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16-09 Transportation Mobility Among Low-Income, Transportation Disadvantaged Older Adults Living in a Low Density Urban Environment Using Innovative Data Collection Methods

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TRCLC 16-09
July 11, 2018

TRANSPORTATION MOBILITY AMONG LOW-INCOME, TRANSPORTATION DISADVANTAGED OLDER ADULTS LIVING IN A LOW DENSITY URBAN ENVIRONMENT USING INNOVATIVE DATA COLLECTION METHODS

Final Report

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16. Abstract

This study investigates the transportation disadvantage that low-income, older adults face on an individual basis. To accomplish this, research team members custom designed an innovative "travel diary" app, *MyAmble*, which tracks planned, completed, failed/uncompleted trips, and unserved trips in its *Trip Planner* module. In addition to the typical transportation planning data (e.g. origin, destination, mode), *MyAmble* collects data related to the completed or failed/uncompleted trip's impact on the participant's mood and quality of life. *MyAmble* utilizes 3 additional modules (*Challenge Logger*, *Travel Buddy*, and *Travel History*) to collect qualitative data related to the role that transportation plays in the participant's life and history.

The field test shows significant promise in terms of capturing data on quantity and impact of missed trips, particularly as they relate to psycho-social-emotional well-being and autonomy; however, the selected population of low-income, community-dwelling older adults face health challenges that may have limited some participants' ability to utilize the app. The study generates critical feedback for continued improvements to *MyAmble*. Participants expressed positive feedback and strong support for the app, specifically the *Travel Buddy* feature. The data generated by *MyAmble* provide new insights into the challenges facing environmental justice communities.

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1. INTRODUCTION

Environmental obstacles to age-friendly communities are especially salient in low-density urban communities characterized by sprawl (Ball & Lawler, 2014). This phenomenon bodes poorly for older adults who desire to age in place, and particularly for those who cannot afford to relocate to more age-friendly environments. In recognition of this link between aging well and the built environment, the World Health Organization (WHO; 2007) began a livable communities initiative to address active aging by optimizing city structures and services to enhance health and quality-of-life for older adults. Transportation mobility is a critical domain for livable communities (i.e., outdoor spaces, social connectivity, communication and information, health and community, civic participation and employment, housing, respect and inclusion; WHO, 2007).

Older adults who are lower income and/or have a disability are often considered transportation disadvantaged (US Government Accountability Office (GAO; 2004), in that they are unable to drive due to disability or a medical illness, unable to afford a vehicle, or lack access to transit services, and also have limited access to other transportation options. In the context of urban sprawl, transportation disadvantage is compounded (Rashid, Yigitcanlar & Bunker, 2010), as they face further obstacles that impede access to healthcare services, nutritious food, social connectivity, and community engagement (Zeitler, Buys, Aird, & Miller, 2012).

Existing studies examining the relationships between older adults and transportation mobility focus on individual level factors (e.g., sociodemographics, health-related variables) with scant attention to the contextual factors behind older adults' experiences with transportation. Mobility remains too rarely framed within the context of social sustainability (Nakanishi & Black, 2015). Furthermore, research on transportation mobility and aging is hampered by methodological difficulties and the limited scope of discovery inherent in the use of traditional travel surveys and travel diaries to capture the lived experience of transport structure (Axhausen, 2008; Preston & Rajé, 2007). Innovative data-collection methods that examine the complexity of travel experiences of older adults at the individual-environment interface appear vital to expand the understanding of the reciprocal interaction between transportation mobility and quality-of-life (Bellemans, van Bladel, Janssens, Wets, & Timmermans, 2009). These new data collection methods will expand the scope of findings to include the impact of transportation mobility on quality of life among older adults and "suppressed travel," defined as latent transportation needs or desires (Duvarci & Mizokami, 2007).

This study builds on pilot data (Adorno, Fields, Cronley, Parekh, & Magruder, 2016) documenting significant transportation needs among low-income older adults in Tarrant County, TX, the tenth most sprawling US metropolitan area among the 83 metro areas indexed by Smart Growth America (2002). Urban sprawl is a common feature of the built environment in metro areas, and older residents seem particularly at risk for diminished quality of life as a result of poor transportation accessibility (Rosso, Auchincloss, & Michael, 2011). Existing methods require far too many assumptions and may invariably lead to mismatches between the resources available and older adults' use of those resources.

This project implements a novel, longitudinal ecological (Bolger & Laurenceau, 2013) study design to examine transportation mobility experiences and their impact on quality of life among this highly vulnerable population, which is often overlooked by transportation researchers. To this end, the study designs a daily transportation diary (using oral entries versus traditional pencil-and-paper entries) for older adults to capture data related to their transportation experiences; this approach extends the typical travel diary to capture more detail about each transportation event and examine the gaps in activity- fulfillment due to transport limitations.

2. PURPOSE AND SCOPE

Transportation planning and engineering traditionally have struggled to serve disadvantaged and lower-income communities. Evidence of this challenge can be seen in disparate transportation system outcomes related to access, opportunity, safety, and health, as well as in perceived misalignment between transportation priorities and community needs. Adequately serving disadvantaged populations requires reassessing long-held assumptions and practices within the transportation profession, particularly with regard to the understanding of transportation gaps and needs in specific socio-economic contexts. The aim of this project is to understand transportation mobility and the impact of transportation gaps on quality of life among low-income, homebound older adults in a low-density, urban environment.

This report is divided into four sections, labeled as tasks. For **Task 1**, a literature review was conducted to identify transportation mobility gaps. While the need for transportation appears clear, the strategies for identifying and quantifying the magnitude of "failures" in the current transportation system to serve EJ populations requires careful examination. This investigation examined studies dealing with categorizing and quantifying transportation gaps for individuals and communities. While all gaps may be important, those that affect EJ communities and populations warrant more attention, thus emphasized in this literature review. For **Task 2**, another literature review focused on the impacts associated with transportation gaps and the importance of quantifying and categorizing them. The investigation sought research that measures the impact of these gaps on human well-being in terms of health (both physical and psycho-social), access to opportunities (including the opportunity type (e.g. work or personal business), frequency, and temporal or spatial requirements), and community connectedness. For **Task 3**, the study used an intensive ecological, longitudinal design to understand the actual and desired travel experiences and gaps in transportation mobility among low-income, transportation disadvantaged older adults living in a low density urban environment in Tarrant County, Texas, the tenth most sprawling metropolitan area in the United States (US). The goal was to capture more in-depth, perceptual data than feasible with closed-ended surveys and static data collection methods. The study used an innovative, custom-designed, digital daily desired transportation activity diary for EJ populations called *MyAmble*. Finally, for **Task 4**, using the experiences and data from Task 3, the researchers document the successes, challenges, mitigation strategies and other recommendations associated with conducting an assessment of transportation mobility gaps using*, MyAmble.* The data from Task 3 were used to determine the number and magnitude of the transportation gaps for low-income, transportation disadvantaged older adults living in a low density urban environment; the data helped quantify and categorize the observed and potential impacts associated with the transportation gaps based on health (both physical and psycho-social), access to opportunities (including the opportunity type (e.g. work or personal business), frequency, and temporal or spatial requirements), and community connectedness. Task 4 also identifies some potential strategies for closing or mitigating the current transportation mobility gaps.

3. TASK 1: *Identify state-of-the art tools and techniques for assessing the transportation gaps of EJ populations.*

Mobility and transportation represent critical factors in determining quality of life (regardless of age) by providing individuals access to the goods and services necessary to lead a healthy and happy lifestyle. Historical progressions of urban segregation and social containment that result from job, housing and lending discrimination have left many low-income and minority residents concentrated in central cities (e.g., Bayor, 1988; Mohl, 1993; White, 1982). The barriers posed by the costs of automobile ownership in combination with public transportation systems ill-equipped to service center-city to suburban trips, have resulted in a well-documented spatial mismatch (Ihlanfeldt and Sjoquist, 1998), which is sometimes called an ‘‘automobile mismatch’’ (Ong and Blumenberg, 1998). These populations, who remain relatively less mobile and pose fewer demands on the road network, benefit less from road investments than the most mobile.

By 2030, nearly one in five residents living in the United States will be age 65 and older (Grayson & Velkoff, 2008) and this number may reach 88.5 million people by 2050. Aging has been reportedly linked to a decrease in travel activities including driving (e.g., Mercado & Páez, 2009; Newbold et al., 2005; Raitanen et al., 2003). As a result of this population growth, the United States could face a serious challenge meeting the transportation needs of older adults because good mobility and decent transportation alternatives enable the older population to participate in social interaction and daily activities. Siren, Hakamies-Blomqvist, and Lindeman (2004) and Páez et al. (2007) report; the ability to drive a personal vehicle appears crucial for older people’s mobility; in fact, older people rely on personal automobiles for more than 90% of their transportation needs in the US (Collia et al., 2003). Thus, as the population of older adults continues to grow, planners and policy makers will need to provide age friendly roadway environments for older drivers and accessible alternatives to the personal automobile.

In the US, the personal vehicle remains the most popular mode of transportation among the older population while public transit persists as the least preferred mode of transportation (Burkhardt et al., 1998). The unpopularity of public transit among the older population seems to be linked to transit systems primarily designed for commuters, which makes their schedules and routes inadequate for seniors who often make neighborhood trips, and individual functional deficits (e.g. boarding and alighting vehicles and walking to stations) that make the use of transit difficult. Also, the transit service level often remains poor in low density suburban communities where the majority of older people live due to aging in place. In this built environment, older people often do not feel that they have any options available to them other than continuing to drive or carpooling with friends or family (Donorfio et al., 2009). Therefore, the loss of a driver’s license can be a major contributor to social isolation in the presence of inadequate public transportation and/or support systems that enable older people to access a personal automobile as a passenger (Hensher, 2007).

A few recent tools show promise for assessing the transportation gaps of EJ populations. Golub & Martens (2014) define and calculate “access poverty” and investigate its relationship to minority and low-income populations. Their access measure can identify neighborhoods with poor access for transit and automobile while the ratio between these indicates the burden placed on transit dependent populations. While this provides a critical foundation for assessing zonal level deficiencies, this approach fails to capture household level gaps and challenges, especially for specific trip purposes. Chowdhury et al. (2017) develop an assessment framework for connectivity equity for Auckland, New Zealand, which considers suburbs as origins and Auckland central as a destination. The results show that people in suburbs with high, middle-high and middle income

have better connectivity. People with middle-low and low income have poor connectivity because they face poor bus-bus transfers, a lack of fixed network infrastructure, long journey times, and large headways. Their assessment framework can be applied to the public transportation systems of major cities to identify transit gaps. Guthrie et al. (2017) explore the effects of a transit network on access to job vacancies for disadvantaged areas in the Twin Cities region of Minneapolis-Saint Paul, Minnesota. This approach helps MPOs or other transit agencies to plan, generate and analyze different accessibility scenarios for EJ communities to fulfil their unmet needs. Aimen & Morris (2012) indicate that traditional public involvement techniques appear inadequate, and effectively limit the meaningful involvement of EJ populations. EJ participation requires identifying and locating underserved populations, fostering participation by these populations, and creating opportunities for meaningful public involvement. These findings lead to the approaches that focus on targeting the EJ populations to identify their challenges.

4. TASK 2: *Identifying the Consequences of Transportation Gaps on Environmental Justice Populations*

INTRODUCTION

The concept of Environmental Justice, or EJ, comes from a Civil Rights movement in the early 1960s, whereby racial and ethnic minority individuals sought to address the inequities in environmental protection throughout their communities (United States Environmental Protection Agency (U.S. Environmental Protection Agency [EPA], n.d.). From this, the Environmental Equity Workgroup was developed to address the disproportionally greater environmental risks of racial and ethnic, low-income, and minority populations than their white counterparts (U.S. EPA, n.d.). In 1994, the Environmental Justice Small Grant Program was established under President Bill Clinton (U.S. EPA, n.d.). This program sought to establish collaborative partnerships to determine local and public health issues, and to resolve these issues by way of education, outreach, and training within the community (U.S. EPA, n.d.).

Most recently, federal investments began using funds to build healthy communities and neighborhoods, specifically appropriating monies to three agencies: The Environmental Protection Agency, Housing and Urban Development (HUD), and the U.S. Department of Transportation (U.S. EPA, n.d.). The overall goal from this programming was to: 1) provide more transportation choices to persons living in underserved communities, 2) promote affordable housing options, 3) enhance economic competitiveness to ensure work opportunities, 4) support existing communities that may need help, 5) coordinate federal policies and investments to benefit and improve conditions for Americans especially in need of assistance, and 6) value neighborhoods and communities, as a whole (U.S. EPA, n.d.).

To this end, efforts of the EPA, "hoped to reduce environmental risks and promote healthy, sustainable, and livable communities, especially among overburdened populations" (U.S. EPA, Plan EJ 2014, n.d.). This effort remains in place with the strategic plan, EJ 2020 Action Agenda. Still, the primary goals, in line with the history of this movement, are to improve the overall health and well-being of overburdened, underserved communities (U.S. EPA, n.d.). The purpose of this review of the literature is to identify the consequences of transportation gaps on EJ populations.

ENVIRONMENTAL JUSTICE DEFINED

Environmental Justice refers to the political and advocacy efforts to aid in equal protection from harms, namely in the environment, and access to benefits among all demographic groups (Rowangould, Karner, & London, 2016). While this started as an action plan through the EPA, defining EJ has been an important movement across professions and disciplines at the federal and local levels for well over twenty years (Executive Order 12898, 1994). Delegates of the First National People of Color Environmental Leadership Summit drafted and adopted principles of EJ (First National People of Color Environmental Leadership Summit, 1991), where these seventeen principles address and affirm the rights inclusive of all persons of color, cultural, language, and belief system. Moreover, these principles aim to secure economic, political, and cultural liberation. The U.S. Department of Health and Human Services (2016) define EJ, with respect of the development, implementation, and enforcement of the laws, regulations, and policies, as the involvement and fair treatment of all persons irrespective of demographics or income.

Job security, schools, education, and recreation, quality housing, health care, democratic decision-making, and freedom from drugs, violence, and poverty are all features of EJ (Bryant, 1995). EJ populations represent high minority, non-English speaking, and/or low-income populations (Silverman, 2012). These populations also include individuals within the categories of elderly, children, and persons with disabilities. The use of the word 'persons' refers to not only citizens of the United States, but also undocumented immigrants under the protection of the Title VI (Federal Highway Administration, 2017). The United States Department of Transportation (2012) requires that the locally developed threshold be inclusive to determine the median income in which the EJ population will be defined. For example, revised within the Moving Ahead for Progress in the 21st Century Act (P.L. 112-141), or MAP 21, a low-income individual refers to a "person whose family income is at or below 150 percent of the poverty line," (Federal Highway Administration, 2017).

Additionally, basic EJ populations include racial and ethnic minorities, African-Americans, Hispanic/Latino-Americans, Asian-Americans, American Indian/American Natives, and Native Hawaiian and Pacific Islanders. Further considerations for EJ population include classes of individuals who have been historically underrepresented (U.S. Department of Transportation, n.d.). Persons of low-income, elderly, minorities, children, persons with limited English proficiency, persons with disabilities, female head of households, and zero-car households are identified as EJ (AMPO, 2011; U.S. Department of Transportation, n.d.).

IMPACT OF TRANSPORTATION DISADVANTAGE ON OLDER, LOWER-INCOME ADULT POPULATIONS, SPECIFICALLY

Transportation issues have impacted the well-being of EJ populations in terms of health, both physically and psycho-socially. Individuals with transportation challenges have decreased or lack of access to their health care provider. Barriers in transportation, not owning a car and/or not having access to a car represent the main factors associated with missed clinic appointments (Gautier & Zenou, 2010). Due to this, EJ persons miss evaluations and treatment of diseases, changes in treatments, and may delay interventions designed to prevent complications associated with disease (Syed, Gerber, and Sharp, 2013). This also impacts one's ability to obtain prescription medications through visiting a pharmacy, whereas EJ persons visit pharmacies at lower rates (Syed, Gerber, and Sharp, 2013).

Sanchez, Stolz, and Ma (2003) suggest that public transportation operates in densely developed urban areas where those who travel outside the core downtown receive poor or no

service. This especially applies to individuals who work non-traditional work hours wherein the needs of the EJ populations are not adequately served. For some, the lack of access to transportation influences negative effects such as air pollution from highway construction impairing overall health and influencing issues within the education system (Sanchez, Stolz, and Ma, 2003).

In comparison to low- and/or high- density urban areas, rural communities struggle to fund and maintain public transportation services. In a study conducted by Schwarzlose et al. (2014) across three rural communities in Texas, surveys determine community members' desire for increased taxes towards the funding of transportation services for older adult community members. While most community members favor raising the tax rate for funding transportation services, the specifics of these services appear unclear. Many older adult community members, in particular, require special mobility needs. Local general and special transit service providers may not support those who need special equipment (e.g., older adults using motorized wheelchairs), and this continues to be a highly resource-constrained transportation option (Lockwood, 2004).

In a seminal study of transportation and EJ populations, Nostikasari (2015) conducts an analysis of data from the National Health Interview Survey (NHIS), Medical Expenditure Panel Survey (MEPS), and Bureau of Transportation Statistics (BTS) to explore healthcare issues among those who do obtain medical care, using a sample of an estimated 3.6 million people. The researched population includes individuals more likely to be older, poorer, less educated, female, and from a racial or ethnic minority group. Research suggests that those with major health concerns have greater transportation deficiencies (Nostikasari, 2015). Regarding the aging population, individuals who have good overall health report fewer deficiencies while traveling but older females have more serious issues with mobility than older males. Nostikasari (2015) also suggests that the African-American population experiences a higher burden of travel than the Caucasian population after controlling for the mode of travel and socioeconomic status (SES).

Racial and ethnic minorities report differences in travel behavior. African-Americans and Hispanic/Latino Americans typically have fewer trips and lower car ownership compared to the non-racial and ethnic minority populations, prompting use of other modes of transportation such as walking, biking, or carpooling. These factors influence lower travel mobility and inability to access socioeconomic opportunities. Individuals may embark on trips using public transportation that involve long travel times and contribute to the inability to incorporate more tasks, lower motivation levels, and feeling handicapped due to the lack of adequate transportation (Li, Raeside, Chen, & McQuaid, 2012). Individuals who do not own a car remain likely to have higher unemployment rates and longer durations of being unemployed, earn lower incomes, have a longer commute time, travel fewer miles to their destination, and tend to search and acquire jobs that in smaller areas as opposed to those with cars. These contributing factors may greatly impact one's lifestyle and represent a significant consequence lived by EJ persons experiencing gaps in transportation.

ACCESS TO OPPORTUNITIES

Opportunities for access to employment, shopping, community and recreational services, and health directly link to transportation planning and a lack of transportation, particularly among EJ populations (Denmark, 1998). Transportation policies aimed at highway transportation rather than the development of public transportation have several substantial negative effects impeding the access to opportunities (Sanchez, Stolz, & Ma, 2003). Racial and ethnic minorities and persons of low-income remain more likely to rely on public transportation on a regular basis than their white

counterparts (Anderson, 2016; Reschovsky, 2000). Persons with disabilities report transportation gaps that affect their lives in very significant ways, for example challenges experienced with use of assistive devices on public transit systems (Rosenbloom, 2007).

Lastly, transportation impacts older adults' well-being and access to opportunities (Cvitkovich & Wister, 2001). Consequences experienced by gaps in transportation among this population include missed opportunities for health care services, time spent with family and loved ones, and opportunities for social inclusion (Syed et al., 2013). Older adults' primary mode of transportation remain personal vehicles, which some may not be able to own due to low-income status or drive due to disability (National Institute on Aging, 2017). Older adults can become an especially isolated population, even more so for older adults with physical and functional limitations/disabilities. Older adults most often rely on transportation for health purposes; however, transportation equally contributes to opportunities for social activities and senior groups, such as senior centers and membership organizations (Transportation for America, 2011).

COMMUNITY CONNECTEDNESS/SOCIAL INCLUSION

Community connectedness is related to the concept of social inclusion, which is defined as improving active participation in society for EJ populations by way of advocacy efforts, improved opportunities, and access to resources (United Nations, 2016). Community connectedness is defined as the merging of individuals' desires to belong to a larger group, to develop an influential relationship within the group, satisfy their own personal needs and to be rewarded through this group participation, while having a shared emotional connectedness (McMillian, 1996; McMillian & Chavis, 1986; Whitlock, 2007; Frost, 2012). Community connectedness and social inclusion may be achieved by access to opportunities, which is driven by access to transportation services (Preston & Raje, 2007; Sen, 2000; Lattman, Friman, & Olsson, 2016).

Gaps in transportation affect the opportunity for EJ populations to participate actively in the community and experience opportunities of social inclusivity (Sanchez, Stolz, & Ma, 2003). Community connectedness among older, lower-income adults may include attending social and disability service appointments, attending religious and community services, and participating in local senior centers. An instrumental feature of aging-well is a sense of connectedness and belonging, which includes active participation in the community achieved by access to transportation services (Plouffe & Kalache, 2010).

One of the most predominant effects of transportation gaps on persons of color and low-income persons include the missed opportunities and social exclusion in society. Components of missed opportunities and social exclusion can be identified as access to affordable housing choices, access to local city parks, access to healthy foods, healthy environments, and strong social support (Cozart, 2017). Older adults rely on visits with family members and local senior centers as points of connection and community involvement; however, older adults experience increased levels of social isolation and a lack of opportunities for social connectedness within the community due to lack of transportation (Cornwell & Waite, 2009; Perry, 2014).

