on specific topics like help and policy while

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others focus on interactions like charting and search results – together features help users understand and analyze data (Thorsby, Stowers, Wolslegel, & Tumbuan, 2016). Visualization features like charts, maps and diagrams have gained popularity in recent years because they allow users to generate insight from a large quantity of data. Visualization features help users identify patterns and outliers by visual inspection - this is especially relevant when users are not familiar with the topic (Gravesa & Hendlerb, 2014). There are visualization functionalities that provide users with static maps and charts; while sophisticated visualization features allow users to customize and visualize datasets on maps, and charts (Petychakis, et al., 2014; Ganning, Coffin, McCall, & Carson, 2014). Charalabidis et al., 2014 consider the newer information visualization features as a second generation of features that can convert users into ‘pro-sumers’ - users who consume and produce data. In sum, features help users to unlock the hidden social and economic value in data (Charalabidis et al., 2014).

Zuiderwijk, Janssen, and Susa, 2016 are of the opinion that features are part of a larger narrative of open government data ‘infrastructure’ because features combine the semantic, technical element of open government data with the social elements of user’s activities to enable use. Results from this study indicates improving interaction mechanisms in the OGD infrastructure like features, tools, applications, services, and software platforms can speed OGD usage and improve user participation and engagement. Studying and optimizing the current set of features to match user’s needs and wants can be a worthwhile goal for two reasons: There is an overall low usage of OGD datasets, and user participation and engagement on OGD portals comes across as ‘stubbornly low,’ ‘problematic,’ and ‘not very user friendly’ (Jurisch, Kautz, & Krcmar, 2015; Wang & Shepherd, 2020; Zhu & Freeman, 2019; Sieber & Johnson, 2015; Attard, Orlandi, Scerri, & Auer, 2015; Martin, C. 2014).
Presentation Challenges of Portal Features.

However, presenting data effectively through features can be challenging. Certain OGD features like comparison and analysis cross reference heterogeneous and subjective qualitative data categories. Each data category has its own quantitative data type. Stephen Few, an author of many books on information visualization, frames this as a presentation challenge (Few, 2012). Data categories have relationships like nominal, ordinal, hierarchical etc. Numerical relationships on the other hand can be based on ranking, ratio, and correlations. Features would have to identify these underlying core relationships in data and present them clearly for users to take desired action (Few, 2012). Secondly, features don’t operate in isolation. Features are a combination of many smaller meaningful tasks which users need to perform effectively. Each of these tasks needs to be presented in a manner expected by user segments, in other words according to their mental model (Young, 2008). Only then the collective experience of using features can be effective in identifying patterns and trends from the data. Thirdly, many scholars consider the look (visual) and feel (interaction) of available features on portals generalized for a large audience. This is because most portals depend on readymade features provided by few software platforms like Socrata and ArcGIS (Weerakkody, Irani, Kapoor, Sivarajah, & Dwivedi, 2016; Zuiderwijk, & Janssen, 2015). These are some feature-specific challenges; while a deeper dive into the larger barriers of usage are discussed in the challenges section. To sum up, presenting open government data through features may be challenging but a valuable goal considering its role as a catalyst in speeding usage and improving user participation and engagement.

Assessment of Portals

In the last decade, the number of open government data portals have multiplied and with that the capabilities of online features have also fundamentally changed the way user’s access, retrieve, and use OGD (Lourenço, 2015). Understandability, there is a
growing interest in studying range of user interactions, affordances, and usability challenges (Osagie et al., 2017). Multiple studies have scrutinized open government data’s usage through portal features and linked features to many valuable aspects like content, quality, etc. This suggest features are not only critical from usage standpoint but also are seen as a measure for user participation and engagement (Sayogo et al., 2014; Thorsby et al., 2016; Zhu & Freeman, 2019; Machova et al., 2018).

Using a cross sectional analysis of 37 U.S. open data portals, Thorsby et al., (2016) examined features available on portals and the supporting content with datasets – a unique study that combined features with content. The researcher hypothesized about the number of datasets and the sophistication of features with size of city, level of education, civic innovation, age of portal and cities participation in regional open data consortium. Among the five hypotheses, only the size of city was statistically significant. The authors of this study concluded, larger cities with higher population display large number of databases and sophisticated features for users because they have access to resources and innovation. The researchers found, a little more than 2/3 of the cities have features that allow users to manipulate and create visualizations with categorical data. However, the data analysis features on portals are limiting, basic, and clunky. Thorsby et al., (2016) believes this is because majority of cities used same software platform Socrata to publish data. Among the features list, searching a database was given higher priority by cities. Standard help features like list, tutorials, and contact forms were seen in only one-third of cities. Only 58% of cities had any clear call to action that encouraged its citizens to use data (Thorsby et al. (2016). The results of this study suggest the available set on features are basic, not customized or personalized which results in underutilization of features.

Zhu and Freeman, (2019) studied basic functionalities of 34 mature municipal OGD portals in the U.S and put forth a user engagement evaluation framework. The framework had 5 criteria’s – Access, Trust, Understand Engage-Integrate, and
Participate. The results showed that, overall, portals perform well in terms of providing access, but did not fare well in helping users understand and engage-integrate with data. One of the results of this study was that larger the cities open data portal the better was the performance of their features that helped users understand, engage-integrate and participate. This relationship between geographical size with availability of data and features was also established in the earlier study done by Thorsby et al., (2016).

Among the software platforms, Socrata performed better than CKAN and ArcGIS in providing features that promoted user access, trust, engagement, and participation. However, there were differences in capabilities even among the portals that ran on Socrata which created variations in user engagement and participation. The researchers are of the opinion that variations are because certain portals have taken a better approach in engaging users and providing data. Furthermore, portals pay very little attention on customizing their content while designing features (Zhu and Freeman, 2019). This suggest, there is an unmet need to connect with users, and focus on content while designing usable and useful features. Furthermore, customizing or personalization can be viable strategies to encourage participation and engagement. Thorsby et al., (2016) and Zhu and Freeman, (2019) both did not empirically test with actual users but their studies have provided the descriptive analysis of available features which can be useful for articulating task analysis and scenarios. Both studies highlight the need to investigate actual usage of portal features and focus on consistently presenting data.

Even at country level, OGD portals lack sufficient search capabilities, data visualization features, and tools for users to access, discover, and reuse OGD, according to a usability study done by Machova, Hub, and Lnenicka, (2018). Even though their study was done at a country level their recommendations related to content, navigation, and filtering are practical and can be considered for local level OGD portals. According to Machova et al., (2018), global navigation should help users with direct access or one click navigation to relevant and important pages like data set lists. To help users

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understand the meaning of the page or section, categories should be formulated in understandable terms. Datasets that can be visualized should be given a priority. Lastly, OGD portals should avoid too much content or features on a single page. (Machova et al., 2018) This study brings the focus on practical considerations like need for efficient navigation, the omnipresent need to present content, and information consistently in plain language (PlainLanguage.gov, n.d.).

The open government data, portals, software platforms and the features form one element of the open data ecosystem (Zuiderwijk, Janssen, & Davis, 2014). The other part of the open data ecosystem can be looked from a consumption aspect with various users, their motivation and the frictions users face while using and reusing open government data.

**Users their Motivation and Usage**

There are many actors in the civic information ecosystem (Zuiderwijk et al., 2014), but two actors are important from the consumption perspective and most relevant to this project. Intermediaries or infomediaries are ‘direct users’ - who makes use of the raw data themselves and share it. While ‘indirect users’ are journalist, developers and nonprofit managers who make use of the data that has been processed by intermediaries (Safarov, Meijer, & Grimmelikhuijsen 2017). Understanding these users, their roles, challenges, and usage would help to map interactions and identify gaps in usage.

**Intermediaries or infomediaries.** Some researchers have grouped journalists and libraries and formed a broader category of intermediaries. For this study, I define intermediaries as an independent nonprofit organization who are positioned in a data supply chain that incorporates open datasets, who are positioned between the open government data producers and end users in the open data supply chain, and who enables the use of open data that may otherwise not have been the case (Open Data Research Network, 2015). Such intermediaries operate in multiple roles – as collaborators, connectors, and direct users themselves. They aggregate all kinds of open data from
multiple sources, check for data accuracy and make the data useful and actionable (World Wide Web Foundation, 2015; Zuiderwijk et al., 2014). Intermediaries engage with the community of users on a daily basis by creating many values added features, products on their portals like interactive and static maps, searchable databases, and reports (Johnson and Greene, 2017).

Chan, Johnson, and Shookner, (2016) discovered infomediaries play a key role as enablers of OGD and allow communities to recognize its full economic value. Respondents who took the semi structured interviews, mentioned access to infomediary website provided them a central source of social and economic data. The second most stated benefit was the local-level information which helped respondents to compare resources available in one community versus another. The most frequently stated economic benefit was time saved by users as the data was readily available without the need to compile it further. (Chan et al., 2016).

According to Janssen and Zuiderwijk, 2014 not only do Intermediaries create a valuable relationship between the producers and consumers of OGD, they support broad public values like transparency by allowing users to analyze, manipulate, combine, or visualize the collected information. Roberts, A. (2014) also considers intermediaries as champions of transparency, at city level, because of their trusted and vibrant network of other intermediaries, producers, and users.

This suggests intermediaries empower, educate and advocate the use and reuse of open government data in the community. Portals organized by intermediaries play an important role in demystifying open government data for citizen users. The portal infrastructure like features, tools and applications can help users use, reuse, compare, and contrast data. This helps help users make informed decisions and to extract higher value from data (Schalkwyk, Willmers, & McNaughton, 2015; Kingsley and Petit, 2014).
**Indirect Users.** The full list of OGD users is growing rapidly but following users are regularly mentioned as interested groups of users - private sector, nonprofits or community groups, academics and researchers, journalists, and media organizations (Chan et al., 2016; Safarov et al., 2017). The following section will cover some clearly defined end users with their characteristics.

Journalists as user groups refers to people who write for traditional newspaper, blogs, and in various social media outlets. They are most interested in trends, and lessons from datasets that they can be used to create more compelling stories. As a user group, journalists are keen to access and validate the recency of data sources on which their articles and info graphics are based (Gravesa, and Hendlerb, 2014). Business users like entrepreneurs and company managers are revenue driven users who seek OGD to market their products and services (Susha, Gronlund, & Janssen, 2015b). Business groups use OGD as a resource for decision making, as a catalyst for innovation, and startups and create diverse and sustainable business models that create value for users, busines and society at large (Jetzek, Avital, & Andersen, 2019). As a user group, business users have the most access to data technology like data mining, data analysis but observing their entire utilization can be difficult because it’s either hidden under trade secrets or not their core activity (Safarov et al., 2017).

Developers as a user groups pursue goals like standardization of OGD process and create tools (Kassen, 2014). Developers aids in the availability of OGD online by creating, accessing and integrating information into Application program interface – API (Hivon and Titah, 2017). Developers collaborate with business groups to create innovation and services in the form of startups (Jetzek et al., 2019). As primary users of OGD, developers are adept in accessing, and decoding the data for their needs hence face less technical barriers than any other group. Their concerns are related to quantity, quality, scope, and formats of OGD that hinders their development of current or new services (Kassen, 2014).
Researchers, depending on their background, explore OGD to inform and investigate policy, process. (Gravesa, and Hendlerb, 2014). As a user group, researchers need both qualitative and quantitative context in data (Safarov et al., 2017). Researchers in certain fields like healthcare find openness, availability, and limited engagement in OGD a challenge (Martin, Helbig, & Birkhead, 2015).

Even though majority of user studies in OGD domain are estimates about users’ (Safarov et al., 2017) the above studies have helped narrow prospective users for this study like journalist, researchers, non-profits, and business sector managers with some indication about their usage. This information will be useful while drafting tasks and scenarios. Very few empirical studies have been conducted on users’ and their usage of OGD – an opinion that has been shared consistently by researchers (Safarov et al., 2017; Thorsby et al., 2016; O’Connor, J., 2015).

Motivation. It’s important to understand why do users engage with Open Government Data (OGD) and what is their motivation to access it. According to Davies (2010) users engage with OGD: to understand the government, improve government through digitalization, create technological innovations, seek recognition or profit, solve specific problems and mix public and private sector to provide novel services.

Wirtz, Weyerer, and Rosch (2017) used standardized online survey with 210 citizens, to determine citizens’ intention to use open government data. They found ease of use, usefulness, intrinsic motivation, and to some extent internet competence are significant factors why citizens seek open government data. The study found citizens perceive open government data to be useful when it’s to easier to find, access, and understand the data. This increases citizens usage intention. In their study, internet competence had a lower effect than ease of use and usefulness but it was a crucial resource that facilitated the use of data. Apart from ease of use and usefulness, citizens in this study were motivated to use OGD when they believed the data will enhance their individual performance which is closely tied to intrinsic motivation and not extrinsic.
motivation. The authors of this study found what drives users’ are factors like inner conviction, personal exploration, joy, and interest – which then makes it challenging to convince and engage users (Wirtz et al., 2017). Portals and the available features would need to be designed in a manner that actualizes the perceived usefulness and ease of use to sustain consistent open government data (OGD) usage.

Some suggestion offered by Wirtz et al. 2017 for online OGD platforms can be relevant for this project like usage of usability standards, and adjusting online platforms according to the needs and capabilities of users to understand various drivers of intrinsic motivation. In addition, the researchers suggest user engagement strategies like customization, multi-channel strategies and gamification to encourage satisfaction and fun in the intrinsically driven OGD users (Wirtz et al., 2017). These practical solutions are useful but will need experimentation during user research and subsequently in the design phase to match the users’ expectations.

**Usage.** Generally, user groups perform five prominent activities on open government data (OGD) portals. Users visit portals to discover, analyze and visualize data. OGD portals also act as a platform for users to connect, provide feedback. Users also visit portals for analysis and assessment of data quality (Zuiderwijk, Janssen, & Susha, 2016). This broad understanding of activities can be used during the research phase in identifying and matching activities of users. However, usage of OGD especially at city level started to emerge from a study done by O’Connor, J. (2015). The researcher studied open data initiatives in the U.S. city of Raleigh. Using a self-reported survey O’Connor, J. (2015) found, most users were white, educated, and working age (25-55). Both male and female users used OGD services. The majority of users had some sort of post-secondary education with a computer and mathematical background. In the same study, O’Connor, J. (2015) compared his results to San Francisco’s open data initiatives. The researcher concluded that majority of users in both OGD initiatives downloaded
datasets for browsing and were single-use visitors looking for specific information. (O’Connor, J., 2015)

**Challenges**

Many scholars think the full potential associated with open government data (OGD) has not been realized (Attard et al., 2015). The high expectations of user’s participation through OGD portals were based on the assumptions that usage would be high, but in reality, user participation has lagged and this has reduced the estimated value from OGD (Susha, Gronlund, & Janssen, 2015a). There are other multi factorial challenges related to topic of OGD which are beyond the scope of this study - like legal and privacy (Rosnay and Janssen, 2014) and trust related issues (Yoon and Copeland, 2020; O'Hara, K., 2012) that can influence the user experience. The following challenges were included because of their direct and indirect impact on interface and interaction on portals.

**Data Issues.** Open government data (OGD) at all levels is heterogenous, cross disciplinary, and subjective (Nahon, Peled, & Shkabatur, 2015; O'Hara, K., 2012). OGD topics can also be as varied as health, crime, housing, and transport all presented on a single portal. In addition, data under each topic can have their own semantics, standards, and schemas – which creates challenges for publishers in aggregating and presenting data to users. The wide variety in datasets and structures can make even simple comparison and aggregate analysis of data a challenge for users. (Attard et al., 2015).

The underlying heterogenous data also displays metadata issues. Meta data are information which helps users discover content like title, description, last updated date etc. (Bascones and Staniforth, 2018). This study explored usage from a presentation standpoint hence the backend and technical aspects of metadata are not a part of this study, but its effect on making content searchable, discoverable, interpretable for users is
recognized by many scholars in different forms. To illustrate, Kubler, Robert, Neumaier, Umbrich, & Le Traon, (2017) found incomplete, poor quality, meaningless, and incorrect metadata led users to misinterpretation and incorrectly use data. In addition, technical adoption of metadata standards and schema in the OGD has been inconsistent, which can lead to poor usability of data (Xiao, Jeng, & He, 2018; Kubler et al., 2017). According to Attard et al. 2015, researchers in OGD domain have approached usability issues from data publishing perspective and not from user consumption perspective. This suggests the current solutions that are offered to OGD users are dependent on publishing capabilities and limitations and are not user driven solutions.

**Discoverability.** The sheer quantity of data, lack of powerful search and browse capabilities together makes it difficult for users to locate data. If users cannot locate the data, they are most likely not going to use the data, no matter how much value publishers and infomediaries may want to assign. National level open data portals like data.gov has more than 200,000 datasets from various sources (Kim, 2019). State websites like maryland.gov display 1,486 data sets from all the counties and operational agencies (Maryland.gov, n.d.). Neighborhood level OGD portals carry 50 Indicators or 8000 data points and is the subject of this study (Baltimore Neighborhood Indicators Alliance, 2018a). Each year data keep increases and this leads to users receiving too much information. This makes users task of searching and finding appropriate data challenging (Zuiderwijk, Janssen, & Susha, 2016). At city, level where this study resides, the datasets are less scalable and operable from a technical standpoint, with national datasets making it hard to find, compare local datasets with national datasets (Yoon and Copeland, 2020).