Community connectedness also involves participating in civil rights activities, such as voting (Nerone, 2017). Kenyon, Lyons, and Rafferty (2002) suggest in communities where persons have high mobility and access to transportation, they can participate more readily within the economic, political and social aspects of the local community. A final feature of community connectedness is a person-to-person sense of community and belonging, relationships connecting family and friends. Access to transportation, particularly public transportation, is driven by the need to work; however, transit is equally as important to connect individuals (Tomer, Kneebone, Puentes, &

Berube, 2011). Availability and access to transportation contributes to a sense of social interaction (Wigan Borough on the Move, 2011). Access to transportation allows for community members, across the lifespan, to connect at sporting events, open parks, restaurants, and other spaces (Wigan Borough on the Move, 2011). Overall, transportation remains fundamental to community connectedness that includes accessing jobs, education, leisure, and other forms of community engagement.

5. TASK 3: *Assess the transportation mobility gaps of low-income, transportation disadvantaged older adults living in a low density urban environment using a daily transportation mobility diary app.*

INTRODUCTION

The United States (U.S.) faces rising demographic shifts such as growing minority and aging populations (Colby & Orman, 2015) as well as increasing income inequality (Proctor, Semega & Kollar, 2016) These factors lead to concerns about how U.S. transportation systems respond to the needs of environmental justice (EJ) populations (Environmental Justice, Title VI, Nondiscrimination, and Equity, 2017). Traditional home interview or travel diary data-collection methods, which are designed to measure completed trips (National Research Council, 2007) may fail to capture holistically the transportation needs of individuals who desire and miss opportunities due to travel disadvantage. This report discusses an alternative methodology to fill a critical gap in existing data collection strategies by recording and investigating both the *actual* and *desired* travel experiences of EJ populations. By considering both *actual* and *desired* travel experiences, one can ascertain the causes of differences between these two domains and the temporal and spatial scales on which these differences occur. The study utilized a theoretically-informed, ecological, longitudinal design to develop and implement a specialized app, *MyAmble*, that measures the impact of TD on the following domains of social exclusion (Pantazis, Gordon & Levitas, 2006) resources, participation, and quality of life. This marks a critical next step in characterizing and quantifying the impacts of TD at the individual or household level. The report first defines TD with a particular emphasis on the population in this study – low-income older adults – and describes the theoretical framework of social exclusion. This section also describes the design and implementation process for the app and the pilot test of feasibility.

TD AMONG LOW-INCOME OLDER ADULTS

Older adults, particularly those who are low-income, may also be considered a subset of the EJ population (Cairns, Greig & Wachs, 2003.). Research estimates that over 600,000 adults age 70 and older will cease driving each year in the U.S. (Foley, Heimovitz, Guralnik & Brock, 2002). Driving cessation in later life is often related to physical decline, changes in cognitive status, and/or vision impairment (Torres-Davis, 2008). The negative impact of driving cessation and TD among older adults is well documented. Driving cessation is associated with declines in physical, social, and cognitive functioning as well as greater risk for admission to institutional care settings and mortality (Chihuri et al., 2016). Moreover, the inability to drive may impede older adults' ability to complete instrumental activities of daily living such as grocery shopping, which in turn may lead to a reduction in social integration and social activity (Mezuk & Rebok, 2008). Older adults who are TD must often rely on other transportation modes (e.g. family/friends, public/private transportation); however, these modes may be inaccessible and/or unaffordable (Adorno, Fields, Cronley, Parekh & Magruder, 2016). Low-density urban environments pose an additional risk for TD among older adults due to high dependency on cars and limited public transportation services (Zeitler et al, 2015).

THEORETICAL FRAMEWORK: SOCIAL EXCLUSION

Social exclusion generally refers to the marginalization of persons or communities such that they are denied access to resources and or discouraged from participating in the wider community (Levitas, Pantazis, Fahmy, Gordon, Lloyd & Patsios, n.d.; Sen, 2000). The Poverty and Social

Exclusion project lists three main domains and 10 sub-domains that contribute to social exclusion: (1) resources – (a) material\economic resources, (b) access to public and private services, (c) social resources; (2) participation – (a) social participation, (b) culture, education, and skills, and (c) political and civic participation; and (3) quality of life – (a) health and well-being, (b) living environment, and (c) crime, harm, and criminalization (Mack, n.d.).

Social exclusion means more than social isolation. It is a *process* by which structural factors within the community impede individuals' opportunities for upward mobility and deny them basic needs and rights. Structural factors may include unfair labor laws, discriminatory voting regulations, and discriminatory allocation of public services and infrastructure, such as transportation. Unsurprisingly, the individuals at high risk of social exclusion tend to be the same individuals who are at high risk for TD – low-income older adults, minority populations, and individuals who are lower income (Sheppard, 2012). TD may even cause social exclusion; at the very least, adequate access to transportation is a fundamental component of social *inclusion* (*17,38,39,40*). (Jocoy & Del Casino Jr, 2010; Preston & Rajé, 2007; Lättman, Frinman & Olsson, 2016; Kenyon, Lyons & Rafferty, 2002)

A paucity of published research using the social exclusion framework to explore TD within the US currently exists. One recent exception is a study of individuals living in emergency shelters. The authors found that the cost of travel, in addition to the time, negatively affected individuals' abilities to engage in desired activities and sharply curtailed or determined their mobility. They conclude that "transport-related social exclusion" (p. 2) is a fundamental problem for people who are experiencing homelessness (Hui & Habib, 2016). Low-income older adults are at a similarly high risk for social exclusion in part due to TD (Cornwell & Waite, 2009).

EXISTING DATA COLLECTION METHODS

Although new innovations for collecting travel data appear to be gaining traction, studies suggest that paper travel diaries remain the primary data collection instrument, despite their shortcomings and high cost (Lawson, 2016.). Metropolitan Planning Organizations (MPOs) need data that include household characteristics and individual trips made by purpose, origin–destination, time of day, and mode to complete their travel modeling and forecasts. Studies define active data collection as self-reports and surveys to generate data and passive data collection as acquiring existing data. All of the active techniques for gathering data use the same basic design, ecological momentary assessment (EMA, Shiffman, Stone, & Hufford, 2008). This design involves repeated measures in the real-time in organic settings. It reduces recall bias and can capture more minute, in-the-moment events that co-occur with the study's object of focus, i.e., travel patterns. While EMA represents the state of data collection practice, the technologies used to gather the data may differ. For example, researchers may collect travel diary data using paper, a website or smartphone app. The paper and website surveys also often use GPS or smartphones to provide supplemental data, which remain important, because a comparative analysis GPS and traditional pen-and-paper travel diaries reveals human errors in the self-reporting of travel behavior (Wolf et al., 2014).

While smartphone use for travel data collection has not yet eclipsed traditional approaches, the smartphone a fundamental innovation to reduce respondent burden while improving travel data quality (Lawson, 2016). The emerging smartphone apps effectively track observed trips and create easy interfaces for smartphone users, but they may not be able to capture data for older and lower-income travelers as well as traditional approaches (Nitsche, Widhalm, Breuss & Maurer, 2012). Most importantly, all of these travel diary methods only attempt to capture data for observed trips and fail to capture underserved travel demand. Studies identify numerous passive data collection

strategies that can collect observed travel data (Lawson, 2016). These include mobile phone traces and location-based social networks, which use geo-tagged posts to social networks. While passive data collection offers some potential for gathering travel data, the smartphone still shows the greatest promise for widespread adoption in gathering quality travel behavior data.

Although the travel diary methods do not attempt to ascertain the needs of EJ populations specifically, most MPOs seek to gather some data regarding these groups. To accomplish this, MPOs typically rely on the public to identify transportation gaps for EJ populations, specifically seniors, persons with disabilities, and persons with low incomes. Focus groups, public forums, surveys, and workshops represent many of the strategies used by the MPOs to identify the needs of EJ populations. While including voices from all counties in a planning region appears to be a consistent strategy among the MPOs, more granularity in the spatial needs appear to be a lesser concern in their EJ needs assessments. This disparity may result in strategies that fail to adequately understand transportation gaps for individual communities or address them in an inefficient manner. These current and even emerging data collection strategies and techniques make determining TD individuals and their corresponding unserved travel demand extremely difficult. Studies recognize the need for future research to address populations facing underserved travel demand (Kolodinsky et al., 2012). A more comprehensive approach to quantifying the factors contributing to TD individuals and the factors influencing underserved travel demand may permit the development of more effective policies and solutions.

NEED FOR NEW DATA COLLECTION METHODS

In order to fully understand the disaggregate transportation needs of EJ populations on a temporally and spatially contextualized basis, new data collection methods must be developed. EMA, as used by transportation planners and civil engineers, tend to focus on travel patterns at peak commuter hours and fail to consider the travel planning needs of those who are *not* currently traveling. New methods may largely replicate the strategies described in the aforementioned existing data collection methods; however, they must also capture under-served or unserved transportation demand. "Next generation" travel survey systems (Zhao, 2011; Fan et al., 2017) do not capture under-served transportation demand (i.e. actual vs. desired travel experiences) nor do they collect qualitative data related to the lived experience of TD. If possible, the new data collection methods should try to capture the consequences of the unrealized activities that originally created the demand. An improved understanding of the consequences will help inform the societal costs of under-served transportation demand. The research team developed *MyAmble* as a data-gathering tool to identify and quantify TD, to quantify unmet transportation demand, and to identify predominant factors impacting TD. Table 3 presents a comparison of traditional, emerging smartphone data and *MyAmble* data collection strategies.

MYAMBLE

The study occurred in two cities in Tarrant County, Texas – Fort Worth and Arlington. Tarrant County is the third largest county in Texas and borders Dallas County in north central Texas. Data from the 2015 American Community Survey (ACS) ("Four Texas Metro Areas," n.d.) reveal that the region includes some of the fastest-growing communities in the US, and Tarrant County's population is projected to grow to more than 2 million people by 2020. Fort Worth is the largest city in Tarrant County, and Arlington is the second largest. Arlington is also the largest municipality in the US to lack a public transit system. The ACS finds that the average regional travel time to work in 2015 was 26 minutes, compared to a national average of 25 minutes. The

poverty rate in 2015 was 13.1%, and persons 65 years and older represented 10.5% of the total population ("Four Texas Metro Areas," n.d.).

Design

A large and diverse team comprised of faculty and graduate students in social work, civil engineering, and computer science undertook this project. The team utilized an intentional inter-disciplinary approach in that the members actively integrated the expertise of the three disciplines into the conceptualization, planning, and implementation of the app ("Committee on Facilitating Interdisciplinary Research," 2004). For example, social-work faculty members collaborated with computer scientists and engineers to incorporate end user needs and capabilities into the original app development in terms of hardware selection and logic sequences within the software. Likewise, the civil engineers contributed expertise in transportation measures, but some civil engineering-specific terminology was modified for end users according to the social worker faculty members' recommendations (e.g., *what is your access mode* vs. *how will you get to your main mode of transportation?*).

TABLE 3 Comparison of Transportation Data Collection Strategies

Features/Data	Paper/Website Travel Diary	Smartphone Travel Diary App	*My Amble*
Observed Trips			
*Mode	X	X	X
*Purpose	X	X	X
*Departure time	X	X	X
*Origin/destination	X	X	X
*Trip importance		X	X
*Trip success		X	X
*Trip challenges			X
*Impact on mood		X	X
*Interact w/ friends/family		X	X
Unserved/failed Trips			
*Purpose			X
*Trip importance			X
*Impact on mood			X
*Reason for no trip			X
*Consequences			X
GPS identifies trips		X	
GPS verification of destination		X	X
Social exclusion and transportation			X
Travel history			X
Visual record of challenges		X	X

App Development

Team members met for eight months, bi-monthly, to develop a new Android-based app called *MyAmble.* The app is designed to prompt potentially TD populations to identify and characterize their transportation plans/desires. In the evening, the participants review the transportation plans,

make any necessary changes to their observed trips, and record the reasons behind the changes in their plan. The participants may record their diary entries manually by interacting with the app or orally by speaking directly into the app. Additionally, the participants are encouraged to take pictures and/or video using the app in order to capture visual data related to their perceptions of their transportation mobility.

At the start of the project, the research team performed a comprehensive literature review to identify key factors related to TD and social exclusion. Information gleaned from this review provided the conceptual framework for the app design. Team members also identified key community partners (e.g., Meals on Wheels) for subject recruitment and a profile of desired beta testing participants. Next, the research team developed the functional requirements of the app along with user interface requirements and end user requirements. This process involved all team members discussing potential key features for the app that capture both the actual and desired travel patterns of study participants. Figure 1 illustrates the flow chart of *MyAmble*. Graduate students then tested the prototype and provided feedback to modify the app. Community stakeholders at the local council of governments also provided feedback with the long-term aim of implementing the app for gathering the transportation data to characterize EJ individuals and traffic analysis zones and assess the resulting unserved transportation demand and its consequences. During the feedback process, the research team received important information related both to the conceptual framework, design, and functional requirements of the app. Based on the feedback, the computer science team members developed a beta version for the app and the corresponding database.

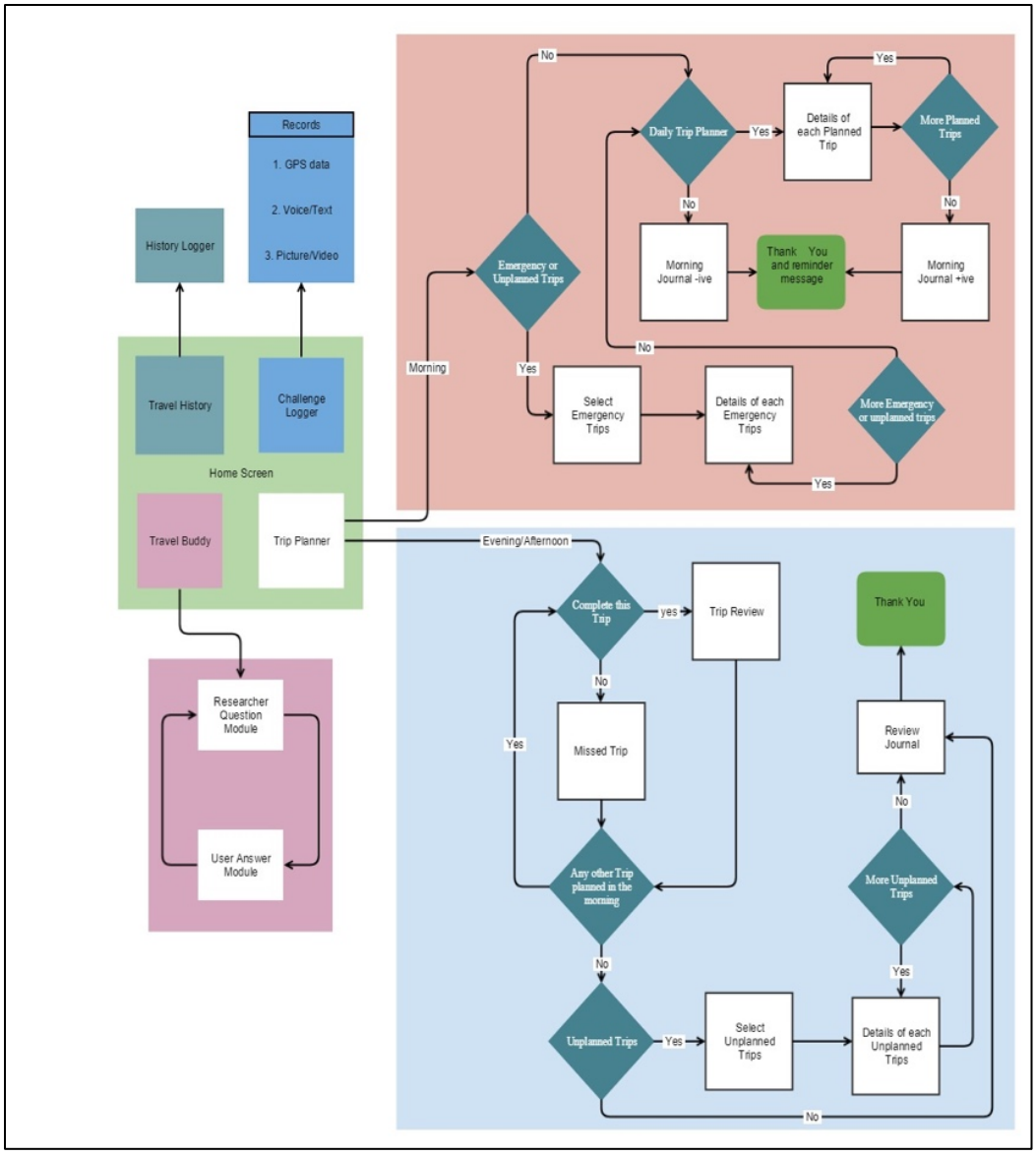


FIGURE 1 Flowchart of *MyAmble*

The research employed a UTA IRB approved user-centered design method that includes iterative involvement of the end user in the process of design through feedback during beta testing. Clients served by the Tarrant County Meals on Wheels program took part in the beta testing of *MyAmble.* Data was collected daily across a seven-day period during the beta test, with a sample of five (n = 5) older adult participants. Based on previous research, the participants were supported in learning how to use *MyAmble* through step by step guidance and the provision of a detailed, illustrated manual (see Appendices). Participants were then asked to give feedback on the user-friendliness of the app as well as the different features via a User-Feedback survey (see Appendices).

The research team first analyzed feedback received following the beta test to evaluate the effectiveness of *MyAmble* and make subsequent improvements to the design. The beta test incorporated interface suggestions and hardened the software (e.g. bugs, security, privacy, and

anonymity of the data). All beta test participants (n=5) were low-income TD older adults. A new sample of participants was then recruited for the final study sample (N=10). The study includes incentives (i.e. retail gift cards) to reduce participant attrition. Figure 2 summarizes the phases of the design.

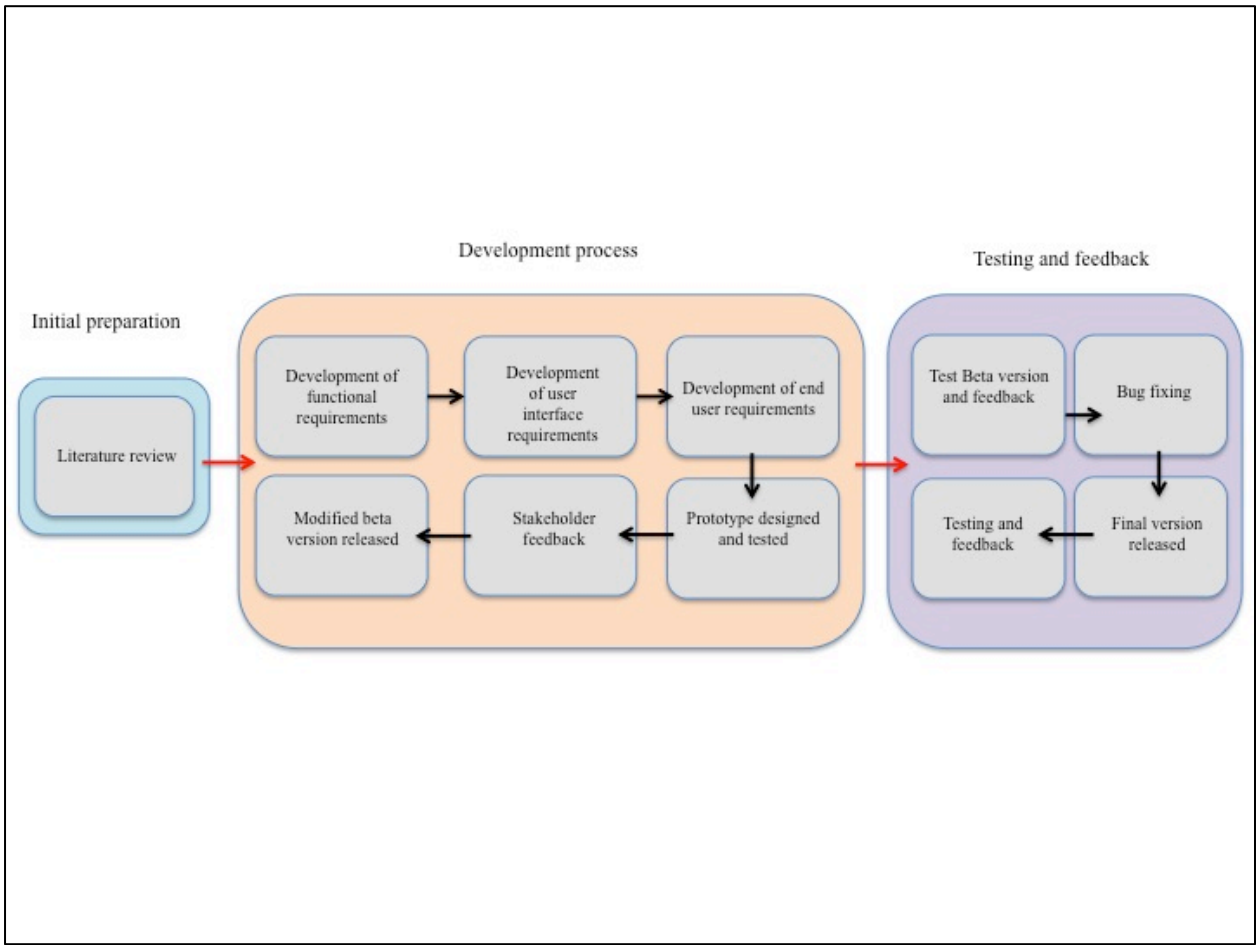


FIGURE 2 Phases of the design.

App features

MyAmble includes four features: 1) daily trip planner; 2) challenge logger; 3) travel buddy; and 4) travel story. Baseline measures were collected once through in-person interviews conducted by research team members at the start of the study using a set of closed-ended questions and standardized instruments. The baseline measures captured a broad range of demographics (e.g., age, race, income level). Additional measures were used to capture the psycho-social-emotional health and wellbeing and physical health history of participants (see Appendices). *MyAmble* currently does not collect objective data in the background because the trip planning and unserved trips represent the significant contribution of this data collection instrument. Background data collection cannot be used to characterize planned and unserved activities. The background data collection was only used to identify unplanned trips and verify the status of planned trips. The four features of the app are illustrated in Figure 3.

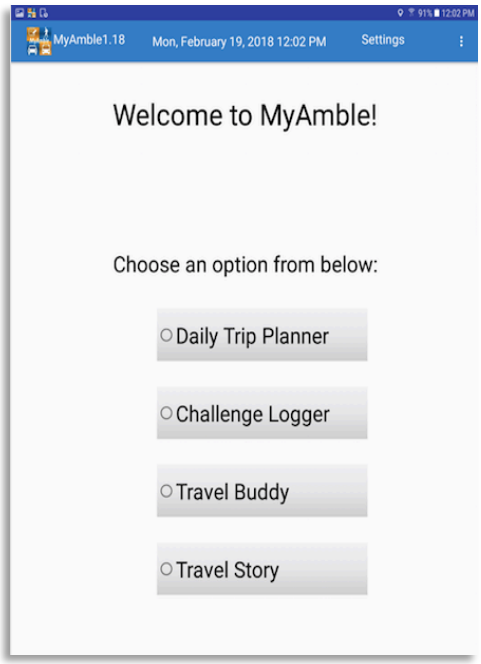


FIGURE 3 Features of App

Daily Trip Planner

The daily trip planner was designed so that participants recorded their experiences with transportation mobility throughout the day. Participants are also able to voice record details about their daily trips as well as use the keyboard feature on the app. Radio buttons are provided for yes/no questions. Every morning, the daily trip planner prompts participants to answer the overarching question: *Do you have a plan for today?* Participants may choose from icons that depict daily maintenance activities (e.g. grocery store, health care provider, social services) as well as discretionary activities (e.g. entertainment, restaurant) and mandatory activities (e.g. school, employment). Subsequent questions ask participants to orally record and type in their plan including the destination, how participants will get to their destination (e.g. paratransit, train, car, bus, Lyft/Uber), whether or not the participants need assistance from another person to use the mode of transportation, and approximate departure time. The importance of the trip is measured using a scroll bar with a Likert scale. These questions all capture daily planned transportation activities. A sample screen shot of the daily trip planner is illustrated in Figure 4.

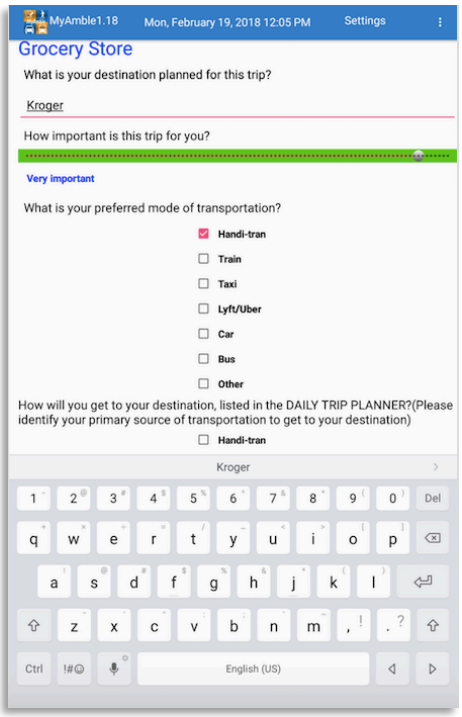


FIGURE 4 Daily Trip Planner

The daily trip planner also asks participants to identify any other activities that they would like to complete that day but cannot. Subsequent questions ask for details about these desired activities and why these trips are not included in the day's plan. These particular questions capture the unserved travel demand of participants.

In the evening, participants are asked to complete a review of their daily plan. Answers from the morning trip planner automatically populate the evening review. Participants are asked what time they departed, which mode of transportation they used, and their transportation/activity access details. The evening review also asks participants if a particular trip enabled them to spend time with friends or family (yes/no), to what extent did completing the trip improve their mood (sliding Likert scale), the importance of the trip (sliding Likert scale), whether the participant faced any problems when completing a particular trip and overall was the trip successful (yes/no). Participants may also add any additional unplanned trips to their day and why they did not plan for this trip in the morning trip planner.

Any trip that participants record in the daily trip planner but are unable to complete is flagged in *MyAmble* as a missed trip. Participants are asked details about each missed trip including the importance of the trip (sliding Likert scale), why was the trip important, why were they unable to complete the trip, the consequences of not completing the trip, and to what extent did missing the trip make them feel frustrated, disappointed, stressed, sad, and/or like they missed an opportunity (Likert scale check boxes). A sample screen shot of the sliding Likert scale asking the consequences of not completing the trip, and to what extent did missing the trip make them feel frustrated, disappointed, stressed, sad, and/or like they missed an opportunity is illustrated in Figure 5. Overall, the daily trip planner is designed to extend the typical travel diary to capture more detail about each realized and unrealized transportation event and unserved travel demand in order to examine missed opportunities due to transport limitations.

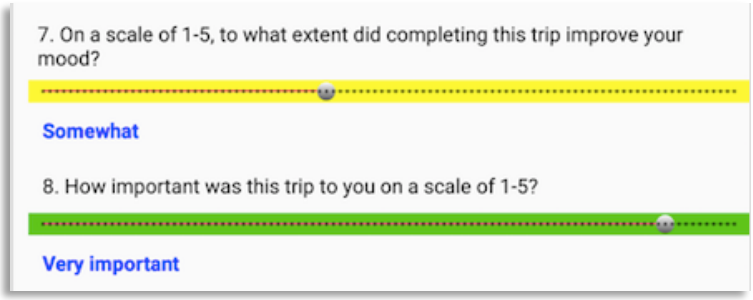


FIGURE 5 Sliding Likert Scale

Challenge Logger

The challenge logger enabled participants to document real-time transportation barriers through videos and/or photos. Participants were asked to take photos/videos to depict their daily experiences with transportation mobility and TD. The challenge logger furnishes a unique methodological strategy to visually capture the impact of TD on a range of issues including participants' home, neighborhood, streets and buildings, and the natural environment. The challenge logger also provides a mechanism for depicting the risks that participants are exposed to with respect to TD and their environment (e.g. busy intersections, broken sidewalks, unsheltered public transit stops). Participants were also able to capture their social environment with respect to TD such as social isolation and/or and social exclusion. GPS data was linked to photos/videos for further analysis. A sample screen shot of the challenge logger is illustrated in Figure 6.



FIGURE 6 Challenge Logger

Travel Buddy

The travel buddy was designed to be a dynamic feature that will capture more in-depth, perceptual data related to TD versus traditional static data collection methods. Each study participant was partnered one-to-one with a virtual "travel buddy" who is a graduate student member of the

research team. The travel buddy feature was designed as a series of on-going, qualitative interview questions sent to participants via text messages. Travel buddy questions elicit information across the three domains of the theoretical framework of social exclusion (Figure 7). The graduate student travel buddy sends questions to participants 4-5 times a week. Probing (i.e. follow up) questions by the travel buddy allows for rich data collection. A sample screen shot of a travel buddy chat is illustrated in Figure 8.

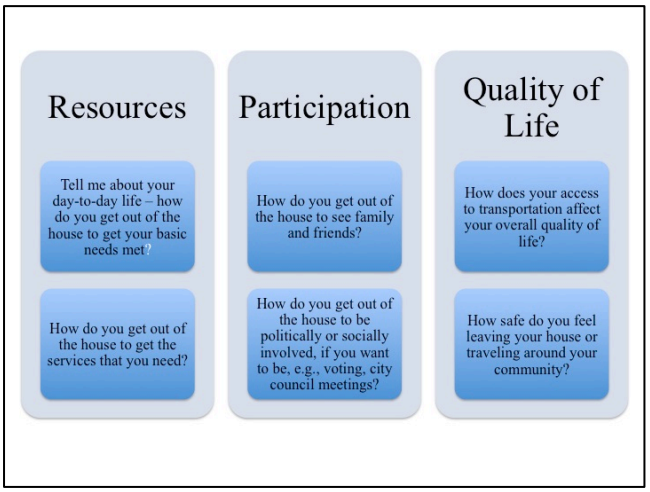


FIGURE 7 Travel buddy and domains of social exclusion.

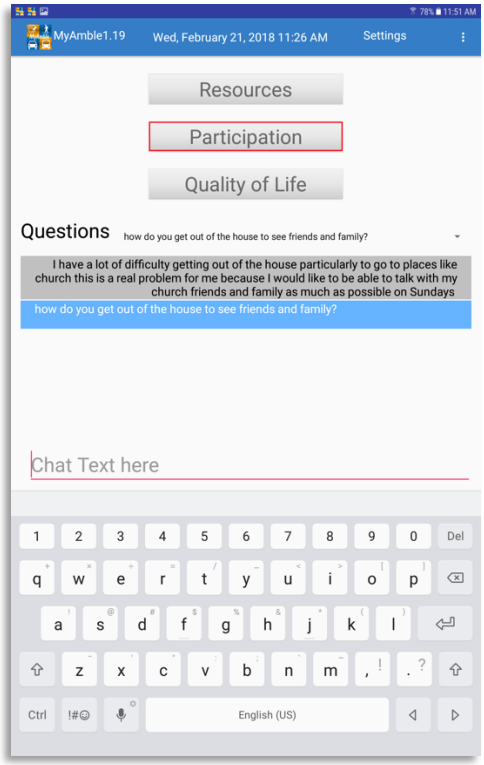


FIGURE 8 Travel Buddy Chat

To notify participants of when they received a message, the tablet device plays a musical alert and presents a pop-up notification. When the participant hits “OK” on the notification, it leads them

directly into the travel buddy chat where they answer the questions. An illustration of the Travel Buddy Alert is shown in Figure 9 below.

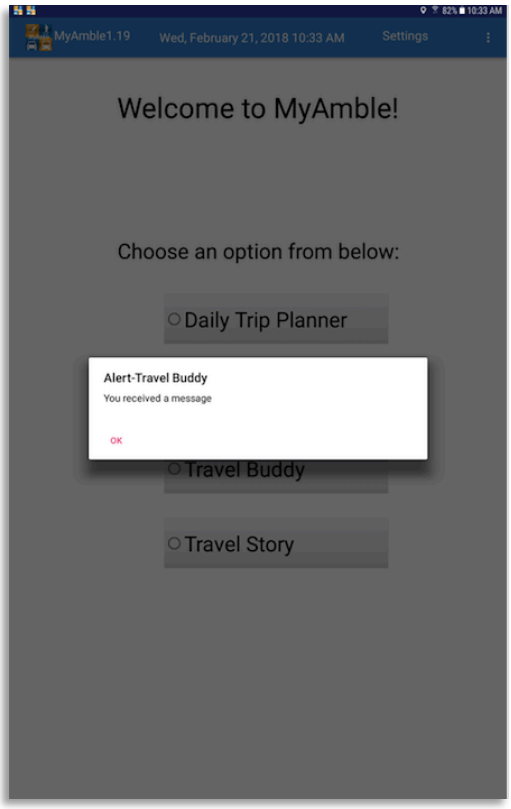


FIGURE 9 Travel Buddy Alert Notification

Travel Story

The Travel Story feature contains a series of questions that study participants can complete on their own any time during the study period. The travel story allows for the examination of the contextual factors behind the participants' lived experiences with transportation. Sample questions inquire about: a) transit/transportation experiences in early life (e.g. did you grow up using public transportation, how did you learn to drive, memories of first car); b) lifelong perspectives about transit/transportation (e.g. what does transportation mean to you now versus in the past); c) driving cessation (e.g. when did you stop driving, why did you stop driving); and d) structural influences on transportation mobility (e.g. do you find it difficult to pay for public/private transit, do you feel safe using public transit?). Overall, the travel history aims to capture participants' antecedents to, perceived consequences of, as well as their perceived solutions to TD.

6. TASK 4: *Analyze the lessons learned during the field test and assessment and analyze the results from the transportation mobility gap assessment.*

BETA-TEST

Data was collected daily across a seven-day period during the beta test, with a sample of five (*N*=5; Mean age = 60.2, SD = 18.3) older adult participants. The study employed a total quality design method that includes iterative end user involvement through beta testing. User feedback surveys indicated that *MyAmble* provided them a new experience, and participants reported finding the face-to- face training helpful. Users reported challenges including issues related to visual impairment (e.g. font size and color), tactile barriers (e.g. need for use of stylus), Wi-Fi reach, and difficulty with the notifications for Travel Buddy. Overall, users reported understanding what questions in *MyAmble* were asking most of the time. Following the beta test, researchers took feedback from users to re-design and modify the app, as necessary, before launching the prototype with the final sample (*N*=10).

RESULTS WITH FULL SAMPLE

The following section reports results from the study using the *MyAmble* app. First, we report the demographic characteristics, then the results from the four features of the app: (1) Daily Trip Planner, (2) Challenge Logger, (3) Travel Buddy, and (4) Travel Story.

Demographics

The sample consisted of ten (10) older adult participants. The mean age of participants was 69.56 years (*SD* = 3.75, *median* = 70). A majority of participants were female (*n* = 7, 70%), retired (*n* = 6, 60%), non-Veterans (*n* = 10, 100%), of Christian faith (*n* = 8, 80%), and spoke English as their primary language (*n* = 10, 100%). Most participants were living alone (*n* = 7, 70%) in a senior housing complex (*n* = 6, 60%) and had lived in their place of residence for longer than five years (*n* = 6, 60%). Participants, on average, had lived in their city of residence for 21.35 years (*SD* = 26.16, *median* = 7.5). A majority of participants reported that they do not currently drive (*n* = 9, 90%), do not own a car (*n* = 9, 90%), and do not have a valid driver's license (*n* = 8, 80%). Most individuals (*n* = 8, 80%) reported using paratransit services (e.g., MITS and Handitran) or a public bus (*n* = 5, 50%) as their primary forms of transportation. For more details on the study population's demographics, see Table 4.

TABLE 4 *Demographic* Data

Variable	***n* (%)**	***mean* (*SD*), *median***
Age*		69.56 years (3.75), 70
U.S. Citizen	10 (100%)	
Gender		
Female	7 (70%)	
Male	3 (30%)	
Race		
African American	5 (50%)	
Caucasian	5 (50%)	
Religion		
Christianity	8 (80%)	

Spiritual, not religious	1 (10%)	
Agnostic/Atheist	1 (10%)	
Marital status		
Single, never married	2 (20%)	
Living with a partner, not married	1 (10%)	
Married	1 (10%)	
Separated	1 (10%)	
Divorced	3 (30%)	
Widowed	2 (20%)	
English as primary language	10 (100%)	
Employment status		
Retired	6 (60%)	
Unable to work	3 (30%)	
Out of work and looking for work	1 (10%)	
No military service	10 (100%)	
Highest level of education		
Some high school	3 (30%)	
High school or equivalent	2 (20%)	
Vocational/technical school	3 (30%)	
Some college	1 (10%)	
College graduate	1 (10%)	
Residence		
Senior housing complex/apartment	6 (60%)	
Own home	4 (40%)	
Living arrangements		
Lives alone	7 (70%)	
Lives with spouse	1 (10%)	
Lives with non-family caregiver	1 (10%)	
Lives with others	1 (10%)	
Length of time in current living situation		
One to two years	2 (20%)	
Two to five years	2 (20%)	
Five or more years	6 (60%)	
Length of time living in city of residence		21.35 years (26.16), 7.5
Does not have a family caregiver	10 (100%)	
Acts as a family caregiver		
No	8 (80%)	
Yes	2 (20%)	
Car ownership		
No	9 (90%)	
Yes	1 (10%)	

Valid driver's license	
No	8 (80%)
Yes	2 (20%)
Currently drive	
No	9 (90%)
Yes	1 (10%)
Current modes of transportation	
Paratransit services including MITS and Handitran	8 (80%)
Public bus	5 (50%)
Catholic Charities	3 (30%)
Family members with cars	1 (10%)
Medicaid and Medicare ride service	1 (10%)
Personal car	1 (10%)

***Note.* Only 9 individuals responded to this question.**

Half of participants in this study reported their current physical health as good, very good, or excellent (n = 5, 50%), but reported low levels of satisfaction with their physical health, with only three participants reporting satisfied or very satisfied (30%). An overwhelming majority reported experiencing pain (n = 9, 90%) and arthritis (n = 7, 70%) and half of the individuals (n = 5, 50%) reported mobility concerns, diabetes, visual impairments, and psychological health concerns (e.g., depression, anxiety). A majority of participants (n = 6, 60%) required assistive devices for mobility (e.g., cane, walker, wheelchair, motorized scooter), but the sample was largely able to complete activities of daily living independently, including feeding (n = 10, 100%), bathing, dressing, and toileting (n = 9, 90%). See Table 5 for more information regarding participants' health.

TABLE 5 Health Data

Variable	***n* (%)**
Self-reported current physical health	
Excellent	1 (10%)
Very good	1 (10%)
Good	3 (30%)
Fair	3 (30%)
Poor	2 (20%)
Satisfaction with current physical health	
Very satisfied	2 (20%)
Satisfied	1 (10%)
Fair	4 (40%)
Unsatisfied	3 (30%)
Self-reported physical health one year ago	
Very good	2 (20%)
Good	3 (30%)

Fair	3 (30%)
Poor	2 (20%)
Self-reported physical health five years ago	
Excellent	2 (20%)
Very good	3 (30%)
Good	4 (40%)
Poor	1 (10%)
Use assistive equipment for mobility	
No	4 (40%)
Yes	6 (60%)
Health conditions over the past five years	
Pain	9 (90%)
Arthritis	7 (70%)
Mobility concerns and falls	5 (50%)
Psychological health including depression and anxiety	5 (50%)
Diabetes	5 (50%)
Visual impairments	5 (50%)
Cardiovascular health concerns	4 (40%)
Orthopedic concerns including fractures and sprains	3 (30%)
Cerebrovascular health including stroke and aneurysm	2 (20%)
Memory and cognition concerns	1 (10%)
Self-reported pain	
Moderate	6 (60%)
Severe	3 (30%)
Very severe	1 (10%)
Bathing, dressing, and toileting	
Independent	9 (90%)
Dependent on others	1 (10%)
Independent feeding	10 (100%)

Most participants in this sample owned a phone (n = 8, 88.9%). Prior to this study, three of the participants (33.3%) had never used a tablet device. Some individuals were able to access Internet from their homes (n = 5, 55.6%) and others occasionally accessed Internet from public spaces. Two participants (20%) had never accessed the Internet, prior to this study. See Table 6 for more details about participants' experience and comfort with technology.

TABLE 6 Experience with Technology Data

Variable	*n* (%)
Owns phone	8 (88.9%)
Owns computer/laptop	1 (11.1%)
Length of time using phones	
Six months to one year	1 (10%)
One to three years	2 (20%)
Three to six years	3 (30%)
Seven years or more	4 (40%)
Length of time using computers	
Never used	3 (37.5%)
Less than six months	1 (12.5%)
Seven years or more	4 (50%)
Length of time using tablets	
Never used	3 (33.3%)
Less than six months	3 (33.3%)
Three to six years	1 (11.1%)
Seven years or more	2 (22.2%)
Length of time using the Internet	
Never used	2 (20%)
Less than six months	1 (10%)
One to three years	2 (20%)
Four to six years	1 (10%)
Seven years or more	4 (10%)
Frequency of accessing web from home	
Never	4 (44.4%)
Daily	5 (55.6%)
Frequency of accessing web from public spaces including libraries	
Never	4 (66.7%)
Less than once a month	1 (16.7%)
Monthly	1 (16.7%)

Daily Trip Planner

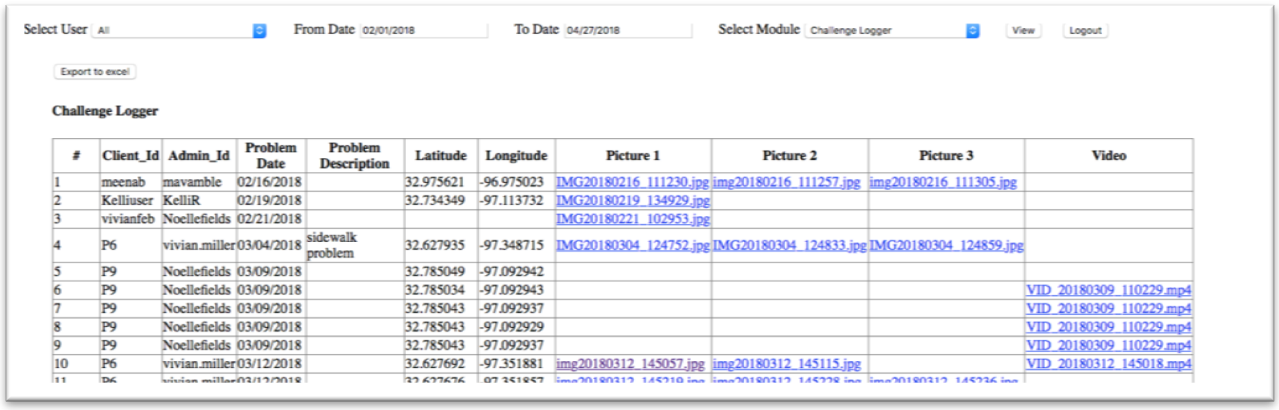
The ten participants successfully logged 60 daily trip plans throughout the course of the study period. Of those trips, more than half of them were planned (n = 36, 60%) and most were reported as of great importance to participants (n = 43, 71.67%). Trip destinations most often included the grocery store (n = 11, 18.33%), medical appointments (n = 9, 15%), social visits (n = 9, 15%), and the bank (n = 8, 13.33%). Only 18 of the trips received a review about whether or not the trip was successful. Of those responses, over three quarters reported successful trip completion (n = 14, 77.78%). See Table 7 for more information about the daily trip planner responses.