An EU study of focused on governmental websites concluded that finding appropriate data was difficult for users. Only 8% of the websites had filters, field-based search was available only on 6% of websites reviewed while map search accounts for only 4% of search (Petrychakis, et al., 2014). While a Greek study of OGD portals found search features were bloated with added information like policy details and research
papers which may not be important for all users. (Alexopoulos et al., 2014). Just like searching, browsing can be difficult for users when similar datasets are described using different terms and vocabularies (Ding, Peristeras, & Hausenblas, 2012). Together this creates an information overload scenario (Zuiderwijk & Janssen, 2014) which can overwhelm the users (Ho and Tang, 2001) as they have to struggle to discover data.

Features or the Lack of it. While portals help publish vast number of datasets, the capacity of current features and tools to help users analyze, and visualize this rich data looks limited. This can lead to lower participation and engagement because users will not be able to make connections and get value from the data with limited features.

An EU focused study found the most frequently provided feature, beside access to data, was groupings of categories for users to browse and free text search features (Petychakis et al., 2014). For any analysis, users need more than access - they need context. A Greek study by Alexopoulos, Spiliotopoulou, & Charalabidis (2013) found OGD portals provided limited information describing datasets. Furthermore, if the data are not interpreted and presented correctly there is a risk of false conclusions as Conradie and Choenni (2014) found in their workshop and interview-based study. The researchers observed that interpretations by users who might not have prior knowledge about the goal of data or topic could lead to misunderstanding, and misinterpretation of results (Conradie and Choenni, 2014).

Data visualization features like maps holds promise in the OGD domain because they can be used by both experts and nonexperts to find connections in data (Liu, Bouali, & Venturini (2014). However, while evaluating the OGD infrastructure, Zuiderwijk, Janssen, & Susha, 2016 found a general lack of data visualization features and support for users. According to Liu et al., (2014) its challenging, even for expert users, to find global relationships and details in large data sets because of limited options to visualize and interact with data. Even in national level OGD portals features fell short in helping users’ access, discover, and reuse data according to Machova, and Lnenicka, (2017). This shows

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the current set of available features on OGD portals are not comprehensive and evolved
efficient enough to help user’s gain insight and context from the data.

**Hesitated Users.** User Participation and engagement are the basic tenants of open
government data but users are hesitant to participate and engage with OGD because there
is a general lack of opportunity and awareness, widening skill gap, and higher
responsibility put on users.

Seiber and Johnson (2015) indicated a general lack of opportunity for users to
participate because of the multitude of ethical- economic tensions while publishing data.
At the interface level, users are unaware of what data are available even though the
concept of use, re-use, and sharing open government data has evolved from static PDF’s
to online access (Attard et al., 2015; Rosnay, and Janssen, 2014). Discoverability
challenge discussed earlier may be the obvious cause of low awareness of data among
users but there are other socially driven top-down challenges that restricts the availability
of data and subsequently its awareness. The perceived - risk based attitude of public
servants, hierarchical structures of authority within government, and bureaucratic
decision-making culture limits the availability of data for citizens (Wirtz, Piehler,
Thomas, and Daiser, 2015). Also, there are privacy concerns, copyrights, and licensing
incompatibilities, data regulation, and liability concerns which causes hesitation among
public bodies to open data. (Rosnay and Janssen, 2014). Together these challenges cause
limited availability and awareness of data - about its type and usage.

Zuiderwijk and Janssen (2014) identified 13 negative effects of open government
data calling them ‘dark side of open data’ which can create an unrealistic picture of the
potential benefits of open data resulting in unrealistic expectations from citizens and
other stakeholders. Birchall (2015) also provides a critical view on the government’s data
driven effort to achieve transparency through citizen’s participation. Birchall (2015)
argues, there are high expectations from ‘ordinary citizens’ to identify, monitor, and
analyze the government data for inefficiency, corruption, and other anomalies. Expecting
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citizens to be users – auditors-advocates-champions without necessary skills, and infrastructure is asking too much. Ordinary citizens don’t have the free time and skills to realize the entire gamut of social value in OGD so instead they will have to rely on ‘market’ to make sense of the data - the data intermediaries and citizen turned entrepreneurs (Birchall, 2015).

Hivon and Titah (2017) supports the opinion passed by Birchall (2015). The researchers defined citizens without technical background as ‘simple data consumer’. These citizens might use applications made with OGD but cannot use raw data to generate insight. Instead they rely on programmers and data integrator who act as data intermediaries for the skill and insight. Nearly 86% (12 out of 14) of their study’s respondents agree to this. Citizens are called upon to be responsible but their awareness, and skill are in shortfall. This discussion in some way explains the growing support for data intermediaries in the open government data landscape in the wake of hesitant users. The portals and the online infrastructure of features, tools, and application by data intermediaries then become vital to make government data relatable and actionable for people with variety of skill sets.

Case for User Centered Design

Open Government data (OGD) offers many solutions to social problems, but this grand promise is a work in progress (Zuiderwijk, and Janssen, 2014; Jetzek et al., 2019). There is a growing need to encourage users to participate and engage with OGD in order to take advantage of many potential benefits OGD has to offer. Intermediary run portals play a vital role in providing access, encouraging users to participate and engage with data at the community level. The portal features are valuable in helping users visualize, compare and contrast data, saving users time and helping them unlock the social and economic value in data (Chan et al., 2016).
However, the current set of features are generalized and basic (Thorsby et al., (2016; Zuiderwijk, and Janssen, 2014). Features have not yet taken full advantage of the available capabilities which can lead to higher engagement (Zhu and Freeman, 2019). OGD users are intrinsically motivated and they prefer ease of use and usefulness in features but the current designs of features are not very user friendly. (Martin, 2014).

Little attention has been paid to surrounding topics like content and the context – both of which can have an impact on user’s understanding of the data. In addition, the concern is that presenting features without providing adequate context can confuse users and misrepresent data (Conradie and Choenni, 2014). Put together, these challenges can result in decision fatigue and overwhelm users (Zuiderwijk & Janssen, 2014; Ho and Tang 2001). Lastly, the supply side research has been successful in identifying many socio-technical barriers, but the lack of attention on user’s perspective has created an empirical gap about usage (Susha, Gronlund and Janssen, 2015; Safarov et al. 2017). Simply put, users are not central to the OGD movement yet. This multitude of challenges and the knowledge gap of users and their usage can be mitigated by taking a user-centered design approach.

**What is User Centered Design**

User Centered Design (UCD) is an iterative process used to gain a deeper understanding of who will be using the product throughout the design and development life cycle (Usability.Gov, 2017). The idea is to create a product that suits the user, rather than making the user suit the product (Baxter, Courage, & Caine, 2015). UCD is driven by three sound principles that makes it possible to create a useful and usable product:

- An early focus on users and their tasks.
- Empirical testing of products with actual users.
- Lastly, the product is designed, modified and tested repeatedly with user feedback. (Rubin and Chisnell, 2008)
Methods. User experience designers mix and match various UCD investigative methods like interviews, and survey with generative methods like workshops in an iterative manner to clarify context of use, scenarios of interaction, and user’s need – both met and unmet. There are numerous methods to choose from and as a result, there can be many variations of the UCD process but generally a UCD process involves four phases as seen in figure 1 below:

![User Centered Design Phases](image)

*Figure 1. User Centered Design Phases. Interaction Design Foundation (n.d.)*

In the first phase, a designer or a multi-disciplinary team identifies who the users are and in what context and condition will they use the product. The challenges and constrains of the system are recognized. Following, which user and stakeholders’ goals and system goals are identified. The research done in the earlier steps then informs the concept and interaction design solution. Wireframes and storyboard are used to conceptualize design and depending on the goal of project, a high fidelity or low fidelity prototypes are used to communicate the idea (Snyder, 2003). The last phase involves checking the design against the user’s need, context, and requirements. How close does elements of navigation, information, interaction, and overall presentation match the user’s expectation. The designer continues to makes iterations in all relevant phases and makes progress towards decided outcomes. (Web Accessibility Initiative, 2008; Interaction Design Foundation, n.d.)

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Advantage of User Centered Methods. There is similarity in the principles of user centered design with open government data – they both help to create a shared understanding of the world around us. However, there are some tangible benefits of using user centered design in the open government data domain.

UCD research method, like contextual inquiry, can help to introduce and understand the missing voice of OGD users (Holtzblatt, Wendell, & Wood, 2005). The heart of such investigation can answer: Who are the users? Why do they access open government data at neighborhood level? What daily work do they do which require them to draw insights from data. Such investigation helps to uncover user context gaps and possible solutions. Secondly, as users are at the center of an UCD investigation, UCD methods can be tailored and scaled to understand user’s usage, context, and the different relationships users have with data. Lastly, literature review indicated current research with OGD users comes across as abstract (Safarov et al., 2017). This could be because of reliance on secondary research methods like case study and desk research. Such methods do not provide actual evidence of usage and are difficult to follow up with. A core requirement of making design decisions is gathering as much information as possible about actual usage. UCD methods like usability testing are suitable for such inquiry because they are based on observation of actual tasks and can be followed up. Finally, carefully selected UCD methods can validate test results, reduce assumptions, and helps the entire team to visualize the end result quickly without investing too much time and development effort. (Rubin and Chisnell, 2008)

In spite of their benefits, User Centered Methods (UCD) methods are not perfect like any other research. UCD methods like contextual inquiry interviews are self-reported. However, the qualitative data generated by self-reported methods needs to be supported by quantitative analysis or follow up observation studies like usability testing. Also, the researcher would need to balance what the users say and what they do in order to arrive at some assumptions about interface and interaction design and this will depend on
researcher’s skill. There are other ways to reduce bias and improve research results - by involving more than one researcher, and combining multiple methods to arrive at results (Rohrer, 2014). However, these suggestions can be time consuming and can make quick iterations difficult.

**Research Approach.** Keeping the balance between rigors and practicality of this project, I choose to do one round of following user centric methods - Google Analytics Review, Heuristics Analysis, Contextual Inquiry, Usability Testing and Prototype Design and Testing. Below figure 2 shows my research plan and some indicative deliverables that will drive this user centric research. A unique aspect of this approach was that even though the end goal was to improve the usefulness and usability of compare years feature, the initial research methods were designed to accommodate a wider area of inquiry and then narrowed to page level specifics.
A few assumptions, before the methods and results section are necessary. The attention of this study remained at the presentation level – interface and interaction level and hence metadata and its impact are not part of this study. I will work with the current available data quality because improvements in quality are an ongoing activity. If users provide any feedback or comment related to quality or metadata, I will note it down and address its impact through interface and interaction design but will not investigate them technically.
Chapter 3: User Centered Methods

Summary

An analysis of stakeholder’s analytics account associated with BNIA website was done to spot opportunities for exploration. Next in the light of the analytics data, the heuristics evaluation of BNIA website helped to expose possible usability issues. The Contextual Inquiry interviews followed with actual users to document their usage and goals. This led to the usability testing of compare years feature. At the end, all research insights were transformed into two digital prototypes for testing.

Google Analytics

Background and Goals

I took the analytics first approach because at this first stage, I wanted to gather facts of BNIA website. The breakdown of user behavior, and actions available over a period of time can provide a head start into identifying problems which could become the focus of this study.

Google Analytics was set up for BNIA website. Google Analytics is a free web analytics tool, by Google, that collects, tracks and reports website traffic data (Google Marketing Platform, n.d.). This data then helps to understand what visitors are doing, how many visitors, where they came from, and their duration of stay (Miller, 2010). Google Analytics can aid UX researchers in three ways – identifying potential issues early, causes of issues and triangulating the quantitative and qualitative data (Nielsen Norman Group, 2013).

Methodology

I accessed Google Analytics on BNIA website. I viewed behavior flow, content, and audience reports. To enhance my understanding of the analytics data in relation to the
current hierarchical structure and content of the website, I created the sitemap (Appendix A). This sitemap was used as a reference throughout the research steps.

**Heuristic Evaluation**

**Background and Goals**

The analytics report identified Vital Signs as an important section of BNIA website, but many potential issues related to navigation, features, and content were identified. There could be many possible reasons for the poor navigation flow, low feature and search usage along with poor content engagement. To limit this investigation and take an educated guess about solutions in a difficult and poorly understood domain like open data, I conducted a heuristics evaluation.

A heuristics evaluation is a usability inspection method where one or more reviewer examines an interface such as menus, features, navigation etc. and compares it to recognized usability principles called heuristics (Interaction Design Foundation, n.d.). According to usability.gov, a reviewer or group of reviewers performs certain tasks and inspects a design to identify possible usability issues which can then be considered and tested. There are many advantages to conduct heuristics analysis – it can provide quick feedback and its results can be used with other user centric methodologies like usability testing to further examine potential issues (Usability.gov, 2020).

**Methodology**

I followed ten usability heuristic principles suggested by Nielsen, (1994) to evaluate the portal interface:

- Visibility of system status
- Match between system and the real world
- User control and freedom
- Consistency and standards
- Error prevention
• Recognition rather than recall
• Flexibility and efficiency of use
• Aesthetic and minimalist design
• Help users recognize, diagnose, and recover from errors
• Help and documentation

The heuristic evaluation was carried out in three stages: Task Preparation, Review, and Analysis. These stages are described below.

To begin, I browsed the entire BNIA website independently for an hour exploring the website. I looked at the flow and interaction of pages and content in light of previous knowledge from the earlier analytical report. Assuming a role of an architype user, I browsed the website again. I assumed a typical user of BNIA website may have some open data background and is aware of Vital Signs report. Users might have accessed or downloaded data from any of the 8 Vital Signs topic at least once a year.

The second time, I narrowed my focus by creating 4 tasks specific to the Vital Signs section which was the most popular section. Below is a list of representative tasks designed to encourage discovery and manipulation of Vital Signs data, starting from the homepage.

• Find a Neighborhood. Example, Fells Point.
• Find an Indicator - gun related crime data in Vital Signs
• Find a Vital Signs topic area – Crime and Safety. Browse few Indicators under a topic
• Under the Crime and Safety section, compare one Indicator data for last 2 years and then explore download options.

I performed the above tasks. While doing these tasks, if an issue was encountered, that issue had to violate at least one of the Nielsen’s ten heuristics in order to qualify as an issue (Nielsen 1994). I wrote short descriptions and indicated the corresponding heuristic that was violated as seen in Appendix B.
For final evaluation, I reviewed the website again this time checking it against previously gathered problem descriptions. Any fresh insights were added to the same heuristic report as seen in Appendix B.

**Contextual Inquiry**

**Background and Goals**

Heuristic Evaluation (HE) identified many potential issues in the *compare years feature*. However, the user’s actual usage was not familiar to either back or disprove HE findings. Also, the broader socio-cultural context of the underlying open data was needed to as background. With the goal of finding actual situations where the comparison feature would be useful and necessary, contextual inquiry was conducted.

Contextual Inquiry (CI) is a user centered technique that belongs to the larger design process called Contextual Design. CI is a qualitative data collecting activity. Field interviews are conducted with actual users in their workplace while they work, observing and inquiring into the structure of the user’s own work practice. This helps to bring focus on the practices and daily activities of users for whom the design is intended and not just the self-reported practice or policies (Holtzblatt, Wendell, & Wood, 2005). Even though CI is time consuming there are many benefits: producing detailed information about high level user goals, their needs and wants. Using this method, accurate and real insights are possible because CI is conducted in participant’s natural environment and as close to their tasks at hand (Think Design, 2020).

**Recruitment**

The stakeholder sent an email to their users requesting a research interview. The format, goals, location and time of the interview were shared. See Appendix C for the email content. I received 4 responses and I scheduled 4 interviews with the following people – an Open data Implementation Advisor, a Project Manager and a Social Impact Manager, and a Health Policy Analyst. All interviewees held at least a Bachelor’s degree,
were in the age group of 27 to 35 years and had at least 2 years of exposure to open data.

Methodology

The four one-on-one field interviews lasted for a maximum of 2 hours each. To maintain consistency of question and order across interviews, I prepared a script for each of the parts of the interview. The entire audio of the interview was recorded using a free audio app – Smart Recorder. I also supplemented the audio with hand written notes especially during the middle section of the interview.

All interviews followed the 4 key concepts of CI: Context, Partnership, Interpretation and Focus (Holtzblatt, Wendell, & Wood, 2005, p.80). To keep context, interviews were conducted at user’s workplace and in their natural surroundings using their own laptops and computers. The goal was to record ongoing experiences and see real motives in display.

To build partnership and relationship, the master / apprentice model was used where the interviewer acted like an apprentice to the interviewee. This was demonstrated to the interviewees during the start of the session. To provide meaning to the observed actions, interpretation was conducted by asking the interviewee open ended questions and sharing interpretations with the users instantly. For example, interviewee said, “This left side confuses me”. I asked, “What exactly confuses you on this left side and why”. Lastly, any surprise, pause, nods and emotions were noted.