TABLE 7 *Trip Planner* Details

Variable	***n* (%)**
Type of trip	
Planned	36 (60.00%)
Unplanned	17 (28.33%)
Missed	7 (11.67%)
Activity	
Grocery store	11 (18.33%)
Doctor appointment	9 (15.00%)
Social visit	9 (15.00%)
Other	9 (15.00%)
Bank	8 (13.33%)
Pharmacy	4 (6.67%)
Religious services	3 (5.00%)
Eat out at restaurant	3 (5.00%)
Hospital	2 (3.33%)
Physical activity	1 (1.67%)
Social services	1 (1.67%)
Importance	
Not important	1 (1.67%)
Neutral	3 (5.00%)
Important	12 (20.00%)
Very important	43 (71.67%)
Transportation mode	
Car	32 (76.19%)
Bus	6 (14.29%)
Handitran	3 (7.14%)
Taxi	1 (2.38%)
Preferred mode of transportation	
Car	24 (80.00%)
Bus	4 (13.33%)
Rideshare (Lyft/Uber)	1 (3.33%)
Handitran	1 (3.33%)
Time with family	
No	14 (77.78%)
Yes	4 (22.22%)
Trip successful	
No	4 (22.22%)
Yes	14 (77.78%)

Challenge Logger

The challenge logger enabled participants to document real-time transportation barriers through videos and/or photos. This feature was a methodological strategy to visually capture the impact of TD on a range of issues including participants' home, neighborhood, streets and buildings, and the natural environment. The challenge logger also provided a mechanism for depicting the risks that participants are exposed to with respect to TD and their environment (e.g. busy intersections, broken sidewalks, unsheltered public transit stops). Participants were also able to capture their social environment with respect to TD such as social isolation and/or and social exclusion. GPS data was linked to photos/videos for further analysis. Results from the Challenge Logger among the sample of 10 participants (*N*=10) were presented in the cloud database. An example of this database is illustrated in Figure 10.


Select User All From Date 02/01/2018 To Date 04/27/2018 Select Module Challenge Logger View Logout

Export to excel

Challenge Logger

#	Client_Id	Admin_Id	Problem Date	Problem Description	Latitude	Longitude	Picture 1	Picture 2	Picture 3	Video
1	meenab	mavamble	02/16/2018		32.975621	-96.975023	IMG20180216_111230.jpg	img20180216_111257.jpg	img20180216_111305.jpg	
2	Kelliuser	KelliR	02/19/2018		32.734349	-97.113732	IMG20180219_134929.jpg			
3	vivianfeb	Noellefields	02/21/2018				IMG20180221_102953.jpg			
4	P6	vivian.miller	03/04/2018	sidewalk problem	32.627935	-97.348715	IMG20180304_124752.jpg	IMG20180304_124833.jpg	IMG20180304_124859.jpg	
5	P9	Noellefields	03/09/2018		32.785049	-97.092942				
6	P9	Noellefields	03/09/2018		32.785034	-97.092943				VID_20180309_110229.mp4
7	P9	Noellefields	03/09/2018		32.785043	-97.092937				VID_20180309_110229.mp4
8	P9	Noellefields	03/09/2018		32.785043	-97.092929				VID_20180309_110229.mp4
9	P9	Noellefields	03/09/2018		32.785043	-97.092937				VID_20180309_110229.mp4
10	P6	vivian.miller	03/12/2018		32.627692	-97.351881	img20180312_145057.jpg	img20180312_145115.jpg		VID_20180312_145018.mp4

FIGURE 10 *Challenge Logger* Database

Uploading the images to this cloud database system allowed the research team to view, in real-time, as the participants captured and logged the challenges they faced while traveling in the community. There are eleven total columns in this component of the *MyAmble* database; within this system the administrators can identify the participant based on their participant ID (Client_Id), the researcher assigned to the participant (Admin_Id), the date when the user logged their challenge (Problem Date), a description of the problem (Problem Description), the exact location the image or video was taken (Latitude/Longitude), and the corresponding pictures and video (Picture 1, Picture 2, Picture 3, Video).

Challenge 1

A study participant, de-identified and assigned the ID of P6, utilized this feature multiple times throughout the study, noting challenges he faced ambulating in the community with his motorized-wheelchair. In a few instances, he a noted a sidewalk problem, located at the following GPS coordinates (32.627935, -97.348715). The picture he took is below (Figure 11).



FIGURE 11 Sidewalk Problem at 32.627935, -97.348715

The image above (Figure 11) identifies sidewalk construction that is especially challenging for him, as he shared he had to travel on the street while this sidewalk construction was taking place. Once entering the coordinates into a map system (e.g., Google Maps), we are able to identify the exact location of the identified problem. An example of the GPS coordinates positioned on a map is illustrated in Figure 12.

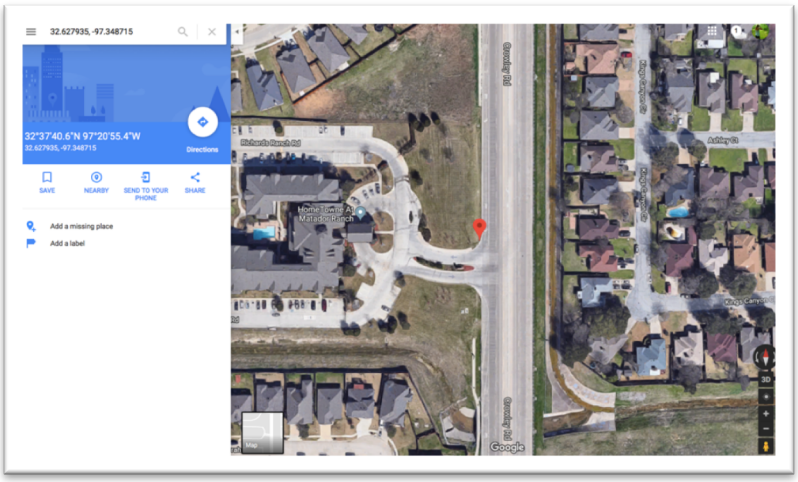


FIGURE 12 GPS Coordinates of image captured positioned on map

Challenge 2

At another instance, user P6 captured an image that showed a sidewalk ending just before the railroad tracks. This is illustrated below in Figure 13. This image was captured at GPS coordinates 32.635149, -97.354029 (see Figure 14 below). Positioning the GPS coordinates on a map shows a birds-eye view of the location and a wide-scope of the challenge this participant faced. Again, this presented a problem for him as he relied on his motorized-wheelchair to transport himself throughout the community.



FIGURE 13 Sidewalk ending at railroad tracks (32.635149, -97.354029)

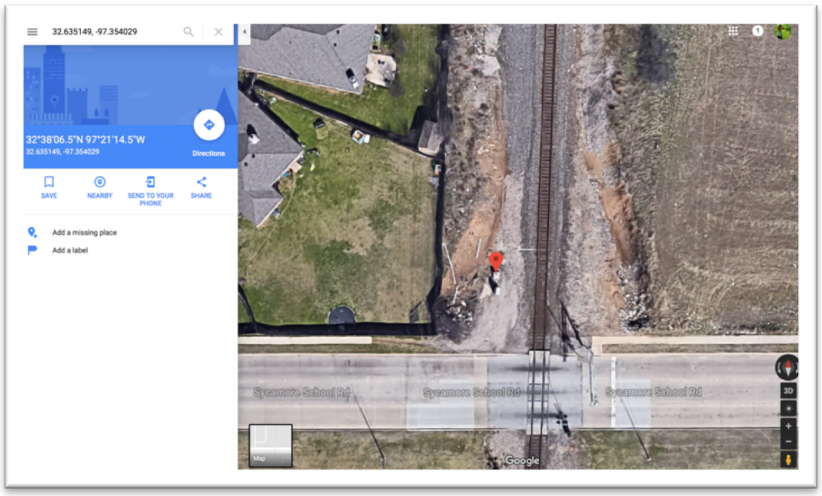


FIGURE 14 GPS Coordinates of image captured positioned on map

Travel Buddy

The travel buddy was designed to be a dynamic feature that captured more in-depth, perceptual data related to TD. Each study participant was partnered one-to-one with a virtual "travel buddy" who was a graduate student member of the research team. The travel buddy feature was designed as a series of on-going, qualitative interview questions sent to participants via text messages. Throughout the course of the study, research team members asked their participants a series of 9 questions across the 3 domains of social exclusion (see Appendices). In addition to these questions, the research team members used probes to gain more in-depth, narratives of experiences and challenges the participants' faced. In other words, probes were used to keep the lines of communication open between researcher and participant, and encourage conversation related to the topic areas (e.g., Resources, Participation, and Quality of Life). An example conversation on *MyAmble,* between a researcher and participant, is illustrated in the figure below (Figure 15).

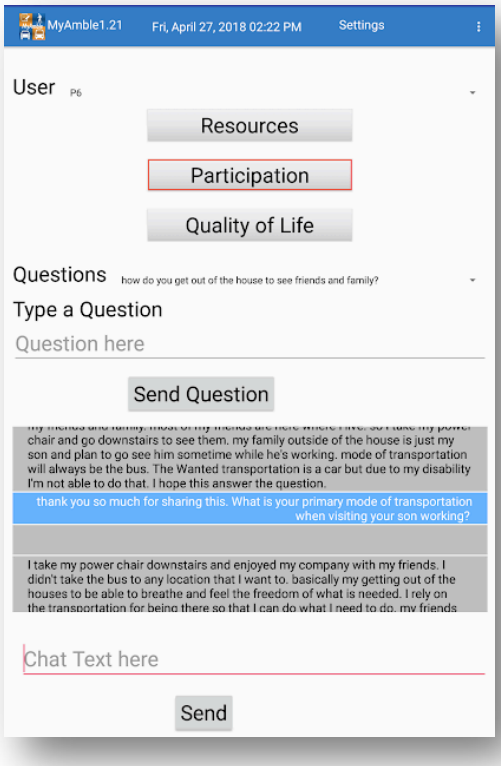


FIGURE 15 Screen shot of chat between research and participant

The following represent results from *Travel Buddy* conversations between the research and participant. In this first example, the researcher asks the participant a question from the Quality of Life domain, "How does transportation access affect your overall quality of life?" The participant responded

> *I rely on bus, MITS and other transportation for grocery, personal care, outings, visiting friends, and just seeing the city of Fort Worth. If my mode of transportation is harm in any way, meaning not available, then it would be hard for me to accomplish any of the aforementioned reasons that I used the local transportation. I'll go I can find a bus route to go to certain places the drop-off location is quite a distance from where the bus stop is. Like today being that my regular driver was not available I would have had to take the bus. The bus stop for my doctor was 15 minutes away from his office. That would require me to drive my power chair 15 minutes both ways. This would have been an inconvenience for me so therefore I had to cancel the doctor's appointment. I hope this explains how things run when you're disabled and need transportation.*

From this, the researcher replied, "Thank you for sharing this challenge... Are there any other areas of your life in addition to your medical appointments that are affected by your access to transportation?" Again, the participant shared

> *If I can't get to my medical appointments then it has a great effect on my life. Doctor trip tomorrow will be cancelled due to the bus dropping me off 15 minutes away from doctors' office.*

The *Travel Buddy* database organized text messages between the researcher and participant first by Participant ID, Researcher, Date, and the Domains of Social Exclusion (e.g., quality of life, participation, and social exclusion). The figure below (FIGURE 16) shows content within the database.

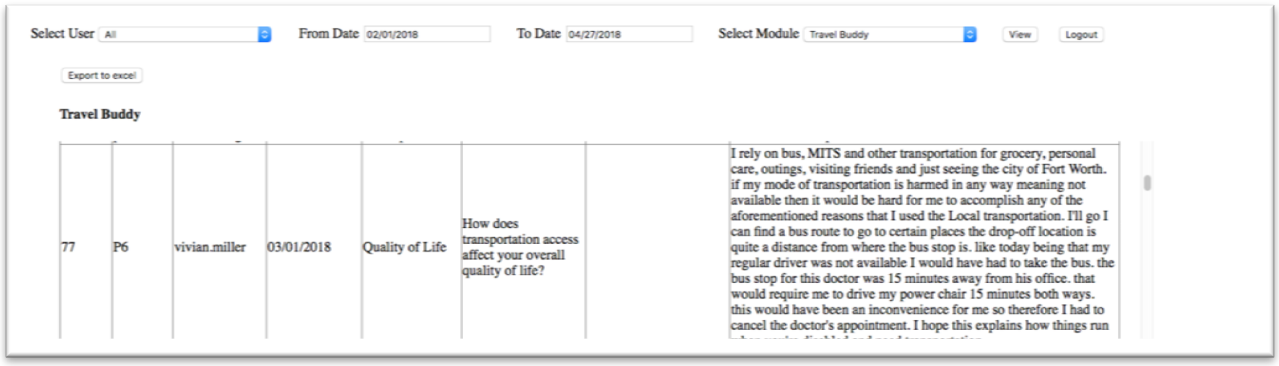


FIGURE 16 Travel Buddy database

The qualitative data captured through this feature articulates how lack of transportation was pervasive and impacted participants' daily living. The following are general themes, which summarize participants' responses to the *Travel Buddy* questions.

Diminished Emotional Well-being

Not having transportation negatively impacts participant's emotional well-being. For example, one participant mentioned feeling "depressed" a couple of times: "it gets very depressing when you don't have transportation to get to some of the places that you would like to go and spend time there…" Similarly, another participant reported feeling socially isolated:

> *Due to our health issues most of our so-called friends have disappeared. One of the few left has a house I cannot get in with a wheelchair. As for faoily (sic), Dawn [her partner] has no family left. I have my 84 year old mother who lives in Keller, but MITS wont go there.*

Community Engagement

Transportation prevented one participant from being engaged in volunteer activities/community life. She really wants to give back but was limited by transportation, saying, *"I would love to volunteer…nursing homes, hospitals… I love meeting new people."* Actively getting around in the community was found to be different every day. Another participant shared

> *[I] can't always go a lot of things depend on my health and how I feel. I know if I catch the 7:45 AM bus I can be at Target when they open their door. (I) can shop and catch the bus back home before they bring my lunch. I like that time of day better for me....*

Resource Intensive

Public transportation was found to be a financial and time- burden on many participants. One participant shared that using the city bus can be an all-day ordeal, and took away from his already limited finances. This was especially true in a couple of examples, such as when the bus was not on time as scheduled, when he had to transfer busses, and when he had more than one doctor's appointment scheduled in one day. This participant stated that he would rely on an alternative mode of public transit, MITS, however

> *the cost for senior citizens and disability people is $4.50 one way so therefore the total cost is $9 for the doctor's appointment travel. if you have more than one doctor's visit per month let's say 5 appointments, it will cost the senior citizen $45 in transportation fee. This therefore takes away from there medicine and food allowance.*

Constrained Autonomy

One conversation emphasized the participant's reliance on others to get out of the house in order to see family and friends and to complete errands, such as taking a trip to the pharmacy. The following are quotes, which represent this theme. The researcher asked, *"How do you get out of the house to see friends and family?"* To this question, the participant replied: *"They come see me or pick me up to go places."* In another instance, this same participant had an emergency trip. The researcher probed the participant, stating, *"I saw that you had an unplanned trip to the pharmacy. I hope that you are feeling okay. If you need services like the pharmacy on a short notice, how do you get out of the house to get the services that you need?"* The participant replied, *"[I] have to wait for a ride from my sister."* In one final example conversation, the research asked, *"How do you get out of the house to see friends and family?"* To which this participant replied that, *"My brother comes and sees us."*

Getting the Hang of It

In the initial stages of project, some participants struggled with the utilization and navigation of travel buddy; one participant response included "*I can't get this tablet to do what I want"* and *"I am starting to get the hand of this tablet."* After several attempts to reach out (from the researcher's part) the participant was able to reply to researcher's questions.

Rapport with Researcher

As the participants became more comfortable with the travel buddy feature, some began utilizing travel buddy to initiate questions such as: *"Do you know what day you are coming to my house?"* In addition, participants utilized travel buddy to schedule and confirm visit dates: *"I will not be home Wed. until after 12:00 I will be here all-day Tuesday."Overall, many participants became more and more comfortable with the utilization of travel buddy as time progressed, gaining confidence to initiate questions and answering researchers' questions to the best of their ability.*

Travel Story

The Travel Story feature contains a series of questions that study participants may complete on their own throughout the study period. The travel story allows for the examination of the contextual factors behind the participants' lived experiences with transportation. At least four participants answered each question. For all questions in the Travel Story, the average number of

responses was about 6 (m = 6.4, SD = 1.67, *median* = 6). Table 8 provides information regarding the number of responses and representative participant quotes for each question, sorted across the categories of childhood, driving cessation, first car/learning to drive, general, and public transit.

TABLE 8 ***Travel Story***

Subject Name	Question	Number of Responses	Representative Answers/Quotes
Childhood	Did you have any challenges or problems with cars growing up?	10	No; "My biggest challenge was having to share a car with my older sister, especially when she kept doing things to get grounded and losing driving rights;" "Not really, my father made sure we could do our own minor repairs in order to keep moving"
Childhood	What are some of your early memories riding in a car with your family?	10	"Going to the country;" "The scenery along the way' "One of my oldest memories is of a bad wreck we had on our way from Fort Worth to Houston;" "Going places with my family"
Childhood	Did you grow up going on road trips with your family?	8	Yes; "Yes…"Most time people are leaving their homes to go to work or doctors or stores or other places, but to go on a trip allows you to have this freedom to do something entirely different than your routine."
Childhood	Did you grow up using public transportation?	6	No; Yes
Childhood	What are your earliest memories of your first family car?	6	"It was a jeep that you can take the top off of;" It was big. It was a stationwagon;" "The first car I remember was my father's company when I was 5. The most vivid memories involved a bad car wreck we had in that car when I was thrown out of a side window"
Childhood	Did both of your parents' drive?	5	Yes; No; "No, just my daddy."
Childhood	Did you have a "dream car" growing up?	5	No; "A sports car;" "I always wanted a corvette;" "I always wanted to get an old school bus so I'd have room for all my friends"
Childhood	How many cars did your family own growing up?	5	1; 2; 5; "Usually at least one, but by the time I was a teenager there were three."
Driving cessation		5	"I stopped driving about seven years ago when I was diagnosed with degenerative bone disease;" "This happened about 15 years ago. I didn't have a car, but still have my driver's licese;" "When I could no longer afford to maintain a car. I would still be driving if I had a car"

	If you stopped driving, when did this happen?		
First car/learning to drive	Do you have a picture of your first car?	10	No; Yes; "No, when I was driving at age 18, we did not have smart phones and the money for a lot of pictures;" "No, but I do have a picture of the car I bought for myself when I was 19"
First car/learning to drive	How long did you have your first car for?	7	"I still have my first car. It's in storage now, but it doesn't run;" "About two years;" "Forever"
First car/learning to drive	Tell us about how you learned to drive...	7	"In the country with my Dad;" "Brother taught me;" "Took Drivers Ed in high school"
First car/learning to drive	At what age, did you learn how to drive?	6	"I learned when I was 15 and got my first license on my 16th birthday;" "13 or 14 or maybe 15;" "18 years old and was always a safe driver"
First car/learning to drive	How old were you when you got your first car?	4	16; 17; 21; 25
General	Do you rely on carpooling?	7	No; Yes; Sometimes
General	Which mode of transportation is your most preferable?	7	Car; Handitran
General	Do you have a favorite car?	6	No; "Handicap accessible vehicles;" "Yes, any Mercedes with at least four doors;"
General	What does transportation mean to you? (lifelong perspective)	5	"It means being able to go where I want when I want;" "Getting stuff done;" "Very important"
Public transit	When was the first time that you used public transit?	8	"At the age of 40;" "When I was five years old, Mom would take me on the train to get to school;" "As a kid in New York on vacation"
Public transit		7	Yes; Sometimes; "MITS rides are $4.00 for each leg of a trip. Eight dollar round trips are a bit too much sometimes;" "From my house everything is so far, so it would be too much money"

	Do you find it hard to pay for public transit fares?		
Public transit	Have you lived in a city with different types of public transit?	7	Yes; "Sort of. There used to be a mini subway in Fort Worth plus the bus system;" "None at all, but I enjoy riding the bus."
Public transit	Have you relied on public transit most of your life?	6	No; Yes; "No, [I] drove until 10 years ago;" "No, but there were times I used the bus system, like when I worked in downtown or had no money for insurance…and of course now I use MITS"
Public transit	If public transit were free would you use it more?	6	Yes; "Yes, it used to be [free] for the handicap, but local bus service changed it to a fee. With limited income for seniors and the handicap [free bus services] was a godsent gift;" "Not really, I'd still have too far to go to get on a bus"
Public transit	What do you do when you're on public transit?(Read?,Sleep?)	6	"Sleep;" "Always alert to my environment;" "Enjoy looking out the window to see what changes have happened since I was last there"
Public transit	How could the public transit in your city be improved?	5	"More affordable and more bus passes for our case workers;" "Add more pick up times;" "Longer hours and 7 days a week service. Make a lesser fee for the handicapped;" "Not all bus routes terminate at a handy place, like closer to my house. I would have trouble wheeling to the nearest pick-up point"
Public transit	If you were to miss your last bus or train ride home, how would you get home?	5	"I have never missed the bus home and never ride after dark;" "I'd have to start calling everyone I know with a car and beg for a ride," "Walk"
Public transit	Do you feel safe when you are using public transit?	4	Yes; "Not anymore;" "I haven't used a bus since I've been in a wheelchair, but I generally feel safe on the MITS vehicles"

User Feedback

Participants were asked a number of Likert-scale questions, with response options ranging from one to five. Higher scores indicate greater satisfaction. For the overall experience, the mean score was a 4.6 (*SD* = 0.73, *median* = 5.0), indicating that participants fell between somewhat satisfied and very satisfied. Participants reported more favorable scores regarding the app providing a new experience (*m* = 4.5, *SD* = 1.27, *median* = 5.0), staff assistance (*m* = 4.7, *SD* = 0.48), *median* = 5.0), instructors' abilities to answer questions (*m* = 4.5, *SD* = 0.53, *median* = 4.5), comfort answering questions (*m* = 4.6, *SD* = 0.52, *median* = 5.0), and staying engaged because of the Travel Buddy feature (*m* = 4.6, *SD* = 0.74, *median* = 5.0).