To maintain focus, interviewees were informed during the initial recruitment phase and reminded one day before about the master / apprentice model of the interview and to focus only on discussing the compare years feature and not the entire BNIA website.

Sessions

On the day of the interview, focus was maintained by following a list of questions as closely as possible for all four interviews. Each interview was divided into three parts -
introduction, observation, and end. Further, each interview part had different questions. To see the informed consent and questions see Appendix D.

The first part of the interview - Introduction collected summary about interviewee’s daily role, responsibilities and goals. Opinion data was collected about the BNIA website. This part of the interview lasted for less than 30 minutes.

The middle of the interview was used for observation where interviewees were asked to revisit or create any report, charts, analysis made using compare years feature. Their usage, sharing, and reusing of data were observed and interpreted. This part of the interview lasted for less than 55 minutes.

The questions at end of the interview probed the attitude, frustrations and opportunities with the comparison feature. This part of the interview lasted for less than 20 minutes.

Usability Testing

Background and Goals

Contextual inquiry introduced real insights about users, validated previous issues raised and introduced new interface level issues. Going forward it was important to make an informed decision about the overall direction and design of compare years feature. The interface level inefficiency and dissatisfaction that surfaced during contextual inquiry needed to be observed. With the goal of validating previous issues, usability testing was conducted.

Usability Testing is a user-centric research process whose objective is to inform design, identify design problems and frustrations that will eventually lead to a useful, effective, efficient, and satisfying product. Usability Testing is done by testing participants, who are representative of the target audience by giving them representative tasks. An important feature of this research method is that an interface is tested and not the users (Rubin & Chisnell, 2008).

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Usability Testing has limitations because it is always conducted in an artificial situation and tests results do not entirely suggest that a product works or does not work. In spite of limitations, when conducted with care, and as a part of overall user-centered design approach the results are reliable indicator of potential problems (Rubin & Chisnell, 2008, pp.25-26).

**Participant Recruitment and Characteristics**

Baltimore Data Day is an annual city-wide open data workshop organized by the stakeholders in Baltimore ("Baltimore Data Day," n.d.). I administered a paper-based UX screener on Baltimore Data Day. The primary objective of this screener was recruitment for the usability testing. The secondary goal was to obtain some usage and preference data about Vital Signs Report and compare years feature.

In all there were 24 accurate responses. To be considered for usability testing a participant had to be aware of Vital Signs and in the past 5 years viewed or downloaded Vital Signs data. As a first step, responses from the following user groups were identified: Non-Profits (5 persons), Researchers (3 persons), Neighborhoods (2 persons), Business (2 persons), Journalist (1 person). Neighborhoods Associations, Journalists and Researchers were already identified at the start of this research. Business and Non-Profits were new groups identified at this stage. To see the questions and the entire analysis report see Appendix E. The respondents from the above 5 groups were contacted via email for recruitment. Below Table 1 has characteristics of 6 respondents who agreed to be a part of the study.

Table 1

*Participant Characteristics in the study*

<table>
<thead>
<tr>
<th>Area</th>
<th>Highest Education</th>
<th>Age</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 Nonprofit</td>
<td>Bachelor</td>
<td>40-49</td>
<td>Female</td>
</tr>
</tbody>
</table>
Methodology

This usability study was designed to accommodate some informal exploration at the start followed by representative tasks. The six participants performed all tasks in a sequential order to maintain consistency. I moderated all six tests in person using the thinking aloud technique (Rubin & Chisnell, 2008, pp.204-206) where participants provided a running commentary of their thought process while performing tasks. The results were analyzed qualitatively by observing the videos, saccades, and heatmap from eye tracking system.

Setup. The tests were conducted at University of Baltimore’s Usability Lab. This lab has a designated testing room and observation room. The observation room had a one-way mirror to the testing room from where the stakeholders observed some sessions.

The testing room was setup for an eye tracking study. Participants used a Windows PC and Internet Explorer 8.0 with a high-speed connection to the Internet. The PC that the participant used had Tobii T60 Eye Tracking system, collected participant eye gaze data, audio and video during the entire test. This eye tracking mechanism helped to identify, record, and analyze patterns of visual attention in web interactions.

Tasks. As all six participants came from different backgrounds every task was prepared to match the participants background with respect to usage on bniajfi.org portal. The personas created during the earlier contextual inquiry research helped to introduce goals and tasks. To see the four personas, see Appendix F. For example, some common
tasks which users performed around compare years feature were researching, synthesizing information to write reports. Data from this feature was also used to keep track of social programs. After being aware of such high-level tasks, I drafted task scenarios.

Task scenarios are actions that user experience researchers ask participants to perform based on their goals, motivation and context. The task scenarios were written to be engaging, realistic, and actionable to not give away answers (Nielsen Norman Group, 2014). As it was important to observe the natural exploration of participants while performing tasks, participants were not directly shown the compare years feature. Care was taken to sequence the tasks and task scenarios so they were as close to user’s general flow of work and at the same time testing goals could be achieved.

Appendix G has tasks and task scenarios for all other participants based on their professional background. To see the designed relationship between tasks, and the conditions required for a task to be marked as successful during usability testing see Appendix H.

Sessions

I used the thinking aloud technique (Rubin & Chisnell, 2008, pp.204-206) where participants were encouraged to share their thought process as they performed tasks. The goal was to understand user’s preference and expectations as they spoke about various aspects of compare years feature that were working or confusing for them. Each test session lasted for maximum of two hour per participant. As I was the only researcher, I took notes, kept time and moderated all sessions. Each testing session was divided into 2 phase - exploration and assessment.

The exploration phase was planned for 30 minutes. To begin, I read the orientation script which introduced the study and me. Participants were informed about the session plan, reminded about thinking aloud technique and that the study was testing the interface and not users’ capabilities. I kept the line of inquiry identical for all six
participants. Every participant was asked the same questions such as their role at work, their process of gathering and using open data, favorite open data websites and how do they compare it with the BNIA website. The participants were free to visit any website, show and talk so that qualitative and preference data can be collected. To end the exploration phase, all participants were directed to BNIA website homepage. I asked questions on homepage readability, findability and organization of Vital Signs data. To see the orientation script, list of questions asked see Appendix I.

After exploration, the participants were transitioned to assessment phase which lasted for approximately 45 minutes. There was less interaction between the participants and me in this part as the goal was to let participants perform realistic tasks. To start, I demonstrated the think aloud method by taking target.com website as an example (Rubin & Chisnell, 2008, pp.204-206). I encouraged participants to share their thoughts and express their opinions. I reminded them that while doing upcoming tasks their commentary would provide valuable qualitative data.

Each participant was given one task at a time to perform. The participant got the first task on the computer. To move on to subsequent tasks, I asked participants to use clear sentences like “I am done.” Once I got a verbal confirmation of the task being completed, I handed the participant another task on paper. The participants were free to discontinue and move to another task as they wished. During tasks, if participants faced difficulties and showed signs of frustration, I gave them ample time to work through their hindrances. I asked users three neutral questions as hints before moving on to the next task and marking the incomplete task as a failed task during analysis.

- Is there anything on the screen to help you?
- Stay on this page, but can you look somewhere?
- Will it help if you start from the first step?

After completion of all tasks, participants were asked specific questions regarding their use of compare years feature on that day as seen in Appendix I. To end the test, I thanked participants for their continued participation in the study.

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Prototype Design

Background and Goals

Usability testing showed obvious strengths and weakness in compare years feature. The previous user research methodologies helped to understand user’s expectations in different context while using the feature. This final phase focused on synthesizing all the opportunities, challenges, and assumptions into a prototype for testing.

According to usability.gov, a prototype is a draft version of a product that allows users to explore ideas and show the intention behind a feature or the overall design concept before any time and money is invested (Usability.Gov, 2014). Prototypes can take many forms. Early on simple paper sketches helps to validate concepts and assumptions while the detailed prototypes at the end can generate both insight and action (Dam & Saing, 2019).

Prototypes may be blunt research instruments to find deep interaction design problems but they are well suited to discover if users’ have broadly understood the concept, navigation and content. Whether or not users can easily go where they want to go using the multiple paths in the interface can also be determined using prototypes. Lastly, prototypes that use real content can be valuable research instruments to understand content and layout priorities especially when users seek information and make decisions (Snyder, 2003).

Design Options

Based on results of previous empirical insights, two meaningful distinct design approaches were pursued. The goal of this enquiry was to gather user’s feedback on the two options and probe why would they prefer one version over another.
**Option 1**

Usability Testing showed users suffered from poor data and navigational context before they even accessed the actual comparison interface. To provide data and navigational context, option 1 had a new landing page for every Vital Signs topic. Users can get access to contextual data about the Vital Signs topic in the form of curated Vital Signs report – seen as *2016 Data story* in figure 3 below.

*Figure 3. Census Demographic Landing Page with Tabbed Indicator Navigation.*

The above page also provided navigational help, both infrequent and frequent users could use the blue *Explore Indicator tabs* in the right-hand column to select grouped Indicator before the actual comparison interface. Frequent BNIA website users who are might be aware of Indicator names could type in the Indicator name directly in
the *Search Indicator* textbox thereby speeding up the selection step. An easy visual navigation approach using icons is suggested for the eight vital sign’s topics.

From the above Census Demographic landing page users navigate by clicking on the average household size Indicator link. Figure 4 below is the average household size Indicator page.

*Figure 4. Indicator Page comparing 5 Neighborhoods using Trend lines*

Earlier usability testing showed users were interested in curated, quick and visual access to their selected neighborhood. In option 1, users are encouraged first to take
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control by narrowing their top 5 neighborhoods and then comparing data them together using a trend line. With easy access to charts, maps and tables in the form of tabs on the same page, navigation remains confined to a single page and thereby the intent was to reduce lengthy user journeys.

The above design was arrived by synthesizing all previous research results, sketching on paper and finishing with visual design. As I finalized the flow of information and layout on paper, I moved to design phase. With strategic use of shapes, colors and contrast I enhanced content, navigation, and the presentation layer to support the design goals. Using visual design principles like contrast, repetition, alignment and proximity, I created layouts to enhance the content and put the user in control - to see the entire completed design set see Appendix U.

Option 2

There were no major issues noted during usability testing that stopped users from completing the comparison task with just tabular data. However, the overall experience was not pleasant because users got frustrated with interface level imperfections. The design direction for option 2 was to keep the current comparison interface same but reduce the interface level imperfections. Option two also kept the same navigational and information flow unlike option one.

Below are 2 key page designs of the Indicator Page with compare years interface. As seen in figure 5 below, the left navigational menu was simplified visually from the original to clarify which page the user has selected. To improve readability, font sizes were increased from 12 to 13 Arial. A confusion among users during usability test was which button to click while comparing - compare years or update selection. To avoid this confusion, the new interaction had only one button for comparison – compare years. Only 3 colors were used. Additionally, these colors were used strategically to get users attention on important interactions like Compare Years and Navigation. Grayed out

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checkboxes and simple language was used to inform users if data was unavailable without making users click – as seen in the pop box in figure 5.

**Figure 5. Option two - Landing Page with Default Indicator before comparison**

Once the user clicks the Compare Years button the same page refreshes to show the compared data. This design provides data context by providing Indicator description, source and easy access to related content like Chart, Trends and Map for further read. Ample space around each table row would make it easy for users to read. Further, alternating shaded table rows any color coding was used to assist users in scanning their compared neighborhood data quickly. Figure 6 below is the average household size indicator page after comparison.

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All the results of previous research were at this stage available and the actual content was easy to access from BNIA website so I designed option 2 directly using Adobe Photoshop.

For user testing both options, I exported the designs as JPG’s into Microsoft PowerPoint program. I created hot spots and mouseovers for users to explore, navigate while doing the tasks. The decision to use PowerPoint program to create a mockup was taken because of it was quick, versatile and easy to create clickable prototypes.

**Participant Recruitment and Characteristics**

All six participants from the earlier usability testing phase were approached with an email request to participate in the prototype testing phase. Two participants volunteered to take
part in prototype design and testing phase. Below Table 2 has characteristics of two respondents who agreed to be a part of prototype testing.

Table 2  
*Participant Characteristics for Prototype Testing*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Area</th>
<th>Highest Education</th>
<th>Age</th>
<th>Gender</th>
<th>Previous Compare Years Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Nonprofit</td>
<td>Bachelor</td>
<td>40-49</td>
<td>Female</td>
<td>Did tabular comparison</td>
</tr>
<tr>
<td>P3</td>
<td>Researcher</td>
<td>Graduate</td>
<td>30-39</td>
<td>Male</td>
<td>Did visual and tabular comparison</td>
</tr>
</tbody>
</table>

**Methodology**

To derive the structure for analysis, the actual audio recordings was used. As there were only two participants, I used paper to analyze the qualitative data. I identified tasks success or failures based on the criteria as seen in Appendix X. The verbal commentary of participants - their comments, and suggestions were used to form themes that either support or contradicted the research goal.

**Sessions**

I conducted two prototype testing sessions individually on my laptop. Both sessions were conducted in a reserved study room at University of Baltimore’s library. The audio of the interviews was recorded using a free audio app – Smart Recorder. Option one was tested before Option two.

I read from a standard script found in Appendix P where I clarified that the latest *compare years feature* designs were works in progress and the goal was to get early feedback. To set expectations, I mentioned that the work in progress designs have limited interactive capabilities – only mouse over and few click areas.
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The same diligence while designing tasks for earlier usability testing was followed. Tasks were prioritized in a way that I could observe what worked or did not work in each version. Tasks and Task scenarios were customized based on user’s background. As Option one and Option two had different design approaches, their task success criteria were different. See Appendix Q for list of four tasks, and task scenarios with their success criteria’s.

Both users started the testing session, from census demographics landing page. From the census demographics page, users were given their first task one at a time written on paper. Users navigated and performed the tasks by finding and clicking certain hotspots. For every page user’s navigated, they were encouraged to talk about their first impression and what actions could be possible on that page. These answers were used for qualitative analysis.

To move on to subsequent tasks, I requested participants to end with clear sentences like “I am done.” Once I got a verbal confirmation of the task being completed, I handed another task on paper till all four tasks were completed in option one. After all tasks were completed, users were asked follow up and clarifications questions which were chosen carefully based on their use on that day and some previous research results.

- Was there something that was not clear about compare years feature to you in this design.
- Did the content and layout help you understand, for example, what are the sources of for this Indicator.
- Do you think the feature design is intuitive?
- Did this design give you an impression of being in control?
- How was your experience using the (option one vs online vs option two)?
- Which option do you think will add value to your work?

I followed a similar pattern for reviewing the designs for option two. To end, I asked participants – Between the two options which do you prefer and why? Both
participants gave a clear answer that they prefer option one over option two. The participants articulated their reasons for or against a design option, and their comments while doing the tasks together helped draft a prototype design report.
Chapter 4: Results

Organization

The results are organized in 5 sections. First, the Google Analytics presented the introductory quantitative background and user behaviors seen on bniajfi.org. Second, the heuristic evaluation showcased possible issues in the compare years interface in comparison to accepted usability heuristics. The above two results help define the project.

The third section shows research of actual user’s work process presented as observation reports and personas created during contextual inquiry. The fourth section has usability testing results which confirmed previous issues and discovered new challenges in the compare years interface. The last section has a report on why users preferred one digital prototype over the other.

Google Analytics Report

A total of 11505 users visited stakeholder’s website –bniajfi.org, out of which 90% of the users were from United States. Nearly 87% of the users used Windows desktop, mobile users were 10.1% and tablet users were 2.3%. Nearly 90% of the total web traffic was local - from Baltimore, Maryland.

The most visited section was Vital Signs. In the Vital Signs section, Census Demographics, Crime and Safety, Children and Family Health, and Housing and Community Development together got roughly 52% of the page views. The most visited pages under vital signs section were community profile pages, data download, and all indicator pages. The top 5 viewed community by page views were Baltimore City, Sandtown-Winchester-Harlem Park, Upton-Druid Heights, Washington Village-Pigtown, and Cherry Hill.

A richer understanding of users is possible with understanding user types, their engagement levels, and flow through the website. Out of total 11505 visitors, 60% were new visitors and 40% were returning visitors.
Browsing was the most preferred way to look for content on bniajfi.org website. Users navigated from one section to another by first taking a detour to the homepage. Most users arrived at the homepage organically, through Google Search. 90% of the users used basic keywords - for example, Baltimore neighborhood Indicator Alliance or BNIA. The keywords indicated user’s intent just to find and land on the bniajfi.org homepage. Based on the events tracked, users accessed search functionality but quickly exited back to the homepage without exploring the entire search results page. The search recorded very few direct indicator names. The majority of the web traffic stayed between the homepage and Vital Signs section pages with very little interaction with the rest of the content such as Help or Resources. On an average, users viewed 3.45 pages in one session. The lowest session duration was 10 seconds while the longest session lasted 30 minutes. Lastly, 52.18 % of visitors visited just one page on bniajfi.org before leaving to visit another website indicating a high bounce rate.