Participants reported less favorable scores regarding the ease of using the keyboard (*m* = 3.6, *SD* = 1.13, *median* = 4.0) and microphone and camera (*m* = 3.6, *SD* = 1.33, *median* = 3.0), receiving notifications (*m* = 3.6, *SD* = 1.13, *median* = 4.0), transitioning between screens (*m* = 3.6, *SD* = 1.01, *median* = 4.0), and ability to log trips without issues (*m* = 3.6, *SD* = 1.24, *median* = 4.0). Of those reporting issues with the app, 44% reported difficulties with the microphone and/or camera, 33% reported that the app was confusing to use, and 33% had difficulties with the app crashing. See Table 9 for more details about the users' feedback.

TABLE 9 ***User Feedback Data***

Variable	***n* (%)**	***mean* (*SD*), *median***
Overall experience with the tablet and app		4.6 (0.73), 5.0
Using the tablet provided a new experience		4.2 (1.48), 5.0
Using the app provided a new experience		4.5 (1.27), 5.0
Able to identify issues when traveling		4.0 (1.25), 4.5
Staff assistance improved overall experience		4.7 (0.48), 5.0
Able to use the app easily		4.0 (0.87), 4.0
Can answer the questions easily		4.1 (0.60), 4.0
Icons and buttons are easy to understand		4.0 (1.00), 4.0
Keyboard was easy to use		3.6 (1.13), 4.0
Microphone and camera were easy to use		3.6 (1.33), 3.0
Notifications/Alerts reminded me to use the app		3.6 (1.13), 4.0
Instructor described dynamics of the app enough		4.4 (0.53), 4.0
Instructor provided a thorough demonstration		4.4 (0.53), 4.0
Instructor was well-prepared		4.4 (0.53), 4.0
Instructor answered all questions		4.5 (0.53), 4.5
Found the app to be easy once explained		4.2 (0.97), 4.0
Would recommend the training to someone else		4.3 (0.71), 4.0
Content presented matched the agenda of training		4.3 (0.71), 4.0
Received adequate amount of information in training		4.4 (0.53), 4.0
Instructor was engaging		4.4 (0.53), 4.0
Size of the tablet makes it easy to use		4.1 (0.93), 4.0
Font is legible and easy to read		4.6 (0.53), 5.0
Icons are easy to use		4.3 (0.71), 4.0
Transition between screens was quick and without glitches		3.6 (1.01), 4.0
Able to log my trips without issues		3.6 (1.24), 4.0
Able to find home screen easily		4.1 (0.93), 4.0
Able to locate the app on the tablet easily		4.2 (0.97), 4.0
Felt comfortable answering questions		4.6 (0.52), 5.0
Travel Buddy helped to stay engaged		4.6 (0.74), 5.0
Issues with the app		

Difficulties with microphone and/or camera	4 (44.4%)
Confusing to use	3 (33.3%)
Crashed	3 (33.3%)
Felt the length of training was adequate	9 (100%)

Benefits and Motivation

Participants were asked open-ended questions about their overall experience. Most individuals responded with a few positive words, but others described enjoying the opportunity to learn a new technology and to record their travel experiences in the moment. One individual explained that this experience helped him/her to better understand his/her own transportation disadvantage and its impact on his/her quality of life. He/she reported, "I enjoyed it and it helped me understand my dilemma more about how to get places and made me realize there are really a lot of places I could go if I had a car."

Participants were asked open-ended questions about what incentivized or motivated their participation in the study. Answers varied among participants, but the most commonly reported motivator was the ability to share their voice and the possibility of helping others (n = 4, 40%). Other responses included being able to access the Internet, the ability to use the tablet for radio and games, participation as an activity to pass time, and the monetary incentives. Participants were offered ($20) gift cards to Wal-Mart for their participation with *MyAmble*. Several participants reported that they would be willing to volunteer for another research project in the future.

Relationship with Research Team Member/Social Worker

Participants were asked to describe their experience with the social worker/research team member, who trained them on the tablet and app and was the main point of communication. Individuals overwhelmingly reported having established good rapport with their assigned research team member. Most participants described the social workers as "*kind*" or "*helpful*." However, one participant seemed to have a hard time answering this question, reporting that due to the social isolation he/she faces, they do not know how to describe the experience. They stated, "we don't get a lot of visitors, so there's not a lot to compare it to."

Difficulties

Participants were asked to describe any difficulties that they encountered using the tablet. Of those who reported any difficulties, most of them reported having problems with the travel buddy component, reporting that it asked some questions over and over again. Others reported confusion about whether or not data were being saved, particularly when using the travel story and daily trip planner portions of the app. One participant summarized, *"When it was asking about your past, childhood questions [travel story]—no matter how many times I did it, it wouldn't say that it had been done, no matter how I tried to answer."* Another reported, "*I logged in two or three times a day, but I never really knew if I was getting everything that I was supposed to."* Further, participants expressed concern about the inconsistency of the app, reporting things like, "Some days the app worked, others it did not."

Another difficulty that arose for many participants was the inaccuracy of the data captured by the tablet microphone's voice recognition feature. Participants described the desire to use the

microphone, but that it was repeatedly "*timing out*" before they had finished speaking, causing frustration. They also spoke of having to manually edit the text because of the errors. Others reported switching to the keyboard altogether because they did not feel that the microphone feature was useful.

In addition to the difficulties with the app and tablet technologies, one participant voiced having difficulties related to the size of the physical tablet. This person rode on a public bus as their primary mode of transportation and felt unsafe because they could not hide the tablet. They stated, "You don't know who is on the bus, but with a tablet that size it's a risk and not concealable." This person suggested that we allow individuals to download the app onto a phone or smaller device in the future.

Training

Participants' opinions of the training varied. Although all participants reported the length of training as adequate (not too short or too long), some described aspects of the tablet and app that they feel could have been better explained during training. These include the microphone talk-to-text features, the camera, and troubleshooting the app when it crashes. Others, though, felt as though the training needs to be based on individual proficiency levels, with one person saying, "It [the training] covered absolutely everything. For someone like me, tell me once and leave me alone."

LIMITATIONS

Attrition

From the initial field test of *MyAmble*, a number of participants dropped from the study (n=10). Findings from this study show that participant attrition was mainly driven by two reasons, categorized as Health and Technology.

Health

The overwhelming majority (70%) of the participants who dropped from the study stated this was due to health concerns. The following are detailed notes per each participant who report health as one of the reasons they were unable to participate fully in the study. P24, began the study using pen-and-paper (P&P). After 3 days on P&P she was sent to the hospital. Participant had carpel tunnel and stated she was waiting to get surgery on this and, as such, could not write in the notebook. She chose to no longer participate in the study. Another participant, P28, stated carrying around the tablet in the bag gave her back spasms. At this time, she decided to drop out of the study. P11 was hospitalized due to Chronic Obstructive Pulmonary Disease (COPD) and did not feel that she could continue to participate in the study with her health concerns. P16 had developed health issues that prevented him from utilizing the tablet for several days. After the participant's brief recuperation, he attempted to start recording trips again. P9 became increasingly confused and commented about frequently taking pain medications, thus she did not able to fully participate in the study due to conflicting health concerns. P20 had a stroke the day after she got the booklet and had to drop from the study.

Technology

Similar to health, seventy percent (70%) of the participants who dropped from the study stated that this was due to issues with technology. The following are detailed notes per each participant who

report technology as one of the reasons they were unable to participate fully in the study. P25 was trained on a Thursday. She reported having no familiarity with technology - computers, smart phones, tablets. She appeared to understand how to use the app. On the following Monday morning, she called to state that she was not feeling well and, due to health, she had to drop out of the study. P28 was trained on Friday. She stated she used a computer for some years during work; however, she never used a smart phone, tablet, or personal computer. She was very hesitant to use the tablet, although she did a great job logging data for about 1-2 days. As the study went on, she stated she was becoming increasingly inpatient and frustrated with the device. At this time, she decided to drop out of the study. Another participant (P16) faced challenges with technology and health. He received thorough training and recorded trips for the next several days and around day 4 he accidently deleted all his recordings. The next day he accidently deleted the My Amble app itself. The researchers immediately reinstalled the app the next day, but by this point participant had developed health issues that prevented him from utilizing the tablet for a several days. After the participant's brief recuperation, he attempted to start recording trips again; however, he stated that, "the app and tablet navigation had become very difficult for him to navigate." Ultimately, he expressed that the app was not at all user friendly. At this point, the study was stopped. This participant completed 2 weeks of binder recordings before the tablet implementation, where he stated it was very easy to understand and record aside from the binder being so heavy.

Internet Connectivity

Nested within the limitation of technology, some participants' data were not saved consistently in the online database due to Wi-Fi issues. Each participant was loaned a Wi-Fi hotspot from Verizon Wireless. Two of the participants (20%; P10, P11) had trouble logging any data because the hotspot did not work effectively in these participants' homes due to lack of cell phone service. Of these two participants, one was living in a precarious housing situation and was traveling to Oklahoma to stay with friends and/or relatives for an undetermined amount of time. This participant eventually dropped out of the study.

STUDENT EXPERIENCES

Graduate Research Assistants were instrumental in this project. Graduate research assistants include three Master of Social Work (MSW) and two doctoral social work students, one serving as project coordinator, under the supervision of two social work faculty members; one civil engineering graduate student under the supervision of one civil engineering professor; and, one computer science graduate student supervised by one computer science professor. The figure below (Figure 17) illustrates the team organization and assignments.

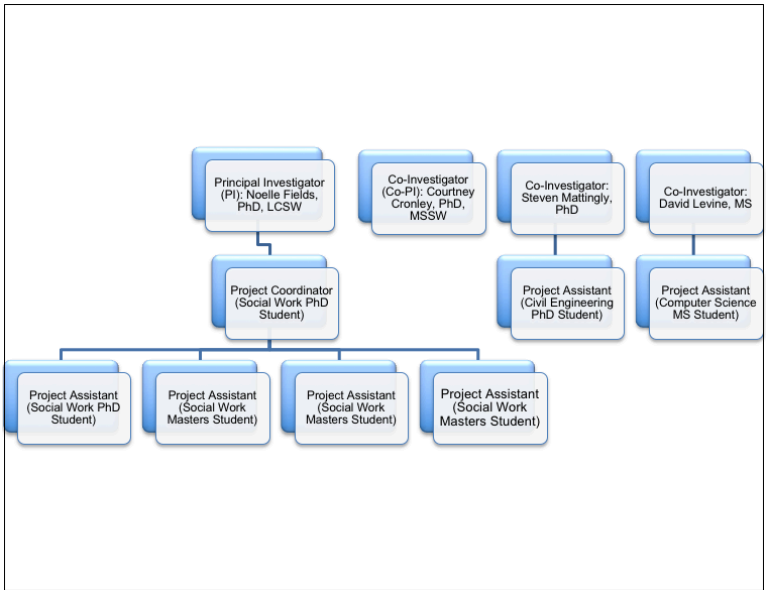


FIGURE 17 Team Organization and Assignments

To examine student experiences working on this project, student team members were asked to complete an anonymous online survey. Participation was voluntary, and students were informed that participation had no impact, positive or negative, on their involvement with the project. Participants gave their informed consent before answering any survey questions. The survey used dichotomous and Likert-scale items to collect data around students' previous experience working on interdisciplinary research teams, likelihood of participating on future interdisciplinary research projects, desired qualities in interdisciplinary research colleagues, and tools and resources that aid in effective interdisciplinary research work. In addition, the survey had open-ended questions intended to collect qualitative feedback regarding students' overall experiences, successes, benefits, and challenges. Qualitative analyses were conducted with Atlast.ti(7).

After coding was completed, the authors met as a group to discuss the emergent themes. The following discussion describes the mutual agreement reached during this meeting. The student team members report that this has been an illuminating project. Together, civil engineering, computer science, and social work student team members were challenged to explore new methodologies and paradigms for research, such as using innovative data collection methods and alternative models, respective to each discipline, to improve the quality of life for transportation disadvantaged community-dwelling older adults and single parents experiencing homelessness with dependent children. This interdisciplinary project has delivered a lasting impact on student learning outcomes and engagement in research. Similarly to students who engage in interdisciplinary coursework, these student researchers demonstrated their ability to synthesize information, develop unconventional thinking skills, and improve critical thinking skills (Ivanitskaya, Clark, Montgomery, & Primeau, 2002). These abilities have carried over into students' own research trajectories, including one social work student team member's dissertation research, which is being funded by a transportation fellowship and explores the intersection of transportation and social support among older adults. Founded on this interdisciplinary research project, students' research agendas have begun to shift as they identify and create more long-term professional identities.

In addition to the professional benefits, interdisciplinary research may help to tackle issues of social justice that may receive less attention when conducted in a traditional, uni-disciplinary research project. Non-traditional collaborations across disciplines may transform attitudes towards poverty and marginalized populations among non-social work disciplines. Student researchers in civil engineering, a profession focused on the built environment and transportation planning, gained unanticipated but revelatory knowledge about the direct impact of community infrastructure on either exacerbating or alleviating the welfare and quality of life for vulnerable populations. Finally, results of this study may be used to inform policy and social change at the local level with city planners and transportation planning civil engineers. To this end, this project benefits the quality of life of at-risk community members and addresses a social justice issue that may not have been acknowledged without this interdisciplinary approach.

Project team members engaged with students and faculty members across disciplines and were exposed to the guiding tenets of each profession. Social work team members gained an understanding of civil engineering's focus on construction and design of the built environment to improve the lives of community members. They also gained understanding of how computer science utilizes technology to innovatively capture data and solve problems. Civil engineering and computer science team members were exposed to the social work profession, guided by values concerned with enhancing the lives of individuals, families, and community members.

This experience was challenging and illuminating, requiring students to explore new methodologies and paradigms for research, working towards improving the lives for transportation disadvantaged older adults and single parents experiencing homelessness with dependent children in North Texas. Ongoing weekly student research work meetings served as best practice while developing the mobile device app and created an opportunity to collaborate for preparation in professional interdisciplinary work in our growing fields, respectively. Interdisciplinary research allowed us to meet students in varying disciplines. Moreover, this work allowed students to understand many ways of tackling issues of social justice, where working independently can present barriers to helping at-risk, vulnerable populations. This graduate-level experience allows each individual to contribute his or her expertise, strengths, and skills to the overall goal. In sum, this study provides a promising example of how to leverage the resources of diverse disciplinary perspectives, as well as new technologies, to develop and experiment with novel interventions and generate holistic data that will shift the transportation paradigm, and potentially many others, from access to equity.

FUTURE RESEARCH

MyAmble is an innovative tool for data collection that can be used for other EJ populations including persons with disabilities and residents of lower-income neighborhoods. Findings from the current study has generated quantitative data about how the trips that people *do not* take result in lost opportunities for them and for their communities. For example, upon further analyses of the data collected, the researchers will be able to quantify the economic costs of under/unemployment due to inadequate transportation infrastructure. In addition, by utilizing the social exclusion framework, the team will be able to quantify the economic costs to individuals and society in terms of increased health care, as well as opportunity costs related to civic engagement, social relationships, and community belonging. Second, results from this study have produced qualitative data that contextualizes lost opportunities and how characteristics of economic justice exacerbate risk for TD, as well as how individuals manage within these intersections of disadvantage.

These data will lead directly into expanded conversations about how to transform transportation planning from *access* to *equity*. Current methods to ensure that all individuals have access to transportation fail to consider that not all individuals have the same resources in society to utilize the transportation that may be available, e.g., mass transit that operates on limited schedules and with limited routes. Infrastructure transformations may include more and more creative solutions for reducing the last-mile gap, and leveraging new technologies such as Lyft, Uber, and app-facilitated ride-sharing to offer door-to-door and on-demand transportation to those for whom mass transit is not realistic, e.g., disabled and older adults or lower-income mothers. *MyAmble* data may also have practical implications for social services in terms of highlighting the role that TD plays in individual general well-being. Case managers and social service providers may want to assess individuals for transportation and develop action plans and referral services to respond to transportation needs. *MyAmble's* data may also begin to generate the sort of holistic and detailed data that will support public policies that fund these innovative transportation solutions.

Appendices

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Details of Performance Measures in SCAG

Performance Measure 1: 2012–2035 RTP/SCS Revenue Sources in Terms of Tax Burdens

Different funding sources (i.e., income taxes, property taxes, sales, fuel, etc.) can impose disproportionate burdens on lower-income and minority groups. Sales and gasoline taxes, which are the primary sources of funding for the region's transportation system, were evaluated for the purposes of this analysis. The amount of taxes paid was analyzed to demonstrate how tax burdens fall on various demographic groups. As in previous RTP Environmental Justice Reports, the 2012–2035 RTP/SCS Environmental Justice analysis examined in detail the incidence or distribution of, the burden of taxation.

The 2012–2035 RTP/SCS Environmental Justice analysis performed a comparative examination of the amount of taxes (sales, gasoline, and income) paid by the five respective income groups and by ethnicity. The analysis indicates that taxes paid as a percentage of each group's disposable income puts the heaviest burden on lower-income groups. This is the so-called "regressive" nature of the excise gasoline tax and retail sales tax levy on primarily consumer durable and non-durables that are necessities of daily living. The lower quintile groups (Quintile 1 and Quintile 2) are anticipated to pay 38.7 percent and 9.9 percent of their gross adjusted income on regional sales and gasoline taxes, respectively. By comparison, the higher quintile groups (Quintile 4 and 5) are anticipated to pay 6.6 percent and 3.0 percent of their income on all regional sales and gasoline taxes, respectively. Although the lower income quintile groups pay a larger percentage of their income on taxes than other quintiles, their contribution of the total share of sales and gasoline taxes is the smallest of the group at 8.4 percent for Quintile 1 and 12.8 percent for Quintile 2. Quintile 4 and Quintile 5, in contrast, pay 23.4 percent and 37.7 percent of the total sales and gasoline taxes in the region. Thus, those with limited financial means will not pay a disproportionate amount of overall taxes under the Plan compared with their usage of the transportation system and their shares of RTP/SCS investment.

The analysis indicates that tax burdens are expected to fall more heavily on non-minority groups, with non-Hispanic Whites paying 48.8 percent of the income taxes and 40.8 percent of the retail and gasoline tax.

Performance Measure 2: Share of Transportation System Usage

In order to determine the existing level of system usage, SCAG analyzed the 2010 National Household Travel Survey (NHTS). The NHTS is a household-based travel survey conducted periodically by the Federal Highway Administration (FHWA). The NHTS is the authoritative source of national data on the travel behavior of the American public.

SCAG then analyzed the transportation system usage by mode by race/ethnicity and income quintile. The data show that most bus and urban rail riders are lower-income quintile households—the lowest two income quintile households combined account for 84 percent of bus riders and 93 percent of urban rail riders. By ethnicity, Hispanics use disproportionately more bus, urban rail, and pedestrian facilities than their share of total households or population, while

non-Hispanic Whites use disproportionately more auto and bike modes, similar to their mode usage for work trips.

Performance Measure 3: 2012–2035 RTP/SCS Investments

One of the most prominent Environmental Justice issues is the transportation investment strategy, which can impact the transportation choices of low-income and minority communities. A disproportionate allocation of resources for various transit investments can indicate a pattern of discrimination.

As a regional MPO, SCAG aims to identify and address Title VI of the Civil Rights Act and the Environmental Justice implications of its planning processes and investment decisions. This analysis intends to determine where the 2012–2035 RTP/SCS is putting its investments and will evaluate whether resources are being allocated equitably. The 2012–2035 RTP/SCS utilized a benefit assessment method that considered to what extent various socioeconomic groups were receiving value from existing and funded transportation investments. SCAG compared the total share of transportation funding borne by low-income households against other income groups. In this analysis, SCAG reported expenditure distribution in several ways. First, SCAG estimated the share of total RTP/SCS expenditures allocated to each category of household income. This was done by totaling expenditures on each type of mode (bus, HOV lanes, commuter/high-speed rail, highways/arterials, and light/heavy rail). These expenditures were then allocated to income categories based on each income group's use-share of these modes.

The results in the 2012–2035 RTP/SCS revealed that approximately 25 percent of Plan investments will be allocated to the lowest quintile group (compared with the group system usage of just under 17 percent), while 19 percent will be invested for the highest income category (Quintile 5), with total transportation system usage of almost 25 percent. In other words, transportation investments would go to modes likeliest to be used by lower-income households.

The current analysis for the 2012–2035 RTP/SCS further reveals that Plan investments will be distributed equitably on the basis of system usage by ethnic/racial groups. The full analysis is available in the Environmental Justice Appendix.

Performance Measure 4: Impacts of Proposed VMT Fees

This is a new analysis area based on the finance strategy in the 2012–2035 RTP/SCS, which recommends a vehicle mile traveled (VMT)–based user fee. This VMT user fee would be implemented to replace the gasoline tax and is estimated to cost about $0.05 (in 2011 dollars) per mile and indexed to maintain purchasing power starting in 2025. The implementation of this strategy requires actions of both the State Legislature and Congress.

This section discusses the land use impact from the "VMT fee" scenario. This is a cursory analysis using SCAG's PECAS land use model. To parameterize the VMT fee scenario for a model run, the following assumptions were applied:

- Current gasoline tax, $0.364 per gallon, would gradually increase until 2025 to $0.50 per gallon.
- After then, a $0.05 per mile of VMT fee would replace the gasoline tax at year 2026.
- Relative to the Production, Exchange, and Consumption Allocation System (PECAS) model's base year, 2007, the travel cost would be 10 percent higher at year 2025 than in 2007. Between 2008 and 2024, this cost increase is linear. At year 2026, the travel cost would be 20 percent higher than in 2007 and thereafter stabilized.

In general, the results suggest that with higher travel costs region-wide as reflected in the VMT-based user fees, people and households will tend to move to nearby local centers where accessibility to job opportunities is plentiful, so as to offset the impacts from an increase in travel costs. On the other hand, employers will relocate to key locations to better align themselves with the newly emerging concentration of workers and households.

Performance Measure 5: Distribution of Travel Time and Travel Distance Savings

SCAG assessed both the distribution of travel time and distance savings that are expected to result from the implementation of the 2012–2035 RTP/SCS by analyzing demographic data and the associated mode usage statistics for each Transportation Analysis Zone (TAZ) in the region. With this input, an estimate for the time savings for each income and ethnic group can be identified for trips involving transit (i.e., local bus and all transit) and automobiles.

The analysis resulted in the following observations:

- Share of travel times savings by income groups are generally consistent with the mode usage for each income group. Higher-income quintile groups captured more savings in person-hours traveled proportionally to their relative higher usage of auto mode. On the other hand, lower-income groups received more benefits from transit related time savings for their higher usage in the transit mode.
- Similarly, person-mile travel changes are also in line with usage by income groups in terms of auto mode.
- The outcomes for share of travel time savings and person-mile benefits by ethnic groups are also very balanced and in line with each ethnic group's use of the transportation system.
- In terms of relative improvements by income/ethnicity group, lower-income quintile groups received greater improvements in person-mile travel reductions and local bus travel time savings than higher-income groups and about the same level of improvement in person-hour savings as higher-income households. Alternatively, higher-income households enjoyed a moderately better improvement in all transit mode time savings.
- The improvements in mobility and person-mile travel benefits are fairly similar and close for all ethnic groups.

Performance Measure 6: Jobs-Housing Imbalance or Job Housing Mismatch

In the practice of urban and transportation planning, the subject of job-housing imbalance and job-housing mismatch is considered a key contributor to traffic congestion and, some argue, an impediment to Environmental Justice. Among the arguments:

- Workers are priced out of the job rich areas, which makes long-distance travel and congestion inevitable for many
- Coastal counties have not built enough housing, forcing workers to move to inland counties where housing is affordable. This results in long distance commuting and traffic congestion

While this analysis is not expecting to allay all concerns of the jobs-housing imbalance and/or jobs-housing mismatch, the statistics are provided to investigate socioeconomic profiles of long-distance commuters—defined here as "intercounty commuters—such that stakeholders and policymakers can better understand the demographic composition of long-distance commuters.

From an economic point of view, transportation and driving are expensive; workers without a car or people with less income who cannot afford a vehicle have to either live close to their jobs where they can have access to transit or can walk or bike. Moreover, since long-distance commuting is expensive, people do not partake in it unless subsidies exist to own a dependable vehicle, access is available to relatively fast and cheap transit, or they have a good-paying job.

The statistics indicate that, almost without exception, all intercounty commuters command much higher wages than those commuters who work and live in the same county. Those commuters also command wages higher than workers who work and reside in their destination work counties. From an Environmental Justice perspective, this research does not provide definitive results. Rather, it raises additional questions that could be investigated to better understand how jobs, workers, housing, and associated income distribution could impact travel patterns of low income and minority populations.

Performance Measure 7: Accessibility to Employment and Services

Accessibility is a foundation for social and economic interactions. As an indicator, accessibility is measured by the spatial distribution of potential destinations; the ease of reaching each destination; and the magnitude, quality and character of the activities at the destination sites. Travel costs are central: The lower the costs of travel, in terms of time and money, the more places that can be reached within a certain budget and thus, the greater the accessibility. Destination choice is equally crucial: The more destinations and the more varied the destinations, the higher the level of accessibility.

Job and shopping accessibility calculations are presented in the Environmental Justice Appendix. Summary highlights from the analysis include the following:

- The elderly population showed only above average accessibility to job opportunity by auto; all other measures come out slightly below average for both job and shopping accessibility. As mentioned earlier, staff plan to research and further study residential location and land uses in

the surrounding areas for this population group, in particular because the region is facing an aging population in the next 20–25 years.

- In general, lower-income quintile households and populations below poverty all showed higher job and shopping accessibility in Base Year 2008 under every transportation mode.

- As in the case of distance-based accessibility, non-Hispanic Native Americans and non-Hispanic other, similar to non-Hispanic White, are below average in both job and shopping accessibility.

- Nonetheless, through the implementation of recommended strategies in the 2012–2035 RTP/SCS, the elderly, non-Hispanic Native Americans, and non-Hispanic others will experience greater improvements than the average population in both employment and shopping opportunities.

Performance Measure 8: Accessibility to Parks

Similar to the method in measuring job accessibility, park accessibility is defined as the percentage of park acreage reachable within 45-minute travel time via 1) automobile; 2) local bus; and 3) all transit options. SCAG's existing typical weekday model was utilized for the analysis, as there is currently no weekend transportation model for the region.

The results of this park accessibility analysis by auto, local bus, and all transit modes for 45 minutes of travel are presented in the Environmental Justice Appendix. General conclusions from the table and figures include:

- Park accessibility statistics indicate that park accessibility by transit is much lower than that by automobile for all groups. This is true for all parks—national, state, or local parks. By transit, there is almost no access to national parks, and very limited access to state parks in all scenarios—Base Year 2008, Baseline, or under the Plan. This observation is consistent with the conclusions of the 2008 RTP Environmental Justice Report that there is a near complete lack of public transportation services into, in particular, the national forests.

- Income quintiles 4 and 5 will have moderately higher access to either state and/or local parks in the region via automobile. Population groups showing marginally lower accessibility to national parks by auto include non-Hispanic Black, income Quintile 1 and 5, and population below poverty. As to state park accessibility by auto, all population groups show slightly lower than average accessibility except for non-Hispanic White and the two higher-income quintile households. More Environmental Justice population groups, including Hispanics, non-Hispanic Asians, income Quintile 2, and the disabled population, show higher than average accessibility to local parks than the average population in the region.

- In addition to the elderly, non-Hispanic Native Americans, and non-Hispanic other, further analysis should also focus on non-Hispanic Blacks where their park accessibility by auto is below the average for all parks. However, the 2012–2035 RTP/SCS provides improvements for these population groups at a greater rate than the rest of the region's population groups.

Performance Measure 9: Gentrification and Displacement

The integration of transportation and land use has been recognized for its ability to reduce vehicle miles traveled, air pollution, and greenhouse gases, while increasing opportunities for physical activity. However, there are concerns associated with transit-oriented development (TOD). Specifically, there has been criticism of smart growth in relation to affordability. Some opponents have suggested that concentrating growth in cities and towns to avoid sprawl can lead to higher household costs, an effect completely opposite of what was intended. In some cases where transit service has spurred significant new TOD, the result can be that people with average incomes are unable to afford to buy homes in or near the new developments. This highlights the need for strategies that, at a minimum, set aside some portion of new development and surrounding households as affordable housing adjacent to transit and in surrounding households.

In response to these concerns, SCAG developed a methodology to model and monitor the demographic trends in and around transit-oriented communities. With this methodology, SCAG has the ability to track demographic changes over time in those areas designated as key growth areas. The results will help SCAG and our partners better understand what demographic shifts occurred from the development of TOD along urban and commuter rail lines. It will also serve as Baseline data for comparison in future RTP cycles. More information on this methodology can be found in the Environmental Justice Appendix. Resources to address gentrification and displacement are provided for informational purposes only. Local agencies may consider them at their discretion.

Performance Measure 10: Environmental Impact Analyses (Air, Health, Noise)

Historical Air Quality and Health Impacts

Emissions Impact on Environmental Justice Populations at the Regional Level

Exposure to air pollutants is an Environmental Justice issue due to the disproportionate share of minority and low-income populations living in close proximity to heavily traveled corridors, particularly near port and logistics activity. This exposure to unhealthy air results in 5,000 premature deaths and 140,000 children with asthma and respiratory symptoms. More than half of Americans exposed to PM2.5 pollution exceeding the national standard reside in the SCAG region.

New to the Title VI and Environmental Justice analysis for the 2012–2035 RTP/SCS, SCAG has mapped data for existing exposure to ozone, concentration of particulate matter emissions, cancer risks, and respiratory hazard risks. In order to assess the historical impacts of emissions on various demographic groups throughout the region, emissions information was summarized to the Environmental Justice communities. Further, additional analysis has been included in the final Environmental Justice Appendix that documents the health and emissions data for children age 5 or under. The analysis compares the performance of the Plan scenario with the Baseline scenario for children age 5 or under within 500 feet of freeways and highly traveled corridors and in areas affected by roadway noise, aviation noise, and near rail lines. It also includes historical air quality and health factors for areas that have a concentration of young children that is higher than the region at large. These findings are available in the Environmental Justice Appendix.

ENVIRONMENTAL IMPACTS ALONG FREEWAYS AND HIGHLY TRAVELED CORRIDORS

The concentration of air pollutants along heavily traveled corridors, particularly PM10 and PM2.5, is a major concern in Southern California. SCAG identified major corridors defined as urban roads with 100,000 average daily trips and rural roads with 50,000 daily trips. Next, SCAG overlaid the income and racial and ethnic composition of those households within 500 feet of the corridor. This analysis allows SCAG to better understand the impacted populations and allow for greater outreach to those communities of concern. After the release of the Draft RTP/SCS, SCAG also prepared additional analysis to high- light the emissions exposure in buffer areas within 500 feet of freeways and high volume roads, and also added analysis of the areas within 1000 feet.

The analysis illustrated the distribution of Environmental Justice communities residing within 500 feet of a heavily traveled corridor. Low-income groups comprise 7 percent of the population living within 500 feet of a heavily traveled corridor, while 7.1 percent of minorities reside in these areas. This is higher than the regional level, which shows that 5.7 percent of the region's population lives within 500 feet of a heavily traveled corridor. These findings are available in the Environmental Justice Appendix.

ENVIRONMENTAL IMPACTS OF PLAN AND BASELINE SCENARIOS

SCAG's air pollutant emissions analysis was based on emission estimates for pollutants that have localized health effects: carbon monoxide (CO) and particulate matter (PM).

An analysis was also conducted for PM exhaust emissions from heavy-duty vehicles: an indicator for diesel toxic air contaminants. The results were calculated based on the estimated emissions at the TAZ level.

It is important to note that total emissions of all pollutants in the region will decrease compared to existing conditions with or without the Plan, due to the combination of measures being taken to meet air quality standards. Since the Plan must demonstrate conformity with regional air quality management plans that call for reductions in emissions of air pollutants, the Plan itself will likewise result in reductions of pollutant emissions. This is generally because the Plan investments will alleviate roadway congestion and provide a greater range of transportation alternatives. The analysis in the Appendix, however, is based on a comparison of Plan to Baseline conditions, rather than a comparison of Plan to current conditions.

Data and analysis included in the Environmental Justice Appendix does not account for Plan improvements in vehicle technology particularly for truck only corridors. These corridors in the Plan are exclusively for zero and/or near-zero emission vehicles. Furthermore, the Program Environmental Impact Report (PEIR) accompanying the 2012-2035 RTP/ SCS includes mitigation measures that would reduce impacts associated with health risk within 500 feet of freeways and high-traffic volume roadways to less than significant. Analysis included in the Environmental Justice Appendix also does not account for emissions improvements through the implementation of these mitigation measures. As such, emissions and exposure analysis shown

in the Appendix is abundantly conservative and demonstrates worst-case scenario outcomes. If these emissions improvements had been accounted for, we believe the analysis would show little or no areas with worsened emissions ("hot spots") associated with the Plan. Moreover, the currently available data on emissions and on the distribution of households and population is imprecise such that the overlay with emissions and Environmental Justice populations will tend to overstate any potential impacts. Nevertheless, given on-going concerns and evolving information on health impacts, SCAG encourages project sponsors to be cognizant of any potential health risks in project design and delivery. Consistent with the mitigation identified and to be implemented as part of the proposed final PEIR, SCAG will assist in disseminating information and identifying effective strategies to reduce risk at the project level.

NOISE IMPACTS

Roadway Noise

The SCAG region has an extensive roadway system with nearly 21,000 centerline miles and 65,000 lane miles. It includes one of the country's most extensive high-occupancy vehicle lane systems and a growing network of toll lanes, as well as high-occupancy toll (HOT) lanes. The region also has a vast network of arterials and other minor roadways. Roadway facilities noise may cause significant environmental concerns.

Noise associated with highway traffic depends on a number of factors that include traffic volumes, vehicle speed, vehicle fleet mix (cars, trucks), as well as the location of the highway with respect to sensitive receptors (i.e., schools, daycare facilities, parks, etc.). According to Federal Highway Administration (FHWA) guidance, noise impacts occur when noise levels increase substantially when compared to existing noise levels. For the purposes of this analysis (consistent with FHWA guidance), noise increases of 3 dB along highways where noise levels are currently, or would be in the future, above 66 dB are considered to be significant, regardless of adjacent land use.

Highways that would be expected to have an increase of 3 dB or more include those where any of the following would occur: (1) the total traffic volumes increase by 100 percent compared to existing conditions; (2) the medium/heavy truck traffic volumes increase by 130 percent compared to existing conditions; or (3) the medium/heavy truck traffic volumes increase by 100 percent and there is an increase in other traffic volumes by 50 percent. These highway segments were identified using the results of SCAG's regional transportation model.

On some highways, there is no potential for noise levels to reach 66 dB. To eliminate these from the analysis, the following criteria were applied: (1) arterials where the FHWA's Traffic Noise Model (TNM) indicated that the motor vehicle volume (and the percentage of medium/heavy trucks) would result in traffic noise levels less than 66 dB; (2) arterials where the calculated motor vehicle speed was less than 17 mph; or (3) freeways where the average volume-to-capacity ratio was equal to or greater than 1.0, which would result in vehicle speeds of less than 30 mph. If a highway met any one of these criteria, it was eliminated from further consideration.

For each highway segment where a significant increase in noise would occur, a 150-foot impact zone was determined on either side (see the Environmental Justice Appendix for roadway segments selected from the 2012–2035 RTP/SCS). Using GIS, the percentage of each affected TAZ's land area that fell within this zone was identified, and this percent- age was applied to the demographic data forecast for this TAZ. This methodology was utilized in both the 2008 and 2004 RTP.

The results show that minority populations were primarily affected by highway noise impacts. As indicated by the distribution of households in highway noise areas by ethnic/ racial category, minority populations, specifically Hispanics, would be disproportionately impacted by highway noise. Approximately 60 percent of Hispanics would be residing in highway noise areas by 2035. This is a 1 percent increase from the results of the 2008 RTP Environmental Justice analysis.

SCAG further investigated the impacts on areas and the number of people affected by improvement of roadway noise from the proposed 2012–2035 RTP/SCS as it com- pared with the 2035 Baseline conditions. As illustrated in the roadway segment maps where noise impacts are identified for both Baseline and for the proposed Plan, areas or number of segments under the proposed Plan are much smaller/fewer than those under the Baseline condition. Thus, it is projected that there will be 183,000 fewer people (13.9 percent reduction) and 63,000 fewer households (15.3 percent reduction) affected by roadway noise than those under the Baseline condition (1,321,600 people/426,700 households).

While the proposed 2012–2035 RTP/SCS improves the roadway noise conditions by reducing the areas, roadway segments, and the number of people affected by roadway noise, the benefits are not proportionally shared by each Environmental Justice category as observed in the roadway noise impacted areas or in the region as whole. SCAG's analysis found that the roadway noise reductions will disproportionately benefit non-Hispanic Whites and the two highest-income quintile groups. Several other Environmental Justice communities also receive greater benefits from roadway noise improvements, including non-Hispanic Asian, non-Hispanic other, elderly, and the disabled.

Aviation Noise

The SCAG region supports the nation's largest regional airport system in terms of number of airports and aircraft operations, operating in a very complex airspace environment. The system has six established air carrier airports including Los Angeles International (LAX), Bob Hope (formerly Burbank), John Wayne, Long Beach, Ontario, and Palm Springs. There are also four emerging air carrier airports in the Inland Empire and North Los Angeles County. These include San Bernardino International Airport (formerly Norton AFB), March Inland Port (joint use with March Air Reserve Base), Southern California Logistics Airport (formerly George AFB), and Palmdale Airport (joint use with Air Force Plant 42). The regional system also includes 45 general aviation airports and two commuter airports, for a total of 57 public use airports. Although the projected demand for airport capacity has decreased compared to the 2008 RTP, there is still moderate growth for the future. The challenge is striking a balance between the

aviation capacity needs of Southern California with the local quality of life for the affected populations.

Projected noise impacts from aircraft operations at the region's airports in 2035 were modeled for inclusion in the Programmatic Environmental Impact Report for the RTP/ SCS. For each airport, modeling produced a contour, or isoline, for the 65 dB Community Noise Equivalent Level (CNEL), a measure of noise that takes into account both the number and the timing of flights, as well as the mix of aircraft types. The Federal Aviation Administration (FAA) considers residences to be an "incompatible land use" with noise at or above 65 dB. To identify potentially impacted populations, the anticipated population within the 65 dB CNEL contour was calculated using the following steps:

1. Calculate the percentage of TAZs that would lie within a 65 dB CNEL contour.

2. Assign the SCAG projected population to the TAZ.

3. Apply the demographic breakdown of the TAZ as a whole to the population within the 65 dB CNEL contour.

It should be noted that after 9-11 and the Great Recession experienced since 2008, the global aviation industry remains in a depressed state. SCAG region air passenger demand and cargo forecasts have been revised downward repeatedly in 2004 RTP and 2008

RTP from the aviation scenario and forecasts adopted in the 2001 RTP. Currently for the 2012–2035 RTP/SCS, projections of aviation demand and air cargo remained significantly less than those projected and adopted in the 2001 RTP. Thus the downward revisions in projected demand at airports resulted in the reduction of airport noise areas and the corresponding communities that will be studied.

For the purposes of this study, aviation noise areas are defined as areas that are adversely affected by aircraft and airport noise. As part of the Environmental Justice analysis, special attention will be paid to income, disability, age, and race/ethnicity of affected populations.

The analysis indicates that the 2012–2035 RTP/SCS results in a disproportionate aviation noise impact to low-income and minority populations. Under the 2012–2035 RTP, the lowest-income group (Quintile 1) will represent 27 percent of the households impacted by noise above the 65 dB CNEL, while the highest-income group (Quintile 5) will represent only 13 percent of the households impacted by noise above the 65 dB CNEL.

Similarly, a disproportionate number of households below the poverty threshold will be affected by airport noise levels above the 65 dB CNEL. While 14 percent of the SCAG region households are projected to be living below the poverty level, 19 percent of those that live within the noise contour areas will be below the poverty line.

In terms of race/ethnicity, the aviation plan of the 2012–2035 RTP/SCS is projected to have a disproportionate aviation noise impact on minority groups, who make up 89 percent of population within the noise contours, compared with a regional average of 76 percent of minority population in 2035. Specifically, Hispanic and African-American populations are

disproportionately affected. These two groups will make up 55 percent and 6 percent of the regional population in 2035, respectively, but represent 62 percent and 21 percent of those that will live within the impacted noise contour area. Consistent with mitigation identified in the proposed Final PEIR, SCAG will assist in disseminating information and identifying effective strategies to reduce impacts at the project level. Potential mitigation measures for noise impacts are included for reference in the Environmental Justice Mitigation Toolbox.

Performance Measure 11: Rail-Related Impacts

As described in the Goods Movement Technical Appendix (p 32), freight rail emissions areas adjacent to railroads and rail facilities, although further discussion and analysis is recommended. This section includes an analysis of Environmental Justice communities adjacent to railroads and rail facilities, rail impacts to sensitive receptors, and a summary examination of potential environmental justice concerns that are alleviated by grade separation projects. The train traffic index and related analysis provided in the Environmental Justice Appendix includes data from both passenger and freight rail traffic.