Nearly 83% of the traffic, downloaded the entire Vital Signs Report directly from the homepage links. Most downloaded reports were in the Census Demographic, Housing and Workforce and Economic Development, and Children and Family Health section. Lastly, during this analysis the analytic account was not setup completely; hence user demographics, certain events, goals and funnel data were unavailable.

**Heuristic Analysis**

There are three main takeaways of heuristic analysis:

**Homepage**

The homepage kept the focus on Vital Signs. The Vital Signs content being grouped may help users to access Vital Signs data more easily. For example, map and community drop down are two easy ways for users to access neighborhood pages. The address lookup feature showed signs of poor interface design. The entered address did not match the results. Instead, the “Information for” and “Quick Links” could be useful for both experienced and inexperienced users in making their interaction efficient.
homepage has clear starting points for tasks but there are usability challenges. Vital Signs Report has a homepage that looks similar to the main homepage with more in-depth content.

**Navigation.**

For the second task of finding Indicator, the three navigation options behaved like a tab but looked like a button, challenging user’s real-world concept of how tabs look and work. Secondly, both navigation and content remain hidden under tabs users will have to recall both the navigation options and content. Search feature which acts as an important interaction accelerator for both novice and experienced users, was not helpful during tasks. Neither the search helped to reach the right vital signs section nor did it provide any help when accessed.

**Vital Signs Compare Feature**

The only data feature on the website that cross references neighborhood and Indicators data - a core of Vital Signs, violated many of Nielsen’s Heuristics for user interface design (Nielsen, 2010, Link). Even before accessing the *compare years feature*, users could be face issues with respect to low visibility of system status and loss of control navigationally (Nielsen, 2010, Link). On landing, a default Indicator data is shown which the user has not chosen to compare. Users have to take the unnecessary step of changing from the default Indicator to the desired Indicator. The web interface fails to clarify this and leaves the responsibility on users to orient themselves. Any change from the default indicator page involves scanning a long, unsorted left Indicator menu. This menu, which when clicked does not provide visible feedback that a new Indicator data is loaded.

The entire *compare years feature* controls - change of topic drop down and selection of years checkbox was hidden under one single button; some users may find it

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hard to locate it. As users find the controls, first they would have to select the years checkbox and then click “Update your selection button which is not laid out in order.

The BNIA website does not allow users to save their selection of Indicator – this requires users to constantly change from default indicator, pay attention in locating their selected Indicator / neighborhood combination for every Vital Signs section they visit. To spot a few neighborhoods and read their values from a 55-row table involves a scanning up and down the table. Sorting the tables is available but it’s very basic – alphabetic and numeric.

After the comparison choices are made, the data table does not highlight change in data – users have to locate any change manually. Users cannot narrow the choices of neighborhoods they would like to see. For comparing, users would have to constantly use the scroll bar up and down the table to track few neighborhoods and values. The entire navigation and the page level interaction combined carries high cognitive load (Whitenton, 2013).

Users would be forced to do lot of trial and error in selecting years because neither the compare years interface nor any dialogue boxes guides users in selecting years that have data to compare. This would result in longer user journeys. Lastly, error prevention heuristics which call for preventing an error in the first place are missing because users would commit errors like selecting years that have no data.

After comparing, downloading options were visible and easy to use but their visual presentation as a button did not match the real world’s presentation of icons or a combination of text and icons. The downloaded excel and pdf files did not have the BNIA’s name, contact or time stamps - quoting such a webpage would be extra work on user’s part.

On any Vital Signs section page, users can view and compare Indicator data only in tabular form for 2 years while an individual Indicator page user can visualize and compare similar data for 5 years using charts, trends, and maps as well as tables. Also, while navigating to some Indicator pages, the drop-down options for years do not reflect
the information displayed as seen in Appendix J.

Contextual Inquiry

Analysis

All 4 interviews were analyzed through an interpretation session of 3 hours each. I heard every audio recording from the interview within two days of the interview. The hand-written notes during the interview and audio generated notes together were organized on paper as seen in Appendix K. This unstructured qualitative data from all the sessions was interpreted to create personas and insight report.

Personas

Persona is a realistic character sketch representing one segment of a web site’s targeted audience. Persona summarizes user research findings and brings that research to life which helps organizations build empathy, focus on specific audiences and make decisions. (Mulder & Yaar, 2007)

The combined understanding of behaviors and attitudes, goals and needs through contextual inquiry helped prepare four role and usage driven personas: Catherine – the open data champion, Marlin – the map expert; Elizabeth – the policy player; and Jayden – the community constant. The next four paragraphs carry highlights of each persona. To see all personas in detail, see Appendix F.

Catherine, an enthusiastic advocate of open data likes to promote the use of open data at her company and among clients. She visits bniajfi.org at least quarterly for neighborhood data. She conducts exploratory analysis and sometimes researches on specific vital sign topics. Highlighting the limits of the compare years feature, she said, “Oh no, I can only compare for 2 years.”

Marlin, a map expert, is interested only in downloading data so he can make his own maps and do the research. As an infrequent visitor to bniajfi.org, compare years feature was not his first choice to interpret data; instead, he likes doing a visual analysis with his own map. The data issues and confusing controls of the feature frustrated him.
Elizabeth, a policy aide visits bniajfj.org only when certain news based on Vital Signs data catches her eye through the BNIA newsletter. She uses neighborhood data for her synopsis, reports and blogs directed at government officials.

Initially she did not notice the compare years feature but after using the current one, she found it was not conducive to comparison nor decision making. She said, “Compare Years was not my first choice.”

Jayden, who works at a nonprofit, visits bniajfj.org to research indicator data in order to support his grant writing process. He is mainly interested in his neighborhood data. He is the only one who seems somewhat satisfied with the current compare years feature. He said, “Current 2 years comparison works for me.”

**Contextual Inquiry Report.**

Along with the above personas the analysis of the unstructured qualitative data also led to four attention points that backed previous research results and also helped shape the next research stage of research: usability testing.

**Overall Vital Signs Usage.** Users found the Vital Signs section as the most relevant project out of the many BNIA projects. These four users have some understanding of the eight Vital Signs topic but the knowledge surrounding Indicators – their names, availability of Indicators to compare, the knowledge how others use Indicator data to create value came across as unclear. Users are also interested in looking, comparing and downloading data for only 5-7 neighborhoods and not the entire set even though it gives them comfort to know that data is available for the entire set of 55 neighborhoods. Users roles and responsibilities defined how they presented Vital Signs data in their daily professional lives and subsequently the reuse of data. For example, Elizabeth, a policy aide, while writing an internal report compared 2 years of data, took a screen shot of a few neighborhoods, saved it as jpg to be inserted in her report and cited bniajfj.org, while in another instance she took the same data and wrote a narrative to be

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Compare Years Feature. All four users found the time series comparison feature to be valuable for drafting reports, analysis, content creation and even personal exploration. However, all four users were infrequent users of this feature – they used the feature quarterly, yearly, and sometimes only need based. Two out of the four users had to be reminded of the availability of the compare years feature on the page. Earlier done heuristics analysis unearthed signs of poor visibility of system status, loss of control and freedom and general lack of help to recognize, diagnose, and recover from errors. All 4 users showed behaviors in different proportion that validate previous research findings from heuristics analysis.

To illustrate, Catherine, from the homepage, successfully chose the topic of Housing and Community Development from Vital Signs. After she landed on the Housing and Community Development page, she quickly started scanning the left menu for few seconds to recollect her last experience.

She selected “Percentage of Properties Under Mortgage Foreclosure.” She then clicked on compare years feature. She easily selected the years 2014 and 2016 then stopped to ask, “Do I use Update? I haven’t done this in some time.” This anecdotally shows she lost control from the interface.

She guessed and chose “Update your Selections” button. The page refreshed and defaulted to Affordability Index data. Surprised, she said, “Its defaulting to Affordability Index.” Now again, she had to visually scan, find, and select her choice of indicator from a long list to view the data – another instance of her losing control.

These observed behaviors show the unnecessary steps users have to take to find and then keep their selection of Indicators before comparing.

With Marlin, the map expert and Elizabeth, the policy player their behavior highlighted the user interface weakness such as button confusion, poor feedback, of
compare years feature. These were noted during and after use of the feature which led to longer user journeys.

Elizabeth prefers to search as she finds it more efficient than browsing. She is an infrequent visitor and had to be shown the location of compare years feature. During usage she could not identify which button to click to view updated data – Compare Years or Update your Selection. Elizabeth clicked on the Orange compare years button many times with the expectation to see the updated comparison data but she failed. Frustrated she said, “Why does it have 2 buttons.” Also, while going through the actual tabular data she had trouble comparing city data with neighborhood data as they were not together visually. To change a Vital Signs topic, she used the top band and when she could not recollect any familiar name, she clicked on the Vital Signs section page. There she used the tabbed navigation and selected Census Demographic to proceed. Elizabeth liked that the interface keeps the year selection on which saved her time. But at the end of use she said, “This was not my first choice. I was not looking to set it up like this.” Her mental model of comparison did not match the current compare years feature – she thought one single interface where all Indicators are listed to compare could be more efficient.

On the other hand, Marlin, being technical, was frustrated with the lack of powerful features and poor feedback. Marlin clicked on the year selection and successfully updated the selection but many times saw no data in the table. He had to constantly try different checkbox options and Indicators. The comparison feature failed to provide any clear visual feedback or alternative action when there is no data.

Lastly, all four users saw value in the current compare years feature but wished for quick and clear actions before, during and after it. As the data gets updated only once a year coupled with the infrequent use of Vital Signs, users hinted for an interface that would provide them guidance, context, clarity and possibly powerful features. The current two years of data to compare was sufficient but users would like to see five years of data. Jayden said any visual aid that helps tracking changes easily for a neighborhood would save time. Technically inclined user like Marlin desired improvements related to
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data, such as standardization and clarity at meta data level and quicker access to downloading granular data. Catherine and Marlin suggested comparing multiple Indicators across any of the 8 Vital Signs topics suggesting their need to compare unrelated Indicators. They also wanted to see few neighborhoods of their choice. Elizabeth, on the other hand, wished for a single powerful comparison interface so that she does not have to visit many sections and pages searching for insight.

Trust. All users trust BNIA as an open data advocacy organization. They wished BNIA could find more ways to democratize open data in Baltimore.

Attitude. The surprising element was that even though bniajfi.org users faced usability issues that made them work hard for the analysis, all of them felt empowered by the data and displayed a positive attitude. This is credited singularly because of the quality and rarity of neighborhood centric data.

Usability Testing

Analysis

I watched all 6 session videos and listen to commentary twice to form my qualitative analysis. Based on the predefined success criteria for every task I identified successful tasks, noted the type of issues, time stamped important places in video where users gave their comments as seen in Appendix L. The qualitative comments and quotes by users specific to compare years feature were entered separately in another spreadsheet as seen Appendix M. Third, users’ responses during posttests were color coded to generate commonality of ideas as seen in Appendix N. In the second review, I rechecked, clarified and grouped the issues further into the same spreadsheets. To validate my observations and comments throughout this analysis, I referred to gaze plots generated by the Tobii testing software as seen in Appendix O. Gaze Plots helped to identify the location of user’s attention, direction, and the intensity of that attention (Tobiipro, 2015).
Executive Summary

Previous research established the compare years feature as valuable but findability, interface and interaction design issues together could be stopping users from taking full advantage of this feature. To observe some of these issues was the goal of this task-based usability testing. The results of this study informed the final phase of this project – digital prototyping.

Six users from relevant user groups such as nonprofits, researchers, journalists and businesses were recruited. They were each given the same six tasks to complete – find vital sign topic, locate an indicator, use compare years, find indicator description, share and save data and navigate to another vital sign’s topic. Types and instances of issues along with quotes and comments were collected for qualitative analysis. Videos and gaze plots were used to cross check instances and observe user reactions and attitudes.

There were no major issues that stopped any of these six participants in using the compare years feature. Below are highlights from this study:

From the homepage, all users managed to find and navigate vital signs topic. Numerous ungrouped Indicators with lengthy label names slowed findability of Indicators. Users became frustrated with the use of navigational defaults and poor feedback from the left Indicator menu which led to longer user journeys as previous research had discovered. This not only reduced exploration of content but also hindered the actual usage of the compare years feature.

All users found the compare years feature valuable but they indicated that deriving insights is laborious. Interestingly for comparison, users split and took two distinct paths. Three users stayed on the Vital Signs topic page and used table for comparison, while the other three users choose to navigate to Indicator page and choose to compare the data visually using maps, trend and charts. Those users who compared
visually, when asked to compare the data in tables, preferred the visual comparison over the tabular comparison as they felt in control of what neighborhoods they could add.

Below are some of top interface related issues during comparison that frustrated users:

- Button Confusion - Between Compare Years and Update Selection button
- Organization of Controls
- Error Message Construction

Users did not find the data on which the compare years feature operates to be up-to-date. Below are some of top data related issues during comparison that slowed users:

- Inconsistent Data Display - Between drop down control and displayed data (Appendix J)
- General lack of context surrounding Indicator – especially when there was no data.
- Unnecessary Selections / steps to view data.

Even though users found the Indicator description language formal, all users were able to identify / use the options to either save, download or share their compared tabular data. However, they were only interested in the above actions for only few neighborhoods of their choice not for the entire 55 neighborhoods. After comparison, users were able to navigate to another vital sign’s topic but not without a detour to the homepage. This detour was for made for two reasons – users missed the navigational dropdown and most importantly the navigational options presented did not match their expectation. This observed navigational behavior validates previous insights of excessive back and forth of user traffic seen between the eight Vital Signs topic pages.

Findability issues, specifically related to navigation, have consistently appeared not only in this research step but also during previous contextual inquiry. They pose
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challenges in the working of compare years hence a complete Information Architecture (IA) review would be a good place to start. The clarity from such review could help make the content more accessible to majority of users and even generate new ideas to present content.

At the interface level, users are looking for a simple consistent error free comparison in order to reach to quick meaningful insights. Users seemed more satisfied when they manipulated and compared the data visually. A worthwhile goal for the next phase of research – digital prototyping would be to check if the visual path of comparing data is a worthwhile change from tabular comparison. Lastly, interaction design and interface issues discovered need to be addressed parallelly in design phase.

Usability Testing Report

For the first task, the goal was to determine whether users can find and navigate to a correct vital sign topic from homepage.

Findings. All 6 users were successful in finding and navigating to a Vital Sign topic from the homepage. Out of the 6 users, 3 users (P1, P4 and P5) instantly used the homepage tab “Vital Signs by topic” to successfully complete their task. Interestingly, the other 3 users (P2, P3 and P6) chose to select a neighborhood first by using the “Find your community” dropdown. All three users (P2, P3 and P6) felt they could sometimes narrow down information more quickly and easily when they locate their interested neighborhoods page first and then view vital signs topic specific to that neighborhood.

After Vital Sign topic is selected can users successfully find an Indicator was the goal for second task.

Findings. All six users successfully found an Indicator but as predicted earlier navigation became a major usability issue for task two. Participant P1 and P5 were given 3 hints each before they could complete this task. Users faced difficulties in finding and
navigating the long-left menu which holds the indicator list. For help, both users accessed top band search functionality but the search results failed them. User P5 successfully located the Indicator but could not attain clarity around her indicator selection because of navigational issues. She said: “It’s not very obvious. This is running me in circles.” (P5, Graduate, 40-49-year-old female, Nonprofit)

Below figure 7 shows instances and type of findability issues while figure 8 below shows instances and type of navigational issues in task 2.

*Figure 7. Instances and Type of Findability Issues in Task 2*
Can users successfully compare data using the *compare years feature* for 2 years? What obstacles do users face and are they similar to the previous research was studied in task three.

**Findings.** All six users found the time series comparison useful and completed the task; however, two users P4 and P5 were given three hints to complete the task. User P4 was the only user who initially could not find the feature and needed hints throughout the task.

Users P1, P4 and P5 found tabular comparison by remaining on the same vital sign’s topic page while the other 3 users P2, P3 and P6 navigated to Indicator page to compare the data visually. Figure 9 below shows the page level journey map of these 2 user groups.

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Visual comparison involved users adding their specific neighborhoods to the trend map while tabular comparison involved using the *compare years feature* and then spotting their neighborhood data from a result table of 55 rows. Even though users like P2, P3 and P6 had longer user journeys they seemed more satisfied and shared many qualitative insights once the task was completed. Below table 3 shows few quotes captured during these two distinct paths users took:

Table 3

*Participant Quotes on the topic of Visual and Tabular Comparison*

<table>
<thead>
<tr>
<th>Visual Comparison. P2, P3 and P6</th>
<th>Tabular Comparison. P1, P4 and P5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like that my query stays and is still sorted. That’s helpful. (between 3 tabs - trend, charts and maps) <em>(P3, Researcher)</em></td>
<td>Do I click on Compare years or Update your selection? I got it but now I have to redo the selection again. <em>(P4, Journalist)</em></td>
</tr>
<tr>
<td>Highlandtown is not so affordable now. Wow. I like it when the data is overlaid on a map</td>
<td>I already told to compare years 5 times and it’s not doing that. Also, how do I just export that row? I do not want to know</td>
</tr>
</tbody>
</table>
During tabular comparison, the same navigational issues from task 2 continued. Participants spend lot of effort in gathering insight. Users had to scan up and down the 55-row table, locate their neighborhoods and then compare it to city average to come up with some insight.