Agency	Program	Year of Report	Needs	Solution Strategies	Comment
Houston-Galveston Area Council	2011 RCTP MTP JARC	October 2016	-Lack of transportation to medical service/doctor's office, work and the grocery store destinations -No adequate funding match -Outdated vehicle design standard	-Providing transportation for low income to doctor and pharmacy -Initiating commuter bus service in Austin county - Use of the H-GAC Buy Cooperative Purchasing program for specialized transit vehicles -Give access to priority destinations for low income - Engaged United Way Nonprofit Connection(NPC) for finding transportation needs - METROLift is a complementary paratransit service - provide transportation for low income youth traveling to and from work	-MTP ridership and its costs increased
Houston-Galveston Area Council (Gap Analysis)	GMP	May 2017	-Lack of local bus	- Receive a portion of the sales tax revenues from citizens go to fund general mobility roadway project improvements	-Needs for cooperation of regional transit operators, local elected officials, business and community leaders and members of the general public
Southern California Association of Governments	RTP/SCS CMIA	April 2012	-Programs for improving mobility - Actions for having functional mobility for multiple modes of transportation and a great sense of place	- Expanded transit investments and high-speed rail system, as well as increased commitment to active transportation -Using hard or push and soft or pull strategies -Expansion of transportation systems like transit, high-speed rail, active transportation, Express/HOT lanes, and goods movement - Accessibility is one of the primary performance measures used to evaluate active transportation - The mobility performance measure relies on the commonly used measure of delay.	- The RTP/SCS is safe, secure, and efficient transportation systems that provide improved access to opportunities, such as jobs, education, and healthcare for our residents
SANDAG	STP	September 2007	- Public Transit Service Needs - Supplemental Transportation Program (STP) Needs - Public Information About Transportation Services - Safety - Accessibility - Coordination - Trip Needs	- Using public outreach process - demographic and transit data was also utilized to identify service deficiencies and gaps	

Atlanta	HST Section 5310	May 2017	-Limit access to transportation options for both low income and disabilities -Program for enhancing mobility for seniors and persons with disabilities	- to leverage many modes in the transportation system such as public transit, carpool/vanpool, specialized curb-to-curb services, pedestrian trips, cycling, and taxis/transportation network companies. -Transportation for seniors and persons with disabilities. -Capital, Operating and Mobility Management	

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MyAmble User Manual

INCLUDING PROJECT ORIENTATION, CONSENT INFORMATION, MYAMBLE INSTRUCTIONS & PEN AND PAPER GUIDE

Transportation Mobility Participant User Manual
SCHOOL OF SOCIAL WORK & DEPARTMENT OF CIVIL ENGINEERING

Transportation Mobility
Participant User Manual

For the purposes of research conducted the University of Texas at Arlington
School of Social Work & Department of Civil Engineering

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Project Background: The Big Picture

We are thrilled that you have chosen to participate in this research study. You were selected as a potential participant for this research study because you may have experienced, or currently experience, transportation disadvantage.

Many people experience transportation disadvantage, and this simply means that you may have encountered problems accessing transportation due to personal or environmental factors. For example, public transportation routes are not always convenient in terms of times and routes. Grocery stores, shopping, and medical offices may be located very far away from your house.

Regardless of the reason for experiencing transportation disadvantage, you may find that you are unable to attend some of the activities that you would like to attend. Or, you might find it very difficult to visit the people and places that matter most to you. This might be bothersome. In fact, some people who experience transportation disadvantage report that their lack of access to reliable transportation negatively affects their quality of life.

Project purpose

This research study was designed to explore the extent to which you experience transportation disadvantage and the impact of transportation disadvantage on the quality of *your* life. The purpose of this research study is to explore your experiences when you try to go places on a day-to-day basis. In particular, the research team is interested in identifying the problems you encounter when you try to plan your day and follow through on this plan, e.g., going to the grocery store or to a medical appointment or to visit a family member.

Use of study results

As a participant in this research study, you will be given both an electronic diary (i.e. a tablet with a mobile app) and a traditional pen-and-paper travel diary. Your diary entries will be collected and then analyzed to better understand the impact of transportation—or the lack thereof—on your quality of life.

By assessing your diaries and the diaries of other research participants, the research team will be able to identify consistent problems that you and others experience while trying to access transportation. Findings from the research study will inform transportation policies in Tarrant County.

We hope that the policies informed by this research will: 1) address gaps in transportation access, and 2) improve public transportation resources for you and others in the Tarrant County community.

Project timeline for participants

You will participate in this study for four weeks (28 days), unless you choose to stop participating in the study before its completion. An assigned research team member will provide you with the specific start and end dates when it is time for the study to begin.

There are two portions of the study. For 14 days, you will be asked to use an electronic diary to catalogue your travel plans and challenges. This electronic diary—an app called MyAmble— is on a mobile tablet that the research team will provide to you. For the other 14 days of the study, you will be asked to record your answers using a traditional pen-and-paper travel diary that will also be provided to you.

Please note: It is expected that you will spend approximately 30-90 minutes each day answering questions on either MyAmble or in your pen-and-paper diary. When you are using MyAmble, you will not need to use the pen-and-paper diary. Likewise, when you are using your pen-and-paper diary, you will not need to use MyAmble**.**

Introduction to the MyAmble electronic diary

MyAmble is the app through which the research team will capture information about your transportation plans and challenges. MyAmble will prompt you to answer a variety of questions related to your daily transportation experiences. In addidtion, MyAmble will allow you to take pictures of travel challenges, record numerous trips, and interact with a research team member in real time. Many of the interactions available on MyAmble are not available with the pen-and-paper travel diary.

Through MyAmble, you will answer a variety of questions related to your daily transportation experiences and your travel memories. The app will also ask you to reflect on how transportation disadvantage affects your access to resources, social participation, and your quality of life.

Introduction to the pen-and-paper travel diary

The pen-and-paper travel diary is very similar to the MyAmble app. Like the app, the pen-and-paper travel diary will prompt you to answer a variety of questions related to your daily transportation experiences. However, some of the features available in MyAmble are not available in the pen-and-paper travel diary. For instance, you will not be able to take pictures or videos of your travel challenges while using the pen-and-paper travel diary. You will also not be able to use your pen-and-paper travel diary to interact directly with your assigned research team member.

In addition to gathering transportation information from you, the pen-and-paper travel diary will allow the research team to compare the practicality and effectiveness of data collection through the MyAmble app to a traditional travel diary.

Consents

In the most basic sense, your consent to participate in this research study simply means that you agree to participate. In the context of a research study, it means that we as the research team have your agreement to participate in the study, including an acknowledgement that you understand the possible consequences of participating. This is called an informed consent.

This section of the user manual will provide you with the highlights of this research study's informed consent. A full copy of the informed consent will be provided to you by a research team member once an original is signed. A research team member will go through the entire informed consent with you and answer any questions you might have.

Highlights of the informed consent

Your **participation is voluntary**. Refusal to participate or discontinuing your participation at any time will not involve any penalty. Should you experience any discomfort please inform the researcher; you **have the right to quit any study procedures** at any time at no consequence. Should you choose not to complete all study procedures, you **will still receive the gift card** for the part of the interview that you completed. Every attempt will be made to see that your **study results are kept confidential**.

Your participation in this research study **will not impact any services** that you are currently receiving or may receive in the future from any social service or healthcare agencies. It cannot and will not impact the services you receive from Meals on Wheels.

All participants will receive gift cards to Wal-Mart as compensation for their time. You will receive a $20 gift card after completing the first two weeks of the study, and another $20 gift card after completing the fourth week of the study. Total **compensation for each participant who fully completes the study** will be $40.00 in gift cards.

The anticipated **risks of participating in this study are minimal**. However, **your location will be tracked using the GPS in the tablet**, which may pose a risk to your privacy. In order to minimize the risks posed to your privacy, you have the option to not have the location recorded for a day/time that you choose by turning off this function on the tablet or by communicating with the researchers that you do not want location data to be included on a particular day/time.

By law, social workers are mandated reporters of suspected elder abuse or neglect. **The research team member assigned to you is a social worker.** The only exception to confidentiality in this study is if there is a suspicion of elder abuse or neglect and the researchers will be mandated to report this to the Texas Department of Adult Protective Services.

Global Overview

Once you consent to participate, you will be given both a mobile tablet device and/or a pen-and-paper travel diary. The MyAmble app will already be loaded onto the tablet when it is given to you. Recall that the MyAmble app is the electronic diary for all of your travel entries. As mentioned previously, you will use the electronic diary for 14 days and the pen-and-paper travel diary for 14 days, for a total of 28 days.

It is possible that you may be asked to complete the pen-and-paper travel diary before you are given the mobile tablet. This is because the start dates for the electronic diary entries are staggered by research participant; we have more research participants than we have tablets. Your assigned research team member will let you know when it is your turn to have the tablet. Please be advised that you *must* return the tablet to your assigned research team member at the conclusion of the 14-day electronic diary data collection period.

It is very important that you fill out both the electronic diary and the pen-and-paper travel diary completely and truthfully during each day of the study. If you ever encounter a problem, contact your assigned research team member as soon as possible.

In between the pen-and-paper travel diary and before your electronic diary, or vice versa, you will complete a demographic questionnaire with your research assistant. This is a normal part of the training and consent process that each participant is asked to complete.

Tablet and MyAmble Overview

The tablet and MyAmble are separate items, but together they function as your electronic diary. You will need to know how to charge your tablet and ensure it is connected to the internet in order for the MyAmble app to gather the data that the research team will analyze.

Tablet Overview

The mobile tablet assigned to you is Samsung Galaxy Tab A 10.1” 16GB (WI-FI), Black.

It is very important that you charge your tablet every night. You may do this by connecting the tablet to an electric outlet using the power cord that is provided to you. You will not be able to use the tablet if it is not charged.

You do not need to turn your tablet off and on every day. As long as it is charged, it may remain on.

Your tablet is enabled with wifi, which means that it can connect to the internet wherever wifi is available.

During the 14-day period that you have the tablet in your possession, the tablet will only allow you to use the digital diary app, a weather app, and Google maps. The tablet will lock you out of all other features.

Your tablet's password is: _____

Hotspot Overview

This hotspot will make it possible for you to connect your tablet to the internet no matter where you are located. This is a nice feature to have, since you may want to use the MyAmble app when you are out and about. You will not have to do anything to connect your tablet to the hotspot or to the internet. This will be set up for you before the tablet is in your possession. The tablet's connection to the internet is what will allow the research team to access all of the information that you enter into MyAmble.

The mobile hotspot assigned to you is Verizon Jetpack MiFi 7730L, Black.



It is very important that you charge your hotspot every night. You may do this by connecting the hotspot to an electronic outlet using the power cord that is provided to you. You will not be able to use the MyAmble features without wifi connection.

You should not have to connect your tablet to the wifi as this will have already been done for you. Should you need the password for any reason though, it is:

The hotspot signal does not have a long reach. **You must keep it in close proximity to your tablet at all times.** It is recommended that you keep the hotspot plugged in while operating the

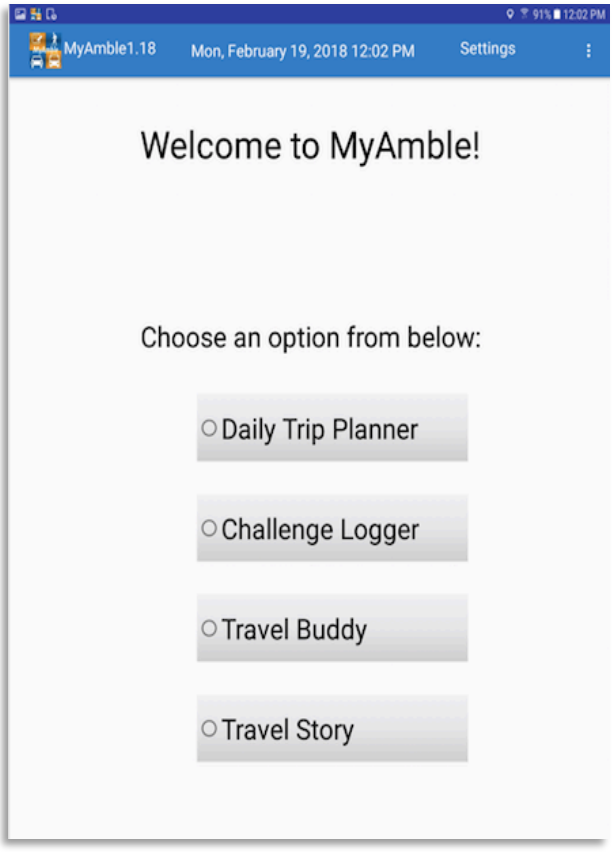
tablet at home, as long as the hotspot and tablet are in the same room. When you travel, please place the hotspot in the tablet's carrying case.

MyAmble Overview

You may access the MyAmble app by clicking on the MyAmble icon on your tablet's home screen:



When you click on the MyAmble icon, the app will direct you to the home screen for the app. On this home screen, you may select between several different components of the app. These components include the Daily Trip Planner, Challenge Logger, Travel Buddy, and Travel History:



An overview of these components will be provided shortly. Each component poses open- and closed-ended questions related to your travel plans and experiences, as well as questions related to the importance of daily planned and unplanned travel.

Your assigned research team member will collect the tablet from you at the end of the 14-day data collection period.

If you need help troubleshooting a problem with the MyAmble app (i.e. you do not remember how to navigate between screens of the app), you should contact your assigned research team a member. If you are having problems with the tablet itself (i.e. you do not remember how to charge its battery), you should reference the tablet's user guide. This user guide will be included in the pen-and-paper binder and/or the tablet case.

Pen-and-Paper Travel Diary Overview

When you are not using your electronic diary, you will be asked to complete a traditional pen-and-paper travel diary. The questions on the pen-and-paper travel diary will be similar to those posed through MyAmble.

The pen-and-paper travel diary is a notebook with questions. These questions include both open- and closed-ended questions related to your daily travel plans and experiences, as well as questions related to the importance of daily planned and unplanned travel. The time to complete the traditional pen-and-paper diary is expected to take 30-90 minutes daily. Your assigned research team member will collect the pen-and-paper travel diary notebook you at the end of the 14-day data collection period.

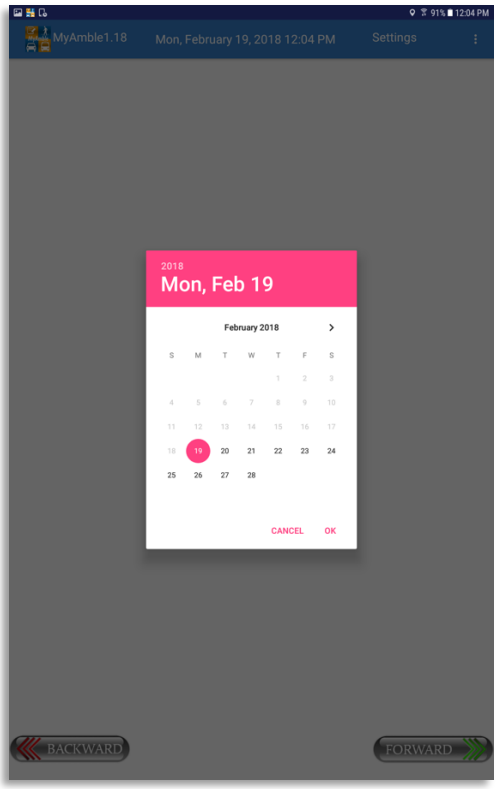
MyAmble Components

The MyAmble app consists of several different components, all of which are important for the overall research study. When you first open the MyAmble app, you will be able to select which component you would like to use. (Recall that the components you can choose from are listed on the home screen icon pictured on the previous page.) You should use all of the components throughout the research study, but you are likely to find that you use some more than others. You will likely use the Daily Trip Planner more often than any of the other components.

Daily Trip Planner

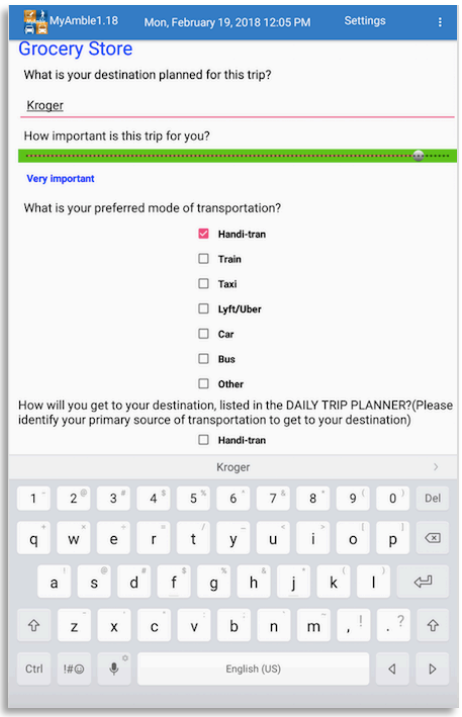
The Daily Trip Planner component of the MyAmble app will provide you an opportunity to share information about your daily travel plans and travel experiences. It will also allow you to comment on the importance of daily planned and unplanned travel.

When you access the Daily Trip Planner in the morning (or the first time you open it for the day), you first choose which date you are planning. Once you choose the date, using the calendar feature, you next mark which places you plan to travel to throughout the day. The Daily Trip Planner will prompt you on how to do so.

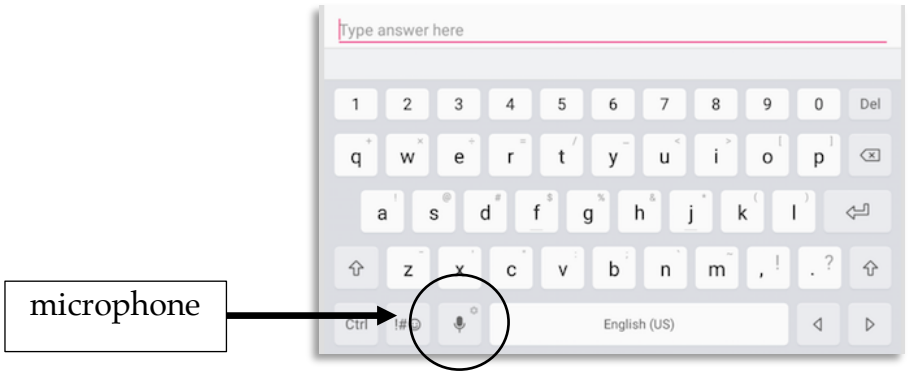


Then, at the end of the day, the Daily Trip Planner will ask you how well you were able to complete your daily travel plans. Do not worry about how to fill out the Daily Trip Planner once you mark the locations you plan to include in your travel: The MyAmble app will walk you through each of the questions you need to answer.

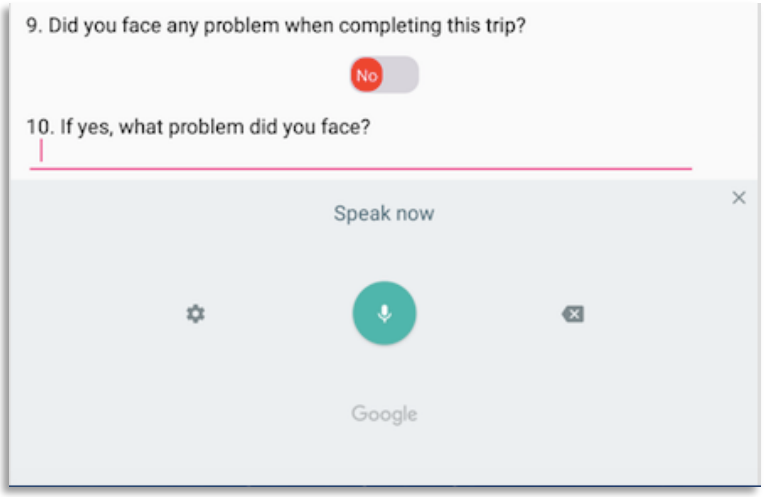
When a question is open-ended, you have a couple of different options for how to provide an answer. You may answer an open-ended question by inputting sentences or phrases through the tablet's keyboard:



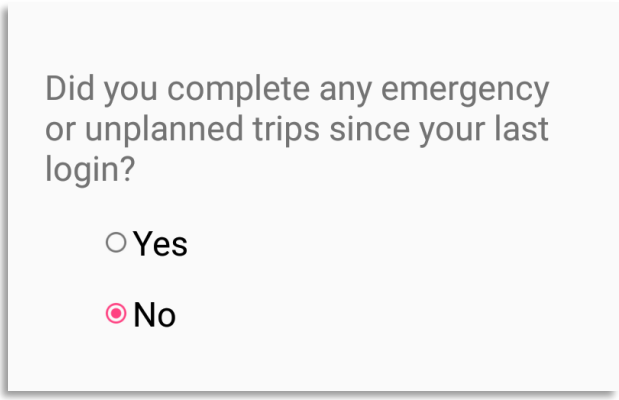
Or, if you would prefer not to type in an answer, you may also make a voice recording for your answer by holding down the little microphone icon that is next to the spacebar that will talk-to-text:



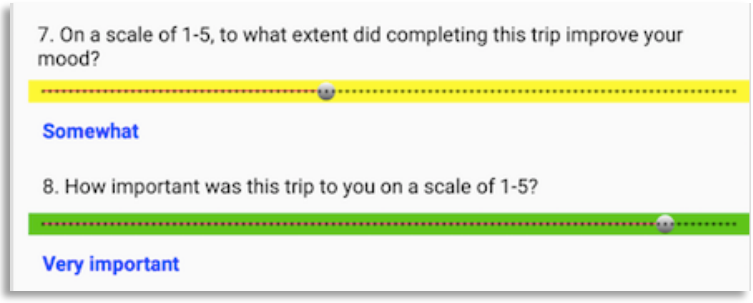
Once you hold down the microphone icon, you may begin recording your answer:



The Daily Trip Planner also has several closed-ended questions. You will be asked to answer yes/no by pressing on a button. The button will turn red when it is selected:



You will also be asked to provide answers on a sliding scale:



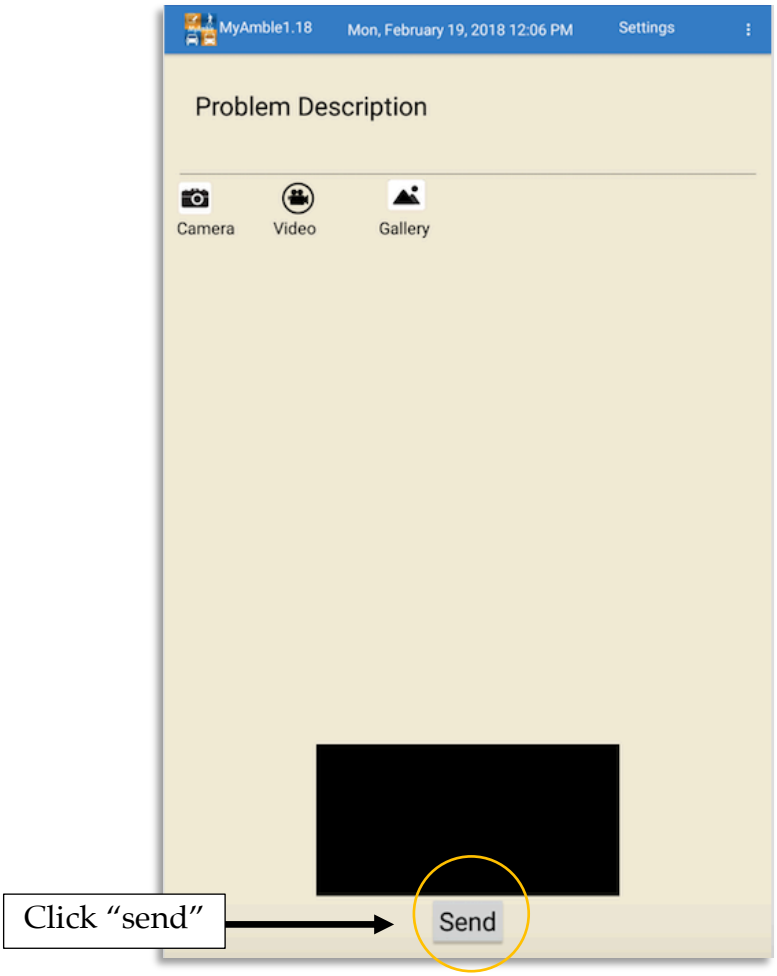
You will complete questions for each of the daily trips you indicate that you had planned. The Daily Trip Planner will walk you through this process for each of the locations you marked as a planned trip.