Many of the interface issues shown in the figure 10 and figure 11 below are similar to the ones described during heuristic evaluation.

**Figure 10.** Instances and Type of Interface Issues in Task 3
Reading the Indicator description helps infrequent users provide context about a known or even unknown indicator. The goal for task four was to determine whether users know where to find Indicator description.

**Findings.** Even though the description is not always displayed on the page, all six users found and read the indicator description. Users used mouse over function over left menu Indicator links to read the description. The saccade map seen in Appendix O together with their commentary confirmed their short and satisfactory access to indicator description. All users found the description helpful for the task at hand but felt it did not have simple language and that the description should be displayed at all times on the page.

The goal for the last task after comparison was to determine whether users prefer to share / save / download data.

**Findings.** Five out of six users successfully identified or articulated their preference to download and then share. This insight matched Google Analytics report of
high download activity for both data and reports. Posttest inquiry led to the discovery that users wished for a functionality to download data for a single row of neighborhood or a few rows of neighborhoods against downloading the entire table of 55 neighborhoods. The same 3 users - P1, P3, and P6 - who compared the data visually could not find ways to save the chart since the interface does not support such a feature. However, these users articulated they would take a screenshot of the chart and use it in their report or newsletter. They wished for a functionality to save chart.

Lastly, once users have compared the data in one vital signs section how do they find a new vital sign topic for exploration or comparison?

**Findings.** All six users were successful at finding another vital sign topic. For this task, the research goal was to find if users notice and use the current vital signs / neighborhood navigation dropdown which is part of the compare years functionality. None of the six users noticed and used this navigational element to directly navigate to another vital sign’s topic.

Instead, users navigated back to the homepage from their respective page. From the homepage, the outcome of this last task was similar to task 1 where three users used the homepage tab “Vital Signs by topic” to successfully complete their task. The other three users selected their neighborhood first and then explored a new vital sign topic.

Posttest inquiry revealed all six users did not notice the drop down nestled inside the *compare years feature*. Users were expecting the eight Vital Sign topic to be shown as links and not as drop down. This mismatched content presentation led users to excessively use the top band navigation for detour to bniajfi.org homepage.

At the end of all task’s users were asked what they liked or disliked about the comparison feature. Below table 4 shows users self-reported answers.
Table 4

*Usability Testing Post Test Self-Reported Answers*

<table>
<thead>
<tr>
<th>2 things you liked about the compare years feature.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value and Percentage change data columns</td>
</tr>
<tr>
<td>Automatic comparison of Baltimore city data with neighborhood data</td>
</tr>
<tr>
<td>Ability to sort data and color coding</td>
</tr>
<tr>
<td>Keep the year selected and change Indicators</td>
</tr>
</tbody>
</table>

| 2 things you disliked about the compare years feature.                                  |
| Interface Issues: Confusing button placement and Interaction. Extra selections to view data and know if Indicator data is unavailable. |
| Only 2 years comparison data                                                           |
| Navigational Issues: Finding and Selecting Indicators from left menu. Navigational defaults on left menu makes little sense. |
| Tabular Design: Table header does not follow data while scrolling down. More visual separation in tables required between city and neighborhood data. |
Prototype Design

Analysis

As participants were performing the tasks during the session, I marked by hand the completion of tasks as seen in Appendix R. Immediately after both interviews were completed, I heard the audio recordings on the same day. While listening to the audio recording, I noted participants comments that were made in support of one option or the other as seen in Appendix S. When participants went off track, I excluded their comments. I heard the audio recording second time, to check for any overlap or misses. In the second round, I used colored marking pens to extract themes on the same paper notes as seen in Appendix S. Documenting the interviews on paper helped me to validate the research goal and identify categories that led to the below report.

Prototype Design Report

All tasks were successful completed by both participant in option one and option two based on the success criteria as seen in Appendix Q. However, option one as seen in Appendix T was preferred unanimously by both two participants. Below are some themes that emerged from their answers that indicated their support for option one:

Landing Page. In testing, both participants identified and liked the idea of landing page along with its supporting content. Participant three, a researcher, said, “This looks like some sort of landing page. I would expect a landing page with similar items.” Participant three, a social science researcher, was talking about blue Explore Indicator navigation tabs, 2016 Data Story report and search indicator box as in figure 12 below.
Efficient Navigation. Both participants found the overall navigation and page level navigation in option one clear than option two. Grouping of indicators into groups like population, age, household was an important reason why both participants preferred the navigation of option one over option two. Such indicative and high-level grouping helped participants to explore, select indicators quickly and successfully complete task one. Participant three, a researcher who specializes in urban and community forestry research, found the content was grouped logically and there was less scrolling and scanning in option one than option two. Below are few comments made by participant one in support of efficient navigation:

I like this (grouped Indicators tab). This makes it easy to get to details.
I look at children data sometimes so this (grouped Indicators tab) makes it easy.
(Participant one, nonprofit background)

During the task two, three, and four both participants successfully identified important action buttons which are required to navigate the compare years feature like – adding neighborhoods, use of tabs for page level navigation, save chart as jpg, and compare 5 years data link.

Both participants were of the opinion that the presentation of compared tabular data in option one would be helpful in arriving at quick decisions because of dedicated sorting buttons, use of colors with up and down arrow icons to highlight change as seen in figure 13 below.

![Figure 13. Option One Tabular Design](image)

**Multifaceted Interface.** Earlier usability testing results revealed that participants were interested in customize data on bniajfi.org portal. Further, the satisfaction of comparing data visually with help of trends, charts, maps and tables was higher than just tabular comparison. These insights were central assumptions for the option one designs. Prototype testing confirmed that both participants found important interface and interactions hotspots with ease while doing the tasks. Both participants felt in control

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while doing comparison tasks because they could add five neighborhoods of their choice and could save their selection.

Option one and option two had similar content but both participants found the information visualization of option one using trend lines, maps, and charts more effective over the tabular focused approach as seen in option two (Appendix U). While doing the comparison tasks participant three said, “Access to trend lines is cool. I like the brief description on top, ranking at the bottom. I like the option to save the chart I made. Together it just makes sense.” While participant one mentioned the advantages of different perspectives she got said, “These multiple formats feels useful. I can get to the details quickly.”

**Overall Positive Impression.** The answers from follow up questions suggest both participants consider option one as a progress from the online version tested. The overall layout and content decisions taken in option one to support navigation were successful in creating a perception that it was quick, easy to explore, organized to compare multiple indicators.

There was a consensus between both participants that option one was more intuitive than option two. Participant three, found overall navigation intuitive – especially the organized left-hand side and tabbed navigation. While discarding option two, participant one said, “Option two is not as appealing and interesting as option one. The different formats to compare in option two is not clear”. The design goal of option two was to keep the same compare years interface while alleviate all interface and interaction issues found during usability testing (Appendix U). During prototype testing the two issues of button confusion and mismatched organization of controls were eliminated, but according to participants option two still carried the same frustrations of having too many points of attention which led to excessive scanning and scrolling.

Lastly, one of the posttest questions asked was, which option do you think will add value to your work? Both participants felt option one was more valuable. To both participants, option one felt more productive because comparison was easy to start, easy
to customize, and also easy to share with their colleagues. Participant one in her support for option one said, “This makes it efficient. No hunting. Its intuitive all on one page.”

While participant two focused on the navigational aspects of option one that made it valuable for him, “The data groupings were clear. Easy access to trend, chart and map. I like the ranking suggestions. It’s good to know.” To end, both participants were asked if they had any suggestions to improve option one. Below table 5 has users’ suggestion and my interpretation.

Table 5

<table>
<thead>
<tr>
<th>Users Suggestion</th>
<th>Researcher Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant one wanted to see two sets of tables, maps and charts - one that showed their selected neighborhoods and the other set that has all other neighborhood data. This would help them identify relevant information quicker.</td>
<td><strong>Content Strategy.</strong> Participants were hinting at a content strategy that contain more personalization and customization of neighborhood data across the entire bniajfi.com portal.</td>
</tr>
<tr>
<td>Landing Page can be more explicit about how to get to neighborhood data. Participant were interested to in multimedia content like videos that will provide more engagement opportunities.</td>
<td><strong>Content and Design.</strong> The tabbed indicator navigation design worked but it can be more explicit. Consider adding clear supporting content on top that informs users that their neighborhood data will be seen after they select an Indicator. Also consider using traditional tab design instead of just orange underline. This comment needs to be looked in the light that both participants saw the landing page for the first time.</td>
</tr>
<tr>
<td>If resources are available adding videos, or infographics on the landing page can be useful in providing both variety of content and context.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
</tr>
<tr>
<td><strong>Participant one mentioned the lack of navigation option to change Vital Signs topic from the inside pages.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Navigation.</strong> The immediate correction could be the placement of the Vital Signs drop down needs more exploration as users missed it. This comment could also be because of the limitation of not showing the top band navigation.</td>
<td></td>
</tr>
<tr>
<td><strong>Participant one commented on unclear table headings. How the percent change and value change were calculated could be clearer.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Content Clarity.</strong> The numerical data in tables was representative content and hence caused some confusion. To clarify data further, the table column headers can carry a question mark icon. A click on the icon would bring a modal window which can show the calculations for percent and value change. Overall, these participants were suggesting contextual help at page level in simple language.</td>
<td></td>
</tr>
</tbody>
</table>
This study set out to explore user’s perspective on compare years feature. The goal was to discover and address any navigational, interface, and interaction design level challenges that restrict user’s ability to understand, analyze, and gather insights from open government data (OGD). Why and how do users use the comparison feature? What were their challenges and does it match their needs and wants? – these are some of the questions that inspired the study. This study concludes, compare years feature is vital to the use and reuse of OGD at neighborhood level because it allows users not only to understand but compare and contrast neighborhood data for various social and economic objectives. These overall findings are in line with Chan, (2016) and Thorsby et al., (2016) whose studies have highlighted the importance of intermediaries in the open data ecosystem and the significance of their portal infrastructure elements like features in connecting and educating users about OGD. However, various navigational, interface, and interaction design factors in previous version of compare years feature consistently reduced the usefulness and usability - which are discussed below. I combined five user centric methodologies to discover these challenges. The results of the analytics review, the heuristics analysis, and the contextual interview informed the usability testing. Usability testing then validated previous insights and subsequently informed prototype design and testing, which lead to a useful and usable comparison feature.

Navigation. The literature focused on discoverability of data; while less attention was paid on findability of data. However, in this study, findability of data was a greater navigational challenge than discoverability. It’s important to note the difference between discoverability and findability from an information design standpoint. Findability is the ability to locate a piece of content or feature that users assume or know exists while discoverability is when users are unaware that a content or feature is available. (NN Group, 2020). In this study, the search feature on bniajfj.org portal was underdeveloped and failed users in discovery of data. This was an obvious discoverability challenge for users. To compensate, users had to rely heavily on browsing to find data for comparison;
this aspect of findability was not efficient either. Right from the first research step of analytics, bniajfi.org portal displayed siloed navigational patterns. This limits user’s exposure to other types of data for comparison. The results of the heuristic evaluation showed that navigational options on the portal were hidden and inconsistently presented visually which confused the users. The contextual inquiry also confirmed that the left navigational defaults were confusing and the following usability testing validated these findings. Usability testing results identified hotspots on webpage where users were losing control while finding data and getting overwhelmed like unorganized indicator lists, navigational defaults, and button confusion. User had to go back and forth between multiple pages to find data for comparison. Users lost their locus of control and with that their short-term memory load increased (Shneiderman and Plaisant, 2004). In all, finding appropriate data before and during comparison was challenging for users. This analysis matched earlier opinions by Petychakis et al. 2014 and Zuiderwijk, (2017) who described searching and finding data as an important first step but challenging for OGD users.

**Interface and Interaction Design.** Besides navigation, the interface and interaction design of this feature was a significant driver of user’s suboptimal experience. Quantitative data from google analytics showed limited data engagement. Heuristics analysis identified layout, design, and content level inconsistencies which undermined user’s ability to understand data and make decisions. Some of the limitations of the comparison compare years feature’s interface like unorganized layout and confusing button interaction were discovered during contextual inquiry interviews.

The following usability testing provided observational proof of specific hotspots on webpage where users were losing control navigationally. Users were also getting confused because of poor interaction design decisions related to buttons. Furthermore, users found the layout of the feature hard to use because of inconsistencies in applying the visual design principles of scale, hierarchy, balance, and contrast (Nielsen Norman Group, 2020). The button design and long data tables, without any interaction support at
COMPARE YEARS FEATURE - USER’S PERSPECTIVE: Chapter 5

page level obstructed users’ abilities to make deep connections with data. In addition, error messages did not support and solve the interaction and navigational challenges users were facing, making it that much harder for users to recover. Gathering insight turned out to be a laborious task. Overall, users were facing an information overload scenario. This observation was considered in earlier studies (Ho and Tang, 2001; Zuiderwijk and Janssen, 2014b). Results of usability testing were significant because it confirmed previous research insights and highlighted the nuances of usage at page level. Usability testing did not measure time to complete tasks nor assigned any score for information overload factors. But posttest analysis combined with insights from previous three research steps made it clear that navigational inefficiencies and interface and interaction design slowed users, leading to underutilization of the feature.

However, the most significant discovery which became an inspiration for a new design direction, was observed during usability testing. Out of the six participants, a group of three participants took a different comparison path. These three participants selected indicator as their starting point into the tasks instead of category. They also selected and compared only 3-4 neighborhoods on a trend line and utilized charts and maps to arrive at a balanced insight instead of passively looking at comparison data of all 50 neighborhoods in a table. These three participants were less confused navigationally, provided more insights, and were satisfied with their end results. I observed when users took control, customized, and visualized the information their engagement and productivity levels with data were higher. The results from the usability testing, in combination with results from the earlier three user centric methods were practical enough to be transformed into two design directions— option one and option two.

Option one design goals were inspired by the earlier discovery during usability testing. The ethos of the option one was to enable users to customize, control, and visualize the information using a user-friendly layout. While in option two, the goal was to address all the interface and interaction design challenges, but keep the previous
version of the comparison feature. The two users who tested both design options unanimously preferred option one. Prototype testing results revealed users saved time because they were able to customize the comparison data at neighborhood level. Providing the right amount of granularity in data and saving users time are important factors to improve user engagement. (Chan, 2016; Wang and Shepherd, 2020).

Users found option one relevant and comprehensive because they were able to pick and choose the neighborhoods that they wanted to compare by using a variety of charts, maps, and diagrams from a single page. Once users became aware that they can customize the compare years feature, they were able to find data, navigate, and complete their tasks almost intuitively. They developed familiarity with interface easily because of already known interactive mechanisms like tabs, icons, groups and lists. Users perceived interaction with option one as quick because they did not lose their locus of control (Shneiderman and Plaisant, 2004) while navigating and comparing. The design decisions that helped users complete all the tasks successfully were: intuitive easy access to navigation at all times, strong call to action at page level, organized interface controls and clear supportive content. These design decisions were synthesized from the results of earlier testing and recommendations from various scholars (Thorsby et al., 2016; Zhu and Freeman, 2019; Machova, and Lnenicka, 2018). After interacting with an organized option one, users were able to make connections in data because the neighborhood data became more relevant and actionable. The results from this study are in line with Zuiderwijk et al., (2016) who concluded that improving interaction mechanisms in features can speed up OGD usage and improve user engagement. Overall, the combined results of usability and prototype testing lends support to the conclusion that customization of features can be a good strategy that can save users time and improve engagement (Chan, 2016; Wirtz et al., 2017). To achieve that, features need to match users’ need and wants and should be designed keeping in mind usefulness and usability. (Young, 2008).
**User and usage.** The literature review helped identifying user groups but the nuances of their usage and motivation to use became clear only after employing user centered methodologies. Users used comparison data to: explore new ideas, support grant writing, triangulate data from other sources, and track social and economic programs. Users roles, responsibilities, and tasks defined how they use and reuse comparison data in their daily professional lives. Users were motivated to use comparison feature because of their interest in local communities, their inner conviction, and exploration. These motivational factors were similar in nature to the study done by Wirtz et al., 2017.

To end this discussion, users will benefit the most from interacting with a comprehensive solution which is customizable and well supported by navigation, design, and content. Users will be able to gather a balanced comparison insight because it presents the data in multiple forms. There is less chance of users getting overwhelmed and more chances of motivation to use because both navigation and interaction design allows users to control the large quantity of information. The interface design of *compare years feature* is focused, logical, and provides context - this saves users time and reduces errors. Lastly, the combined effect of all these improvements provides users the best opportunity to decide and take action while realizing the importance of open government data at neighborhood level.
Chapter 6: Conclusion

From a project perspective, there are few directions compare years feature can take based on the enthusiastic user feedback. The next version of this feature can benefit from more interactive opportunities for contextual help and accepting feedback from users. The comparison feature needs to either integrate or conceptualize a new feature that will allow users to compare data (Indicators) from two diverse categories like crime and education in neighborhoods of their choice for hidden associations.

While these are broad directions based on user feedback, the insights from this practical study are valuable for some immediate follow up studies. Firstly, navigation was an important factor that improved the usefulness and usability of compare years feature in this study. Hence it will be valuable to evaluate navigation not only in the comparison context but for the entire portal. A detailed information architecture review focusing on findability and discoverability would be useful and can possibly inform the design of the feature. Secondly, the success of the suggested comparison feature is based on the premise that users would take control and customize the neighborhoods they want to compare. Also, the suggested design gives priority to visualization using a combination of charts, diagrams, and maps over tabular comparison. Both these aspects of user control and visualization priority needs to be tested widely and thoroughly with a larger group.

Subsequently, the focus can shift on testing the interface with citizens as user– the ultimate beneficiaries of open government data (OGD). While testing with citizens, topics like literacy and plain language would become more even more relevant because citizens’ understanding of OGD, motivation, and skills may not be similar to this current group. How will citizens’ knowledge of data (neighborhoods, categories, and indicators) influence the design of the comparison feature can be a worthwhile exploration.

This project was a first step towards realizing the goals of BNIA-JFI – to unlock the hidden potential of OGD by empowering users with insights. To realize this goal, I followed a robust user centric methodology to discover and alleviate navigational,
interface, and interaction design frictions that were responsible for the underutilization of previous compare years feature and transformed it into a customizable, relatable, and actionable version. The results of this practical study, hopefully, will justify a more consistent user centric evaluation of the comparison feature and bniajfi.org portal.
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Appendix A: Initial Site Map of Website bnajfi.org
Appendix B: Heuristic Description Document

<table>
<thead>
<tr>
<th>Page</th>
<th>Usability Heuristic Applied</th>
<th>Problem Observed in Brief</th>
<th>Broad Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>T000</td>
<td>Find and COMPARE YEARS Feature, Compare years</td>
<td>Visibility of System Status</td>
<td>Section is clear but what indicator here I landed is unclear. Vital signs section on top bar is not highlighted so its hard to know where ones is. There are no visual aid or navigational bread crumbs. After the compare years feature is used there is no help for user to denote highlight change in data hence decision making will be tough.</td>
</tr>
<tr>
<td>4</td>
<td>Add/Insert button on left instead should be on the right, left hand menu a long list with groups. Would benefit greatly</td>
<td>Add/Insert button on left instead should be on the right, left hand menu a long list with groups. Would benefit greatly</td>
<td>Add/Insert button on left instead should be on the right, left hand menu a long list with groups. Would benefit greatly</td>
</tr>
<tr>
<td>6</td>
<td>Consistency and Standard</td>
<td>Compare years data seems inconsistent on Indicator page. Drop down vs Data shown. Rich presentation in Indicator pages while only tabular data.</td>
<td>Compare years data seems inconsistent on Indicator page. Drop down vs Data shown. Rich presentation in Indicator pages while only tabular data.</td>
</tr>
<tr>
<td>8</td>
<td>Error Prevention</td>
<td>Error Prevention</td>
<td>Error Prevention</td>
</tr>
<tr>
<td>8</td>
<td>Recognition rather than recall</td>
<td>Recognition rather than recall</td>
<td>Recognition rather than recall</td>
</tr>
<tr>
<td>10</td>
<td>Flexibility and Efficiency of Use</td>
<td>Flexibility and Efficiency of Use</td>
<td>Flexibility and Efficiency of Use</td>
</tr>
<tr>
<td>10</td>
<td>Authentic and Minimize Design</td>
<td>Authentic and Minimize Design</td>
<td>Authentic and Minimize Design</td>
</tr>
<tr>
<td>10</td>
<td>Help users recognize, diagnose, and recover from error</td>
<td>Help users recognize, diagnose, and recover from error</td>
<td>Help users recognize, diagnose, and recover from error</td>
</tr>
</tbody>
</table>

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Dear BNIA-JFI Community Partner,

I oversee the Baltimore Neighborhood Indicators Alliance at the University of Baltimore. Annually, we prepare the City’s *Vital Signs* report, which is the compilation of over 100 indicators measuring quality of life for all of our communities. The data in *Vital Signs* is available online through our interactive website [www.bniajfi.org](http://www.bniajfi.org). This year we are focused on improving the usability and accessibility of our website for members of the community that may not use our website very often.

We want to hear from you as someone who has worked with us in the past and/or attended a Baltimore Data Day workshop. That will help us create content, features that are more suited to your situation and at the same time be usable, accessible and valuable.

**We are looking for 4-5 people in Baltimore who can volunteer as a participant for a User research session in November or December.**

Following are the highlights of this user interview session.

- **Format:** One on One informal. Not a traditional question answer session but an interactive hand on session where you will perform your regular activities on the BNIA website.
- **Goal:** Observe and learn from you and NOT test you in any way. Specifically, we at BNIA-JFI want to understand your needs and wants with respect to specific features on our website.
- **Location:** A place where you normally access, share and talk about BNIA-JFI data. That can be your office, a neighborhood office or even a coffee shop.
COMPARE YEARS FEATURE - USER’S PERSPECTIVE: Chapter 5

- Time: Maximum 2 hours.
  
  This session will be conducted by Vipul Katira - a graduate student in Interactive Design & Information Architecture at the University of Baltimore.

  
  We would greatly appreciate your participation in this research. As a small token of our gratitude, you will receive a hard copy of the 14th edition of Vital Signs.

  
  If you decide to do so, please email Vipul (vipul.katira@ubalt.edu). He will get in touch with you with more details.

  
  Thanks,
  
  Stakeholder, Credentials
  Baltimore Neighborhood Indicators Alliance—Jacob France Institute

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INFORMED CONSENT

As a part of master’s thesis capstone project, I Vipul Katira, am conducting interviews to better understand the users of BNIA-JFI. I would like to understand your needs and wants with respect to BNIA-JFI’s data. I also hope to understand your research process and how BNIA-JFI can better support the users.

For the interview, I hope to spend approximately two hours with you at a location normally used by you to access BNIA-JFI website. I will talk to you about your open data needs and see you performing certain tasks such as:

- Locating, accessing and downloading materials based on your interest, work
- Use and evaluate the Compare Years feature

I will facilitate the interview and take notes. I would like to video tape the session only to supplement our note taking. I would like to take a picture of you so that we can create a user profile based on your research to present to Dr. Walsh and the sponsor BNIA-JFI.

Lastly, I want to assure you that I am not testing you or your ability to do the tasks rather I would be using this as an opportunity to improve the information on BNIA-JFI’s website.

If you have any questions or concerns about the research or your participation in this study, please feel free to email me at vipul.kitara@ubalt.edu, or call me on 443-883-5148, or contact the UB Institutional Review Board at 410 837-6199, or irb@ubalt.edu.

Thank you for your participation.
I, __________________________, permit Vipul Katira to observe my research behavior and video tape the session. The video will be used for research purposes within the team only. I also permit the interview team to photograph myself and my work space. I understand that the photograph will be used in a user profile to describe general search behaviors and methods of research.

I have been informed that my participation in this research study is voluntary and that I am free to withdraw or discontinue participation at any time.

____________________________ ___________________________________
Print Name     Signature

______________________
Date

Start of Interview: Allocated time less than 30 min.

Start Off
1. Can you tell us a little bit about yourself and the organization?
2. How long have you been working?
3. What’s a typical day for you at work?

Domain Experience / Knowledge
How would you describe your knowledge of open data to lay person?

BNIA Related.
1. How did you hear about BNIA?
2. What’s your first contact point with BNIA. (Website Vs email Vs physical event)

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3. What are your views on the role of organizations like BNIA? Data Intermediaries
4. Did you use other websites besides BNIA? What do you seek? Vs BNIA.
5. Can you compare BNIA’s website to other website in terms of your experience, role?

Goals
- So, what goals do you have when you access BNIA website.
- What are the most common reasons to access open data from BNIA website?
- Are there any favorite or least favorite parts in the website for you?

Middle of Interview. Observation mode: 55 min
Change gears. / Based on the last question you answered how you used Vital Signs

Can you help me understand your usage of BNIA website?

Can you please explain how you made this chart, / analysis?

- How do you use open data?
- How many years of data is useful to you?
- Do you use the data to track, improve some internal programs?
- Do you make reports or grant documents with open data?
- Page Level: Is there something on this page that is very important to you. How easy it is to understand.
• **Use, Reuse and Share Content**
  - How do you share BNIA’s open data across your organization?
  - How do you reuse downloaded content? Different reports?

• **Organize Content**
  - What information is important for you to know about your content? (e.g., source)
  - How do you document that?
  - How do you "save content", and if so, why?
  - How much time do you get while gathering open data to make a report or write a grant?

• **Do you use (Can you use) Compare Feature on BNIA site? Why? Why Not? Does it work for you?**

  - Is the feature useful and necessary?
  - When do you use this feature?
  - Failure: How do you work around problems?
  - Expertise: What shortcuts do you employ?

**Goals and Behavior’s:** Are there any other basic tasks that you perform that the website supports for you to accomplish these goals?

**End of Interview: 20 min.**
Attitudes
- Are there any favorite or least favorite parts in the website for you?
- Would you recommend this website to your friends or coworkers?
- Overall, do you trust BNIA, their data. Why and Why not
- Is there anything BNIA can do for you to generate more trust and value

Frustrations: You had hinted at some frustrations with the website some time back. Can we talk about that?

What frustrations do you have with accessing content in general?
What frustrations do they have with this within Vital Signs?
Do you face similar issues with other products?

Communication (with BNIA)
- Did you ever communicate with BNIA?
- Through their Newsletter? Why? Why not

Opportunities
(BNIA is investing resources in understanding users better)
Do you have any suggestions for new ideas / features? Compare in that one

Vital Sign
Which features or content is the most valuable for you easy to complete? Love
Overall, do you have any improvement in mind for BNIA that will make your life easy

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Wrap: Thank. Ask: for Suggestion another user and participation in Usability Testing
Appendix E: Usability Screener and Results

BNIA-JFI – Usability Screener

Instructions: Please check the box(es). Fill in the blanks to support your answer.

1. Are you aware of Vital Signs data from BNIA-JFI’s website.
   □ Yes
   □ No (If no, please go to question 7)

2. In the past 5 years, have you viewed/ downloaded Vital Signs data.
   □ Yes.
   □ No. (If no, please go to question 7)

3. Which data categories seems most relevant to your work? Check as many as applicable.
   □ Census Demographics
   □ Children and Family Health
   □ Crime and Safety
   □ Housing and Community Development
   □ Workforce and Economic Development
   □ Sustainability
   □ Education and Youth
   □ Arts and Culture

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4. What do you use BNIA-JFI’s data for...
   - Applying for Funding
   - Evaluate and set goals for your programs
   - Conduct Research and Report Writing
   - Write Articles, Blogs and other journalistic pieces
   - Design and Develop Civic Apps
   - Other Please Specify

5. Finding what you want from Vital Signs is
   - Very Easy
   - Somewhat Easy
   - Neither easy nor difficult to find
   - Somewhat difficult to find
   - Very Difficult to find

   Please expand on your choice

6. How useful is “Compare Years” feature in Vital Signs for you.
   - Useful
   - Very Useful

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7. In the next 3 months, would you be willing to participate in a paid research study with BNIA-JFI.

☐ Yes

☐ No

---

<table>
<thead>
<tr>
<th>NAME</th>
<th>ORGANIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TITLE</th>
<th>EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

UX Screener Result

- Total Response Count was 26
- 2 respondents said no for testing.
• 24 accurate responses were considered.

**User Groups Identified (based on title, company, usage):**

<table>
<thead>
<tr>
<th>Non Profits 5</th>
<th>Education 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researchers 3</td>
<td>Business 2</td>
</tr>
<tr>
<td>Neighborhoods 2</td>
<td>Historian 2</td>
</tr>
<tr>
<td>Journalistic 1</td>
<td>Unidentified 2</td>
</tr>
<tr>
<td>City Officials 3</td>
<td></td>
</tr>
</tbody>
</table>

**Overall**

Out of 24 only 3 persons were unaware of Vital Signs and did not view/download Vital Signs Data. One was from Neighborhood, City Officials, and Unidentified group.

**Top 5 relevant data categories across user groups:**

1. Census Demographics
2. Children and Family Health
3. Crime and Safety
4. Housing and Community Dev
5. Workforce and Econ Dev

Arts and Culture seems less represented. Only 5 respondents, found Arts and Culture as a relevant data category for their work.

**Findability (Finding what you want from Vital Signs is)**

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All user groups seem to have selected Very Easy and Somewhat easy. Only the journalistic minded were neutral (Neither Easy nor difficult to find).

The question asked was Finding what you want in Vital Signs is: and one business respondent choose Somewhat Easy and note saying "Need better search functions"

Usefulness (How useful is Compare Years feature in Vital Signs?)

13 respondents seem to select Useful to Very Useful for the compare Years Feature. Only 4 selected that they are not aware and hence do not use Compare Years Feature.

The journalistic group found Compare Feature only Acceptable. While Business group was evenly split. One said difficult to use and the other found it useful.

Goals. User Groups Identified had slightly different usage of BNIA data.:

Non-Profits (5) They used data mainly for Applying for Funding, Evaluate and set goals and Conduct Research and Report Writing.

Non-Profits seems to find all Vital Signs data categories as relevant unlike other user groups.

Researchers (3) Researchers use data mainly to conduct Research and Report writing. They also support that with Articles, blogs and other journalistic pieces.

Neighborhoods (2) Reason to use the data was not filled.

Journalistic (2) Used BNIA data for data visualization and writing articles in Baltimore Sun, Baltimore Brew, City Paper.

City Officials (2) Used data to Conduct Research and Report Writing.

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Education (2)
Used data to design academic Assignments in Social Work and Conduct Research and Report Writing.

Business (2) Business seems to using BNIA data to Evaluate and set goals and Conduct Research and Report Writing. They are most interested in Workforce and Economic Development, Housing and Sustainability data categories.
Appendix F: Personas

**Catherine. The Open Data Champion**
Works as Senior Implementation Advisor
35-year-old female / Master’s in Public Policy.

*Oh, no I can only compare 2 years.*

<table>
<thead>
<tr>
<th>ROLES AT WORK</th>
<th>USER GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Manager:</strong> Shares BNIA website as an example to leading US city officials while talking about open data initiatives.</td>
<td><strong>Find and research Vital Sign Indicator(s):</strong> that can measure a policy objective.</td>
</tr>
<tr>
<td><strong>Content Creator:</strong> Uses BNIA data to support her research and translate it in blogs, or company podcast.</td>
<td><strong>Identify and Target Neighborhoods for social programs and compare it to Baltimore City.</strong></td>
</tr>
<tr>
<td><strong>For Exploratory Analysis:</strong> on personally interested topics like Housing to understand what indicators are used to measure it.</td>
<td><strong>Brainstorming:</strong> To browse datasets and get new ideas. For e.g., Usage of Proxy Indicators</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FRUSTRATIONS</th>
<th>WISH LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard to find, select and track Indicators from Left Menu</td>
<td>5 years of comparison data.</td>
</tr>
<tr>
<td>Could not keep track of changes in subsequent pages</td>
<td>More context and clarity in features and data</td>
</tr>
<tr>
<td>Poor Title Name of downloaded files</td>
<td>Compare multiple Indicators easily.</td>
</tr>
<tr>
<td></td>
<td>Downloads and maps to provide more background</td>
</tr>
</tbody>
</table>
## Marlin. Map Expert

**Works as Project Manager**

30-year-old Male / Bachelor in Computer Science

*I would not know one could change years*

### Roles at Work

<table>
<thead>
<tr>
<th>Content Creator: Uses BNIA data to create maps to show clients. Also uses data to support research and writes blog articles.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Manager: Technology oversight in multiple open data projects. Coordination and team management.</td>
</tr>
</tbody>
</table>

### User Goals

- Find and download Vital Sign Indicator(s) with a topic in mind. E.g. Art Data in Baltimore.
- For Exploratory Analysis: Uses data from Open Baltimore data portal in conjunction with BNIA to explore interested topics.

### Frustrations

- BNIA's geographical data mismatch with other data sources that led to time consuming data cleaning.
- Data issues like - No data Found
- Confusing Controls and Navigation
- Maps Not Useful – similar looking, not interactive and no shape files

### Wish List

- Wants clear, quick and easy access to download.
- To aid comparison, he seeks analysis, context, around dataset.
- Standardization of data formats. Data Dictionary.
- More granular data. Comparison of data nationally and across neighborhoods.
**Elizabeth. Policy Player**
Works as Health Policy Analyst at State Level Organization
45-year-old female / Master’s in Public Administration.

*This was not my first choice. I was not looking to set it up like this.*

<table>
<thead>
<tr>
<th>ROLES AT WORK</th>
<th>USER GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementer:</strong></td>
<td>• Find and research a Particular Topic(s) that is relevant to her current work or popular through BNIA's Facebook and Twitter posts.</td>
</tr>
<tr>
<td>Read, interpret and implement latest healthcare law at state level.</td>
<td></td>
</tr>
<tr>
<td><strong>Content Creator:</strong></td>
<td></td>
</tr>
<tr>
<td>Research and prepares synopses, reports, papers for her department and state workers.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FRUSTATIONS</th>
<th>WISH LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Page Navigation and selection does not aid comparison nor decision making.</td>
<td>• At least 5 years of data to compare</td>
</tr>
<tr>
<td>Unable to carry forward selection of years across Community Page</td>
<td>• Clear Download and Action Buttons</td>
</tr>
<tr>
<td>Download Page title confusing</td>
<td>• Single place to compare multiple neighborhoods across years</td>
</tr>
<tr>
<td>Lack of Search Tool &amp; Poor Results</td>
<td>• Wants BNIA to work on consistent data introduction and easier access.</td>
</tr>
</tbody>
</table>

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Jayden. Community Constant
Works as Social Impact Management Specialist at a Community based Non-Profit Organization
28-year-old Male / Master’s in Public Administration.

Current 2 years comparison works but if I need a trend I cannot get it.

<table>
<thead>
<tr>
<th>ROLES AT WORK</th>
<th>USER GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Grant Writing: Researching grants. Responsible for grant writing.</td>
<td>• Grant Writing: Quote certain Indicator data specific to his neighborhood to establish need for grant in the community.</td>
</tr>
<tr>
<td>• Social Media Engagement: Manage social media tools. Measure likes, comments.</td>
<td>• Track Internal Programs: Seek data to justify, support and track Internal Programs. Share BNIA data internally to the board</td>
</tr>
<tr>
<td>Coordinates all social media efforts and online events.</td>
<td>• Triangulate open data: check data received data from other sources and compare it with BNIA website.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FRUSTATIONS</th>
<th>WISH LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hard to spot patterns, differences and reach insights in data because of format, visual clutter.</td>
<td>• At least 5 years of comparison data. Easy way to spot trends.</td>
</tr>
<tr>
<td>• Lack of context and explanation that leads to exit from bniafi.org in search of explanations.</td>
<td>• Clear Tabular Design that highlights city vs neighborhood explicitly.</td>
</tr>
<tr>
<td></td>
<td>• Better integration of maps with compare years feature.</td>
</tr>
<tr>
<td></td>
<td>• Quicker updates to data.</td>
</tr>
</tbody>
</table>
## Participant 1. Non-Profit.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Task Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find Correct Vital Sign Topic</td>
<td>You are looking to gather Vital Signs 15 data related to High Schoolers as your organization has academic programs that benefit 9th – 12th grade students. If its valuable, you might use it in a report. How would you go about identifying some basic information related to High School Students?</td>
</tr>
<tr>
<td>Locate an Indicator</td>
<td>Your organization wants to start a program that creates employment opportunities for Young Adults in School. The board of directors have requested you to see if there is any previous year’s data. To start, you are most interested in finding what was the employment rate for Young Adults (16-19 years) in 2015.</td>
</tr>
<tr>
<td>Use Compare Years</td>
<td>Before you send anything to the Board, you decide to research - if the rate of employment among Young Adults (16-19-years) is increasing, decreasing or is steady in the neighborhoods that your organization serves. Is there a way to compare the 2015 employment percentage to previous years?</td>
</tr>
<tr>
<td>Find Indicator Description</td>
<td>Can you find a formal description of “Percentage of Population aged 16-19 in School and/or Employed”?</td>
</tr>
<tr>
<td>Share / Save /</td>
<td>How would you share / save the data?</td>
</tr>
</tbody>
</table>
BNIA collects Vital Signs data from reputed sources at federal, state and city level since 2009. All that data gets sorted in 8 topics. For example, Crime and Safety, Census Demographics, Census Demographics etc. One such topic is Vital Sign Topic. How would you find that topic?

---

**Participant 2. Non-Profit.**

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Task Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find Correct Vital Sign Topic</td>
<td>You are looking to research Vital Signs 15 data related to Housing. Your organization is considering to start a program that supports low-income renters. If the data is valuable, you might use it in a report. How would you go about finding data related to Housing?</td>
</tr>
<tr>
<td>Locate an Indicator</td>
<td>You are aware of rising rents and stagnant incomes that have created a Housing Affordability crisis in Baltimore. To start, you are most interested in finding - What is the Affordability Index Rent in 2015 for your target neighborhood.</td>
</tr>
<tr>
<td>Use Compare Years</td>
<td>Before you decide to add something in the Report, you want to know - if the Affordability Index Rent is steady or fluctuating for your target neighborhood. So, is there a way to compare the 2015 Affordability Index Rent to previous years?</td>
</tr>
<tr>
<td>Find Indicator Description</td>
<td>Can you find a formal description of “Affordability Index Rent”?</td>
</tr>
</tbody>
</table>
BNIA collects Vital Signs data from reputed sources at federal, state and city level since 2009. All that data gets sorted in 8 topics. For example, Crime and Safety, Census Demographics, Census Demographics etc. One such topic is (Vital Sign Topic). How would you find that topic?

### Participant 3. Researcher.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Task Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find Correct Vital Sign Topic</td>
<td>For your personal analysis, you want to find if Vital Signs 15 has data related to urban population walking to work and trees related data.</td>
</tr>
<tr>
<td>Locate an Indicator</td>
<td>You are researching to write a report on tree plantation in disadvantaged neighborhoods. Firstly, you want to find what were the number of trees planted in few target neighborhoods.</td>
</tr>
<tr>
<td>Use Compare Years</td>
<td>Secondly, you want to know if the number of trees planted is steady or fluctuating for those target neighborhoods.</td>
</tr>
<tr>
<td></td>
<td>Is there a way to compare the Number of Trees planted in 2015 to previous years?</td>
</tr>
</tbody>
</table>
Find Indicator Description
Can you find a formal description of “Number of Trees Planted”?

Share / Save / Download Data
How would you share / save the data?

Find and Navigate to another vital sign topic from inside page
BNIA collects Vital Signs data from reputed sources at federal, state and city level since 2009. All that data gets sorted in 8 topics. For example, Crime and Safety, Census Demographics, Census Demographics etc. One such topic is (Vital Sign Topic). How would you find that topic?

Participant 4. Journalist

Tasks Task Scenario
Find Correct Vital Sign Topic
Carpooling has many benefits like less commuting stress, less pollution and need for parking etc. You decide to research carpooling to work. If you get valuable data in Vital Signs 15, you might consider writing an article. How would you research carpooling and its related topics?

Locate an Indicator
You are researching on usage of public transport to work in few disadvantaged neighborhoods. To start, you are most interested in finding the number of people who actually use public transport to work in your target neighborhoods.

Use Compare Years
You are curious to know if the number of people using public transport is steady or fluctuating for your target neighborhoods. Is there a
way to compare the “Percent of Population that Uses Public Transportation to Get to Work” to previous years?

Find Indicator Description
Can you find a formal description of “Percent of Population that Uses Public Transportation to Get to Work”?

Share / Save / Download Data
How would you share / save the data?

Find and Navigate to another vital sign topic from inside page
BNIA collects Vital Signs data from reputed sources at federal, state and city level since 2009. All that data gets sorted in 8 topics. For example, Crime and Safety, Census Demographics, Census Demographics etc. One such topic is (Vital Sign Topic). How would you find that topic?

Participant 5. Non-profit.

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Task Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find Correct Vital Sign Topic</td>
<td>A nonprofit has requested your help in finding data about High Schoolers. That nonprofit wants to apply for an academic grant that will benefit 9th – 12th grade students. How would you identify some basic information in Vital Signs 15 that is related to High School Students?</td>
</tr>
<tr>
<td>Locate an Indicator</td>
<td>A nonprofit from Southern Park Heights is applying for a grant that creates employment opportunities for young adults (age 16-19 years) in school. The nonprofit is unable to obtain the relevant data so they requested your assistance. To start, you are interested in finding how many school going young adults are employed in Southern Park Heights.</td>
</tr>
</tbody>
</table>

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Before forwarding any data, you got curious to know if the number of young employed adults (age 16-19 years) in school is steady or fluctuating for Southern Park Heights. So, is there a way to compare the number of young employed adults (age 16-19 years) in school to previous years?

Can you find a formal description of “Percentage of Population aged 16-19 in School and/or Employed”?

How would you share / save the data?

BNIA collects Vital Signs data from reputed sources at federal, state and city level since 2009. All that data gets sorted in 8 topics. For example, Crime and Safety, Census Demographics, Census Demographics etc.

One such topic is (Vital Sign Topic). How would you find that topic?

Life Bridge Health supports many Community Programs. Your community care team has requested for some data related to poverty affecting children under 18 years. How would you go about explore poverty related data in Vital Signs 15?

Life Bridge Health is seeing an increase in geriatric patient population. You are preparing a report which will assist the management in defining the requirements and needs for this population.
To start, you are most interested in finding what is the population of 65 years and over for some target neighborhood.

<table>
<thead>
<tr>
<th>Use</th>
<th>Secondly, you are curious to know if the number of people 65 and over is steady or fluctuating for some target neighborhoods. So, is there a way to compare the “Percent of Population 65 years and over” to previous years?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compare Years</td>
<td></td>
</tr>
<tr>
<td>Find Indicator</td>
<td>Can you find a formal description of “Percent of Population 65 years and over”?</td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>Share / Save / Download Data</td>
<td>How would you share / save the data?</td>
</tr>
<tr>
<td>Find and Navigate to another vital sign topic from inside page</td>
<td>BNIA collects Vital Signs data from reputed sources at federal, state and city level since 2009. All that data gets sorted in 8 topics. For example, Crime and Safety, Census Demographics, Census Demographics etc. One such topic is (Vital Sign Topic). How would you find that topic?</td>
</tr>
</tbody>
</table>
### Appendix H: Objective- Task - Success Criteria Relationship

<table>
<thead>
<tr>
<th></th>
<th>Goal</th>
<th>Usability Objective</th>
<th>Tasks</th>
<th>Success Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Findability</td>
<td>After getting the first impressions of BNIA Homepage. Can users find and navigate to Vital Signs topic from homepage?</td>
<td>Find Correct Vital Sign Topic</td>
<td>The user can explore the top navigation successfully clicks on “Vital Signs” to find the right topic. Or Use the Vital Signs by topic tab to find and navigate to right topic page.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Findability, Navigation</td>
<td>Can the user locate a given Indicator and its data?</td>
<td>Locate Indicator</td>
<td>The user finds the Indicator given in the task. Maybe user can articulate some analysis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Findability, Navigation,</td>
<td>Identify obstacles in finding and using the compare years feature.</td>
<td>Use Compare Years</td>
<td>The user uses the compare years interface. Compares the data for 2 years</td>
</tr>
<tr>
<td>4</td>
<td>Findability</td>
<td>Can the user find Indicator description? Is the description valuable</td>
<td>Find and Read Indicator description</td>
<td>The user finds and mouse overs the link and articulates the explanation. OR User uses the left menu to navigate to Indicator Page and reads the Introduction content. Or Navigates to All Indicator Page to find description. (Longer route)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>5</td>
<td>Findability</td>
<td>Understanding User’s preference to save, share or download the data after comparison.</td>
<td>Share / Save / Download Data</td>
<td>Qualitative Answer. The user articulates or shows few steps to either share / save / download data. Eye tracking will</td>
</tr>
</tbody>
</table>

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6. **Navigation**

<table>
<thead>
<tr>
<th>Capture users identifying Copy, Excel, PDF and Print Icons.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed the inefficiency of navigating Vital Signs Inner pages which was presented in the earlier research. Especially do users use the compare years feature drop down to change Vital Signs Topic.</td>
</tr>
<tr>
<td>Find and Navigate to another Vital Sign Topic from Inside Page.</td>
</tr>
<tr>
<td>The user successfully navigates to another Vital Signs topic using navigation options. The top band or browse back on homepage to start again.</td>
</tr>
</tbody>
</table>
**Introduction Session**

Good Morning, [Participant Name] thank you, for making time in your schedule to participate.

My name is Vipul, I teamed up BNIA to evaluate and improve their web content and data features.

During the rest of this session, I will be reading from this script to ensure that I cover everything and the instructions are same for every participant in this study.

Here is how this 1-hour session will work,

- For the first 20-25 minutes, we will talk about your work, role and explore how you use open data in your organization. What websites and type of data you seek? During this time, please show us how, you use BNIA website or any other website which you use to access open data related to Baltimore. I will ask you a few questions as and when required.

- And then we will change gears, I will ask you to do some basic tasks. You may or may not have done these tasks before. The first task will be shown to you on the computer screen and you will also get a printed copy. From then on you will get printed copy for all tasks one at a time. Whenever you are ready just say, “I am ready” and start.

When you are comfortable and feel the task is done just say “I am done” and we will move on to the next task.

While you are doing those tasks, please try to think out loudly. So, by that I mean, please tell us what you’re looking at, what you’re trying to do,
and what you’re thinking. This will be a big help to us in our research.
[Let me demonstrate that think out load. Target.com].

One important thing, before we start.
We are testing the BNIA website, not you or your capabilities. There is not a right or wrong way to do things. Your every action, thoughts and ideas will help us to evaluate the website. So simply tell us whatever you are trying to do, thinking – that will help our research a lot.

If you have any questions as we go along, just ask them. I may not be able to answer them right away, since we’re interested to know what users would normally do at their office or home. When we’re done, I’ll try to answer them to the best of my knowledge.

Any questions before we start?

Start the Google Homepage

Exploration Phase: Google Open
I know a little bit about you through this UX Screener. So that’s great start.

(Hand this out to the Participant) Wait.

I was curious to know a few things:

1. What does a [name of title / post] do on a daily basis at [or].

2. Talk to us about how and why [organization] uses open data. Who uses it most and how?

3. What is your process - (When you have to set goal, writing report or Articles? Q4 from UX screener)

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4. What other websites other than BNIA do you look at.
5. How do you compare BNIA website with respect to others?
6. Is there something specific you like in some of these websites? For example, say content or structure. Search, Visually Appealing, Ease of Use, understanding or reading.
7. Are there any favorite Web sites?

BNIA Homepage Questions. 3 to 4 minutes.
Can you please browse the BNIA’s homepage and can you give us your impressions?

(Stop. Let the user browse for 1-2 minutes.)

- How do you approach the Vital Signs Data?
- Do you think Vital Sign data is organized for your task at work?
- On the homepage what is important to you.
- Is it easy to find data on the BNIA homepage?
- Is the homepage easy to read?
- BNIA has other projects too. Do you follow these other projects?
- BNIA is active on social media. Do you follow them for updates?
- I know this is in the past but I have a few follow up questions related to this Screener (hand this to user)
  a. UX Q3 Which data categories are most relevant to your work
  b. UX Q4 What kind of usage
  c. UX Q5 –Finding What you want from Vital Signs
d. UX Q6 – How Useful is Compare years

Probing Questions related to Compare Years:

Wait for the user to complete all tasks.
Follow up on any particular problems that came up for the participant.
I have a few follow-up questions that I would like to ask you.

- Was the Compare Feature what you expected?
- Does the page help you with the task at hand?
- BNIA want to know if you find the overall content valuable?
- Can you talk to us specifically about the table -format, layout?
- Table heading? Value Change and Percent Change makes sense?
- Do you find this page easy to read?
- Do you find this page easy to Find data?
- Is the source of the Indicator Important at (X) stage
- How do you follow Indicators or discover new ones?

Post Test Questions

What are the two things that you absolutely liked about the Compare Years Feature?

What are the two things you just did not like about the Compare Years Feature?

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Appendix J: Mismatch of drop-down content with display on page
Appendix K: Contextual Inquiry Analysis
## Appendix L: Qualitative Task Analysis

<table>
<thead>
<tr>
<th>Task</th>
<th>Success with one Attempt</th>
<th>Success (Indicator Trend)</th>
<th>Success (with 3 Hints, longer time)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Compare Years Feature:** Find the compare years feature [orange button on top right] Use the checkbox to add more than one year in the past. Click on Update selection button. View the queried page. Articulate about the data. Use sorting feature or.

**Unnecessary Clicks:**
- Keep clicking Compare Button expecting the page to update and show her selection.
- Did not use the Compare Years Feature instead used the Indicator Trend but did the analysis of comparison between neighbourhoods accurately. Added neighbourhood.
- Did not use the Compare Years Feature instead used the Indicator Trend but did the analysis of comparison between neighbourhoods accurately. Added neighbourhood.
- Did not know if the compare years feature exists. Went back to Homepage. Vital signs Archive. Feels there is no way to compare. Unnecessary Clicks: on the left hand side to maintain focus on the Indicator. (Note: Moment User Says: I DON’T KNOW HOW TO DO A COMPARISON: DO I DO COMPARE YEARS OR THIS. I HAVE TO RIC DO THAT SELECTION AGAIN. NOW HOW DO I GET (8-40 to 9-04)). Unnecessary Clicks: kept clicking Compare Button expecting the page to update and show her selection. Mistake: Update years selection button: Wrong Mental Model: After selecting years in compare years clicked on the Indicator in table expecting to travel to a page to see data. (Note: Moment User Says: (8-53): 2 years comparison data isn’t really much. 5.**

**Loosely Indicative Trend Challenge:** User already had done the comparison using the Trend Chart but could not find the Indicator Trend tab again. Instead went to chart and then the process all over again.

**Inconsistent Data:** [8-42] Users guess / view about stagnant data and maybe its projection. I am not sure why there is a mismatch of data.

**Page Interaction unclear:** [8-53] User waiting for the loaded page with updated data. Unnecessary Clicks needed to open the data.

**Lost Control of Compare Page:** Started with Park Heights but due to the confusion ended up telling the data for Baltimore City.

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Appendix M: Qualitative Analysis specific to Compare Years

<table>
<thead>
<tr>
<th>Was the compare years expected</th>
<th>Expecting Line Graph as opposed to comparing it for 2 years in tabular form</th>
<th>Yes and No. Good Start. I expected it to be more intuitive. I should not have to chasing buttons. Go it to work once. Maybe its not. I have no idea.</th>
<th>No. Expected Indicators to be compared with other indicators</th>
<th>No. Using it for the first time.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the page help you with the task at hand</td>
<td>OK. The more useful feature was line graph.</td>
<td>Yes</td>
<td>more intuitive, context specific assistance. Go somewhere else.</td>
<td>No.</td>
</tr>
<tr>
<td>Overall content of compare page</td>
<td>Valuable for what it is. Need more data on Transportation. Fresh.</td>
<td>Yes sufficient for job</td>
<td>Valuable for what it is. Need more data on Transportation. Fresh.</td>
<td>Yes sufficient for job</td>
</tr>
<tr>
<td>Table format, presentation</td>
<td>Hates Table, Color Coding Liked</td>
<td>Did not know about Compare Years</td>
<td>Yes it is very useful. Its not intuitive.</td>
<td>Yes makes sense.</td>
</tr>
</tbody>
</table>

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## Appendix N: Post Test Answers

### Z Things you learned about Compare Years

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>City and Neighborhood Data next to each other</td>
<td>Like the fact that one could do it.</td>
<td>Choose Topic and Year</td>
<td>Like the fact that one could do it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Comparing data at Neighborhood level</td>
<td>Ability to correlate data by Percent Change</td>
<td>Multiple options above table to view/share (EAP)</td>
<td>Select Topic, Easy to Read and Review.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Column Headers - Value and Percent Change</td>
<td>Column Headers - Value and Percent Change</td>
<td>Keep the year selected and change the indicator</td>
<td>Column Headers - Value and Percent Change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Color Coding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Z Things you learned about Compare Years

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>More Visual Separation of City and Neighborhood Data</td>
<td>Only 2 years comparison</td>
<td>Missing Data - No way to know if you join years that don’t have data</td>
<td>Wish there was no option to select years where there is no data. (Deleted out years)</td>
<td>Header bar does not scroll with the data</td>
<td>Only 2 years comparison</td>
<td>I want to see more.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Update Selection Button placement and interaction</td>
<td>Update Selection and Compare Years button felt inconsistent and confusing</td>
<td>Update Selection + Compare Years button makes sense.(9/14)</td>
<td>Update Selection + Compare Years button makes sense (9/14)</td>
<td>Only 2 years comparison</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Appendix O: Gaze plot example for Task 4- Find and Read Indicator description
**Version 1**

What you are going to see today is a version of the Vital Signs Topic page and compare years. These screens are work in progress; nothing is finalized at this stage.

The goal in showing you is to get feedback like you gave us during the usability testing— that helped immensely. Since you are aware of that my hope after seeing this version you can compare the versions.

**Show Homepage Tab screen:** This is not a full working version. The screens you will be seeing are copy pasted in PowerPoint and only a few links are clickable. (demo) So, one tip before I want to share with you a tip is on the screen if you take the mouse over the screens it will change to hand and that means that link is clickable. The rest are not.

Say can you click on the census demographic link - Keep the Homepage Tab screen. Just look at the page and talk to us about what you see and what can you can possibly do. Don’t click yet. I have a print out here if that helps.

**Version 2:** So, let’s look at another version of Compare years.

Similar instructions to what you previously saw. A) the design is not final, and we have tried to simplify the online version. We are looking at getting early feedback.

**Show Homepage Tab screen:** The tip, while exploring will help, take the mouse over the screens it will change to hand and that means that link is clickable. The rest is not. (demo this) Say can you click on the census demographic link - Keep the Homepage Tab screen. Just look at the page and talk to us about what you see and what can you can
possibly do. Don’t click yet just move your mouse.

I have a print out here if that helps.
## Appendix Q: Prototyping - Task, Task Scenarios and Success Criteria

### Table 6

**Version 1 - Task, Task Scenarios and Success Criteria – P1 Non-Profit**

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Task Scenario</th>
<th>Success Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>For your report, you want to add some Household related Indicator data. You are keen to see if BNIA has any Average Household Size data.</td>
<td>Identify verbally or point to Average Household Size. The user should be able to navigate the tabs on landing page.</td>
</tr>
<tr>
<td>2</td>
<td>How will you compare the Average Household Size for Cherry Hill neighborhood?</td>
<td>Identify and click on the Community Drop down and complete comparison. OR Articulate some steps to add neighborhood. Like point to Chart. Mouse over community drop down</td>
</tr>
<tr>
<td>3</td>
<td>For comparison, you want to add your 5 target neighborhoods to the chart and save the chart for a report. Can you talk and show some possible steps?</td>
<td>Point and Click on the community dropdown. Look at the drop-down list and add at least one neighborhood.</td>
</tr>
<tr>
<td></td>
<td>You compared the data visually; can you see if there is any tabular</td>
<td>The user should be able identify and click on the tabbed</td>
</tr>
<tr>
<td>data to compare for the same indicator for 5 years.</td>
<td>navigation and explore the charts, maps and table</td>
<td></td>
</tr>
</tbody>
</table>
Table 7
Version 2 - Task, Task Scenarios and Success Criteria – P3 Researcher

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Task Scenario</th>
<th>Success Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Can you tell us without clicking, what’s the Average Household Size for Brooklyn / Curtis Bay neighborhood?</td>
<td>The user should be able to read the table and say the value 2.9</td>
</tr>
<tr>
<td>2</td>
<td>Compare the Average Household Size for Brooklyn / Curtis Bay neighborhood for 2015 and 2016 years.</td>
<td>The user should locate the compare years button and complete at least 2 steps.</td>
</tr>
<tr>
<td>3</td>
<td>You are curious to explore Brooklyn / Curtis Bay neighborhood page. Once you reach there can you again compare the Census Demographic section for 2015 and 2016 years.</td>
<td>The user should be able to find and click Brooklyn / Curtis Bay link. Also, the user should locate the compare years button on this page button and complete at least 2 steps in task 3</td>
</tr>
<tr>
<td>4</td>
<td>On the average household size indicator page, can you see if there is a visual way to view the tabular data.</td>
<td>The user should be able to locate the 3 links – Charts, Trends and Map.</td>
</tr>
</tbody>
</table>
Appendix R: Prototyping – Task Completion Checking
## Option 2 - P1

<table>
<thead>
<tr>
<th>1st Impressions</th>
<th>2nd Impressions</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Similar to current format</td>
<td>- Indicator not grouped as previous option</td>
</tr>
<tr>
<td>- Not visually appealing</td>
<td>- Too many points of attention</td>
</tr>
<tr>
<td>- Easy to read</td>
<td>- Icon + Text</td>
</tr>
<tr>
<td>- Takes in previous version clear vs link</td>
<td>- Baltimore City data not needed set on top</td>
</tr>
<tr>
<td>24:00 - Same frustration with the same</td>
<td></td>
</tr>
</tbody>
</table>

### Task 1

- 2:9 - Success

### Task 2

- That's clean - Success

### Task 3

- Yeah, I like it
- Fairly easy - Success

### Tasky Map

- We can see visually - Success

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Appendix S: Prototyping Notes created after listening to Audio Recordings

- Improve under neighborhood geography
- Clear indicator: tabbed group
- Story, video
- PDF download
- Text can be bigger
- Color not even
- Imperson [get-to-data-quickly]
- Detail: easy to use
- Indication: tabbed
- Explain indicator, change text to explain
- Indicator term - not clear
- Need frequency of used term

5:51, I like this detail

- Trend directly is cool
- Brief description: ranking on lotion
- Save chart

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COMPARE YEARS FEATURE - USER’S PERSPECTIVE: Chapter 5

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COMPARE YEARS FEATURE - USER’S PERSPECTIVE: Chapter 5

Option 1

Followup
Icon to save table
Dropdown topic change

Followup

download button

Navigation

LHS
previous prototype liked it
other then last page grouped

Intuitive
liked previous
not as appealing/innovating
small, not clear in dark formats

1st version progress

1st grouping clear

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COMPARE YEARS FEATURE - USER’S PERSPECTIVE: Chapter 5

map color can be more clear. Explicit color on map trend was easy to map vs colors commonly.

Follow-up questions/feedback:
- topic 1: unclear. Clicked on indicator icon, but higher level navigation
- will go to homepage

New experience:
- like multiple formats and how it looks visually

Content comments:
- 3 things noted in 2016:
- this seemed pretty straightforward.
- chart - 2016, data - yes it help to remind.

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Appendix T: Option 1 Design Set

**Average Household Size**

Measures the average size of the households within an area. The average size of a household is obtained by dividing the number of persons in households by the number of households (or households). Read More

**4 ways to use Trend Analysis**

- Compare this trend with other trends to understand different characteristics at play and what might be influencing them.
- Plan your next steps strategically. Compare the trend with your internal reports and efforts.
- Develop a narrative around Indicator for your next grant report.
- Save the data and bring it at your next neighbourhood meeting and start a conversation - it's important.

**Figure 14. Option One – Trends tab**
**Average Household Size**

Measures the average size of the households within an area. The median value of number of persons living within a household. The average size of a household is obtained by dividing the number of persons in households by the number of households (or householders).

**Figure 15. Option One – Charts tab**

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Figure 16. Option One – Maps tab
### Average Household Size

Measures the average size of the households within an area. The median value of number of persons living within a household. The average size of a household is obtained by dividing the number of persons in households by the number of households (or householders).

---

#### 2016 - COMPARE PREVIOUS 5 YEARS

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allenwood / Irvington / S. Hilton</td>
<td>2.7</td>
</tr>
<tr>
<td>Baltimore City</td>
<td>2.5</td>
</tr>
<tr>
<td>Beechfield / Ten Hills / West Hills</td>
<td>2.5</td>
</tr>
<tr>
<td>Belair-Edison</td>
<td>2.6</td>
</tr>
<tr>
<td>Brooklyn / Curtis Bay / Hawkins Point</td>
<td>2.9</td>
</tr>
<tr>
<td>Canton</td>
<td>2.0</td>
</tr>
<tr>
<td>Cecilton</td>
<td>2.5</td>
</tr>
<tr>
<td>Cedar Grove / Frankford</td>
<td>2.7</td>
</tr>
<tr>
<td>Cherry Hill</td>
<td>2.4</td>
</tr>
<tr>
<td>Chequespine Park / Belvedere</td>
<td>2.4</td>
</tr>
<tr>
<td>Clermont / Armistead</td>
<td>2.4</td>
</tr>
<tr>
<td>Clifton-Berea</td>
<td>2.7</td>
</tr>
<tr>
<td>Cross-Country / Cheswold</td>
<td>2.6</td>
</tr>
<tr>
<td>Dickeyville / Frankstown</td>
<td>2.2</td>
</tr>
<tr>
<td>Dorchester / Aishtown</td>
<td>2.7</td>
</tr>
<tr>
<td>Downtown / Seton Hill</td>
<td>1.4</td>
</tr>
<tr>
<td>Edmondson Village</td>
<td>2.9</td>
</tr>
<tr>
<td>Felts Point</td>
<td>2.1</td>
</tr>
</tbody>
</table>

---

*Figure 17. Option One - Table tab before Comparison*
Figure 18. Option One - Table tab after Comparison

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Appendix U: Option 2 Design Set

VITAL SIGNS 16

Choose a Topic Area
See how all communities measure up. Read each indicator description. You can switch to other topics and navigate to neighbourhoods.

- Census Demographics
- Children and Family Health
- Crime and Safety
- Housing and Community Development
- Workforce and Economic Development
- Sustainability
- Education and Youth
- Arts and Culture

Figure 19. Option Two - Homepage Tab
Figure 20. Option Two - Census Demographics Landing page
COMPARE YEARS FEATURE - USER’S PERSPECTIVE: Chapter 5

Average Household Size
The median value of number of persons living within a household. The average size of a household is obtained by dividing the number of persons in households by the number of households (or householders).

Sources: U.S. Bureau of the Census, American Community Survey
Topic Area: Census Demographic
Years Available: 2012-2016
Indicator Related: Chart | Trends | Maps

Figure 21. Option Two - Interface Modal Window Design
**Average Household Size**

The median value of number of persons living within a household. The average size of a household is obtained by dividing the number of persons in households by the number of households (or householders).

**Sources**: U.S. Bureau of the Census, American Community Survey

**Topic Area**: Census Demographic

**Years Available**: 2012-2016

**Indicator Related**: Chart, Trends, Maps

<table>
<thead>
<tr>
<th>Community</th>
<th>2015</th>
<th>2016</th>
<th>Value Change</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baltimore City</td>
<td>2.4</td>
<td>2.5</td>
<td>0.1</td>
<td>4.2%</td>
</tr>
<tr>
<td>Allendale/Avondale/Colonia/Elkton</td>
<td>2.6</td>
<td>2.6</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Beechfield/Ten Hills/West Hills</td>
<td>2.4</td>
<td>2.6</td>
<td>0.2</td>
<td>8.3%</td>
</tr>
<tr>
<td>Belair-Edison</td>
<td>2.9</td>
<td>2.9</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Brooklyn/Gunters Bay/Hawkins Point</td>
<td>2.6</td>
<td>2.9</td>
<td>0.3</td>
<td>11.5%</td>
</tr>
<tr>
<td>Canton</td>
<td>1.9</td>
<td>2.0</td>
<td>0.1</td>
<td>5.3%</td>
</tr>
<tr>
<td>Cecilton/Frankford</td>
<td>2.5</td>
<td>2.5</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Cherry Hill</td>
<td>2.6</td>
<td>2.6</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Chingapin Park/Belvedere</td>
<td>2.3</td>
<td>2.4</td>
<td>0.1</td>
<td>4.3%</td>
</tr>
<tr>
<td>Claremont/Aermsted</td>
<td>2.4</td>
<td>2.5</td>
<td>0.1</td>
<td>4.2%</td>
</tr>
<tr>
<td>Clifton/Brenta</td>
<td>2.8</td>
<td>2.8</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

**Figure 22.** Option Two - Average Household Size Indicator Page after Comparison
Figure 23. Option Two - Neighborhood Page with Census Demographics section
Figure 24. Option Two - Interface Modal Window in Neighborhood Page
**Census Demographics**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2015</th>
<th>2016</th>
<th>$</th>
<th>2015</th>
<th>2016</th>
<th>$</th>
<th>Percent Change</th>
<th>2015 City Data</th>
<th>2016 City Data</th>
<th>$</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Household Size</td>
<td>2.8</td>
<td>3.9</td>
<td>1</td>
<td>3.5%</td>
<td>2.5</td>
<td>2.5</td>
<td>0</td>
<td>0.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median Household Income</td>
<td>$38,174.0</td>
<td>$41,482.0</td>
<td>3,308</td>
<td>6.0%</td>
<td>$42,241.0</td>
<td>$44,252.0</td>
<td>2,011</td>
<td>4.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of Children Living Below the Poverty Line</td>
<td>36.9</td>
<td>36.1</td>
<td>-0.8</td>
<td>-0.8%</td>
<td>33.5</td>
<td>33.3</td>
<td>-0.2</td>
<td>-0.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of Family Households Living Below the Poverty Line</td>
<td>18.6</td>
<td>19.6</td>
<td>1</td>
<td>1%</td>
<td>19.0</td>
<td>18.3</td>
<td>-0.7</td>
<td>-0.7%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of Female-Headed Households with Children Under 18</td>
<td>74.1</td>
<td>74.9</td>
<td>0.8</td>
<td>0.8%</td>
<td>54.4</td>
<td>52.6</td>
<td>-1.8</td>
<td>-1.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of Households Earning $25,000 to $40,000</td>
<td>17.0</td>
<td>15.6</td>
<td>-1.4</td>
<td>-1.4%</td>
<td>15.4</td>
<td>15.1</td>
<td>-0.3</td>
<td>-0.3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of Households Earning $40,000 to $60,000</td>
<td>17.9</td>
<td>20.7</td>
<td>2.8</td>
<td>2.8%</td>
<td>16.5</td>
<td>16.5</td>
<td>0</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of Households Earning $60,000 to $75,000</td>
<td>7.6</td>
<td>6.7</td>
<td>-0.9</td>
<td>-0.9%</td>
<td>8.9</td>
<td>8.9</td>
<td>0</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 25.** Option Two - Neighborhood Page after Comparison

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