Additionally, the Daily Trip Planner will ask you whether or not you took any unplanned trips during the course of the day. If you say yes, the MyAmble app will prompt you to answer a series of questions with the same methods pictured above.

Challenge Logger

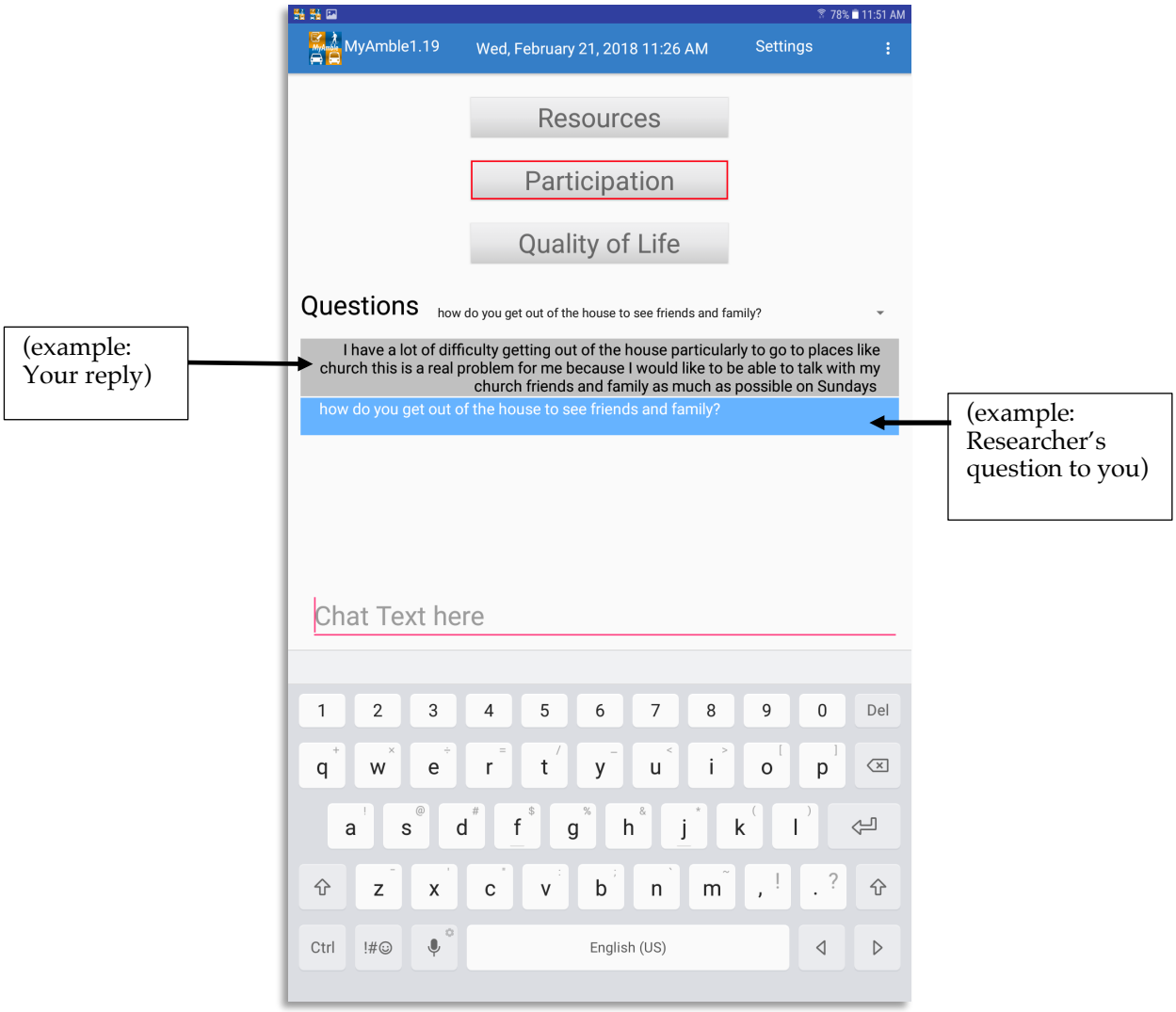
You should access the Challenge Logger component of MyAmble when and if you encounter a challenge while travelling during your day. For example, you may encounter a pothole that makes it impossible for you to cross a sidewalk. Or, you may try to get in a van that does not have wheelchair access. If you encounter these challenges, or any other similar challenges, the Challenge Logger will give you an opportunity to take a picture or video of the challenge.

You may do so by clicking on either the camera or video icon shown in the image below. Make sure that the flash is on when taking pictures. At the top of the screen, you will see a lightning bolt. If you click this icon, it will change the flash setting on the tablet's camera. The lightning bolt with the line through it indicates that the flash is off. The lightning bolt with an *A* beside it indicates that the flash is automatic. The yellow lightning bolt indicates that the flash is on. Or, you may attach an image from your photo gallery by clicking on the "attach from gallery" icon. Then, you can click underneath "problem description" to type information about the challenge you encountered. Click "send" once the image or video is uploaded.

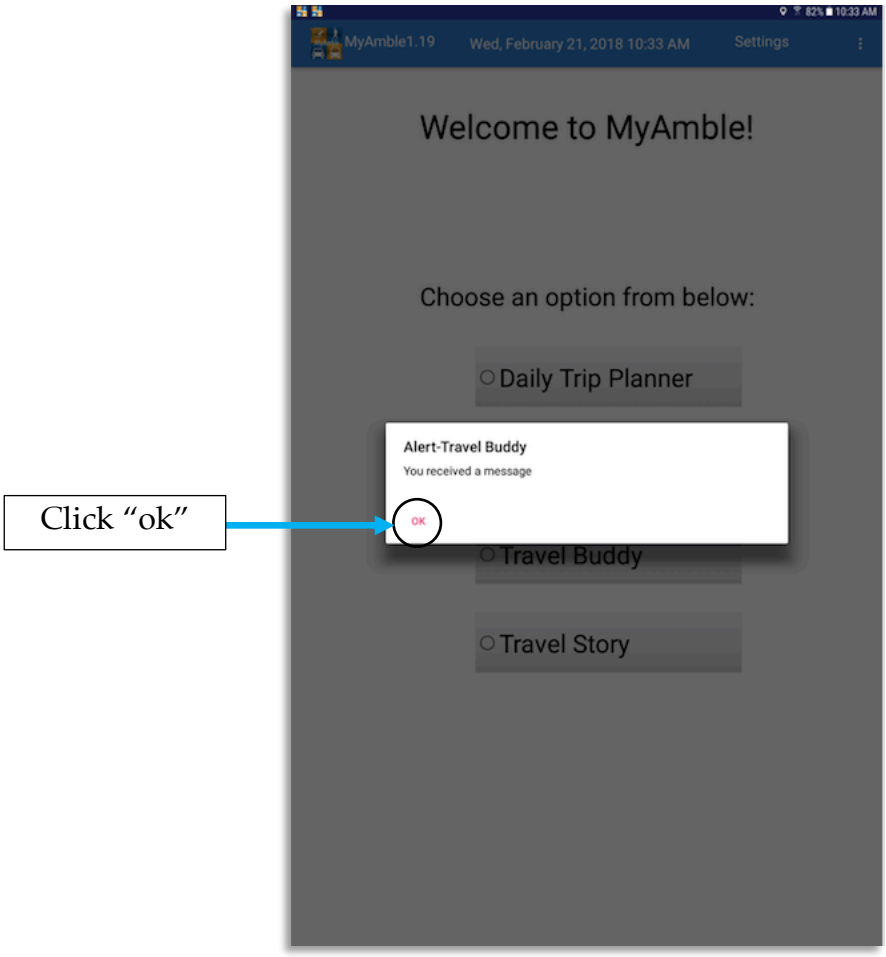


Travel Buddy

The Travel Buddy component of MyAmble is a chat feature that will ask you to answer open-ended questions related to how transportation challenges affect different aspects of your life. Your research team member will ask you questions through the Travel Buddy feature every day or so for you to answer. He or she will try to message you at a time of day that is convenient for you, so please tell your researcher when is best for you. The following picture shows you what this chat looks like on your tablet:



When you hear your tablet play a musical alert notification, this means that you've received a Travel Buddy question that is waiting for your answer. To view the question, click on the MyAmble icon on your tablet and you will see a "pop up" notification, which will take you directly into the Travel Buddy feature when you click "ok." From there, you will be able to answer the question. Or, if you are already in MyAmble , just return to the main MyAmble home screen to see the "pop up" notification and click, "ok." When you click "ok" you will be taken directly to Travel Buddy. The picture below shows what this looks like on your tablet device:



Travel Story

Finally, the Travel Story feature of MyAmble is an opportunity for you to answer questions about your travel memories. Questions posed to you in the Travel Story portion of MyAmble include questions about your first car, first road trip, and more. You do not have to answer all of the questions in one sitting. You can keep returning to Travel Story to fill in your answers to questions throughout the 14-day electronic diary portion of the study. You may answer questions by either typing on the tablet's keyboard or using the voice recorder button. Images of these buttons are included on previous pages if you would like to reference them.

Pen-and-Paper Components

The pen-and-paper travel diary is quite similar to the MyAmble app, except that you will use the provided notebook to answer all questions. The only component of the app that is not likewise included in the pen-and-paper travel diary is the Travel Buddy feature. Thus, it is not possible to message back and forth with your assigned research team member while completing the pen-and-paper travel diary. If you encounter problems, you should still reach out to your assigned research team member by calling him or her.

Daily Trip Planner

The Daily Trip Planner portion of the pen-and-paper travel diary will pose questions about your day's travel plans and experiences. Just like MyAmble, the pen-and-paper version will ask you to answer questions about planned and unplanned travel. You may be asked to answer yes/no questions, scale responses on a scale of 1-5, or provide a sentence or phrase in response to a question.

Challenge Logger

The Challenge Logger in the MyAmble app allows you to take a picture of your transportation challenge. Although the Challenge Logger in the pen-and-paper travel diary does not give you an opportunity to take a picture or video, you will have pages in your notebook that you may use to describe any travel challenges you encounter. If and when you experience a transportation challenge, describe it by writing about it in the Challenge Logger section.

Travel Story

Finally, the Travel Story section of your pen-and-paper travel diary will pose several open-ended questions for you to answer about your travel memories. You may answer these questions throughout the 14-day pen-and-paper travel diary period. You do not need to answer them in one sitting.

Whom Should I Contact with Concerns?

Whom you should contact depends upon the nature of your concern.

If you have questions about the app or the pen-and-paper travel diary, you should contact your assigned research team member:

Name: _____ Phone #: _____

Email:_____

If you have questions about the tablet, you should first reference your tablet's user guide to troubleshoot your problem. If the user guide does not answer your question, you should contact your research team member at the phone they have provided you.

If you have questions or concerns about the research study, or choose to withdraw from the research study, you should contact the Principal Investigator, Dr. Noelle Fields. You may reach

her at 614-947-9783. You can also contact the co-Principal Investigator, Dr. Courtney Cronley. You may reach her at 865-742-1150.

If you have any questions about your rights as a research participant or a research-related injury, you may contact the Office of Research Administration; Regulatory Services at 817-272-2105 or regulatoryservices@uta.edu.

The school and college affiliation of this study is The University of Texas at Arlington, School of Social Work, located at 211 South Cooper Street, Arlington, Texas 76019.

List of Products as of Date of Report

Conference Presentations

1. Murphy, T., Miller, V.J., Rahman, Z., Balasubramanian, M., White, K., & Wills-Thames, E. (June, 2017). "Working on an Interdisciplinary Team to Address the Transportation Experiences of Environmental Justice Populations." Poster presentation accepted for the Transportation Research Center for Livable Communities Fourth Annual Summer Conference.
2. Miller, V.J., Roark-Murphy, E., Kelley, D., Rahman, Z., Reza, S., & Balasubramanian, M. (September, 2017). "Working on an Interdisciplinary Team to Address Transportation Disadvantage among Older Adults." Poster presentation accepted for the National Institute for Transportation and Communities (NITC), 2017 Transportation & Communities Summit.
3. Cronley, C., Fields, N., & Mattingly, S. (September, 2017). Using innovative data collection methods to document transportation disadvantage in environmental-justice populations: An interdisciplinary case study. Poster presented accepted at the National Institute for Transportation and Communities' Transportation and Communities Summit, Portland, OR.
4. Fields, N., Cronley, C., & Mattingly, S. (September, 2017). When you can't get out - Losing opportunities due to transportation disadvantage among environmental justice populations. Poster presented at the National Institute for Transportation and Communities' Transportation and Communities Summit, Portland, OR.
5. Miller, V.J. & Cronley, C. (October, 2017). "Leveraging interdisciplinary research collaborations with social work and engineering to improve quality of life among transportation disadvantaged populations: A Case Study." Poster presentation accepted for the Council on Social Work Education 2017 Annual Program Meeting.
6. Rahman, Z., Mattingly, S., Fields, N., Cronley, C., Miller, V., Balasubramanian, M., & Murphy, E. (April, 2018). "An Innovative Data Collection Approach to Include Low-income, Transportation Disadvantaged Older Adults in the Transportation Planning Process." Paper presentation abstract accepted for the 2018 Annual Transportation Research Forum.
7. Miller, V.J., Murphy, E.R., Gwak, L., Crawford, M., Fields, N., Cronley, C., & Mattingly, S. (April, 2018) "Leveraging App Technology to Measure the Impact of Transportation Disadvantage: A Methodological Case Study." Poster presentation accepted for the 2018 School of Social Work Research Office Student Research Showcase.
8. Rahman, Z., Mattingly, S., Fields, N., Cronley, C., Miller, V., Balasubramanian, M., & Murphy, E. (June, 2018). "Techniques for Assessing Transportation Gaps of Environmental Justice Populations." Paper presentation accepted for 7th Transportation Research Board Conference on Innovations in Travel Modeling.
9. Miller, V.J., Murphy, E., Crawford, M., Gwak, L.B., Reza, S., & Khademi, S. (June, 2018). "Leveraging Social Work Skills to Engage Lower-income Older Adults in Research on the Impact of Transportation Disadvantage." Student poster presentation accepted for the Transportation Research for Livable Communities 2018 Annual Conference.
10. Miller, V.J., Murphy, E.R., & Cronley, C. (July, 2018). "Leveraging innovative interdisciplinary efforts in social work education to improve quality of life among transportation disadvantaged populations." Poster presentation accepted for the SWSD 2018 Social Work, Education and Social Development Conference.
11. Cronley, C., Fields, N., Miller, V.J., & Murphy, E.R. (November, 2018). "Rethinking data collection strategies to document transportation disadvantage - An Interprofessional

Approach." Poster presentation submitted for the Council on Social Work Education 2018 Annual Program Meeting.

12. Fields, N., Cronley, C., Mattingly, S., Miller, V.J., Murphy, E., & Keaton, C. (November, 2018). "Without a ride: Testing the feasibility of app-technology to measure transportation mobility among older adults." Poster presentation submitted for the Gerontological Society of America 2018 Annual Conference.
13. Twis, M., Miller, V.J., & Cronley, C. (January, 2019). "Using Mobile Technologies for Qualitative Data Collection: A Multiple-Case Study." Poster presentation submitted for the 2019 Society for Social Work and Research Annual Conference.

Publications

1. Miller, V.J., Murphy, E.R., Cronley, C., Fields, N.L., & Keaton, C. (accepted, 2018). Student experiences engaging in interdisciplinary research collaborations: A case study for social work education. *Journal of Social Work Education.*
2. Fields, N. L., Cronley, C., & Mattingly, S. P. (2018). *Leveraging App Technology to Measure the Impact of Transportation Disadvantage: A Methodological Case Study*. (U.S.) National Research Council, Transportation Research Board 97th Annual Meeting Online, 18-06073.
3. Twis, M., Miller, V.J., Fields, N., & Cronley, C. (under review, 2018). Implementing a qualitative data collection app among older adults: Report from a pilot study. Submission planned for *Journal of Society for Social Work and Research.*

Webinar

1. Fields, N.L., Cronley, C., & Mattingly, S. (2018). Improving Daily Transportation- Ecological Momentary Assessment (EMA) Strategies. Retrieved from http://nitc.trec.pdx.edu/events/professional-development/webinar-february-2018

Conference Training

1. Cronley, C., Fields, N.L., & Mattingly, S. (2018). Ecological Momentary Assessment Methods with Transportation-Disadvantaged Populations – Leveraging App-based Technologies. National Institute of Transportation Research's 2018 Transportation and Communities Academy.

Meals on Wheels Letter of Support

MEALS ON WHEELS INC of Tarrant County
Carla Jutson
President & CEO
Carla@MealsOnWheels.Org

5740 Airport Freeway
Fort Worth, Texas
76117-6005

Main: 817-336-0912
FAX: 817-338-1066
mealsonwheels.org

Our Mission

To promote the dignity and independence of older adults, persons with disabilities, and other homebound persons by delivering nutritious meals and providing or coordinating needed services.

MEALS ON WHEELS AMERICA 2016 MEMBER

United Way
Community Partner

Delivering meals and so much more...

February 16, 2017

The University of Texas at Arlington
Office of Regulatory Services
202 East Border Street, Ste 201
Box 19188
Arlington, TX 76010

To Whom It May Concern:

I am writing to confirm Meals On Wheels of Tarrant County's support of Dr. Noelle Fields (PI) and the research project entitled: Transportation Mobility Among Low-Income, Transportation Disadvantaged Older Adults Living in a Low Density Urban Environment Using Innovative Data Collection Methods.

Meals On Wheels staff will ask clients who fit the study inclusion criteria if they would be interested in speaking with Dr. Fields (or one of the social work research team members) about the study. If a client grants the staff permission, the staff member will then call Dr. Fields with the names of potential volunteers. None of the staff at Meals On Wheels of Tarrant County will be assisting with participant recruitment, but rather, we will refer potential study participants that might be interested in the project. Dr. Fields and her research team will contact the participants individually to discuss the research study as well as to obtain written consent for participation.

The study procedures, including the use of the Travel Buddy app, will take place with Meals On Wheels clients under the direct supervision of Dr. Fields and her research team. The staff at Meals On Wheels of Tarrant County will not be involved in data collection or data analysis.

If you have any questions please let me know.

Sincerely,

Carla Jutson
President & CEO

Mission Statement
"To promote the dignity and independence of the disabled, the elderly and other homebound persons by delivering nutritious meals and providing or coordinating needed services."

IRB Approved Documents

Recruitment Script for Transportation Diary Study- Meals On Wheels Staff

Hi, my name is _____ (member of Meals On Wheels staff).

The University of Texas at Arlington is conducting a new research study that I wanted to speak with you about today. Could we talk for a few minutes? *If yes, the following will be presented:*
A research team from the University of Texas at Arlington that includes the School of Social Work and College of Engineering are collaborating with Meals On Wheels on a new study. As a part of the study, they are collecting data related to transportation disadvantage among older adults in Ft. Worth and Arlington.
Would you be interested in speaking with a member of the UTA research team further about this research opportunity? With your permission, I would give your name and contact information to Dr. Noelle Fields who is leading the research project. If yes, please tell me the best way for Dr. Fields to reach you. If not, thank you for your time.

Participant Recruitment Script

Hello…

May I speak with (name of Meals On Wheels, Inc. client/Potential participant)?

My name is (member of the research team). I'm part of a research team at the University of Texas at Arlington School of Social Work and the College of Engineering that is conducting a study about transportation in Arlington and Fort Worth, Texas. The study investigator, Dr. Noelle Fields, is a social worker and a faculty member at UT Arlington who teaches and conducts research about older adults and transportation mobility. You've been contacted because a caseworker at Meals On Wheels indicated that you are interested in participating in our study. Would you like to hear more about the purpose of the study and how you might be able to participate?

If no: We appreciate your time. Goodbye.

If yes: Thank you. This study is funded by a grant from the Transportation Research Center for Livable Communities. Our research will contribute to the overall goals of adopting evidence-informed transportation policy initiatives by the Cities of Arlington and Fort Worth and the North Central Texas Council on Government's Access North Texas Plan for improving transportation mobility for transportation disadvantaged older adults.

Do you have any questions so far?

If yes: (Address the question(s) at hand)

If no: We will be conducting a study with 25 residents of Arlington and Fort Worth, Texas who are at least age 60 and older. We have designed a digital, daily transportation diary app for older adults to capture data related to their transportation experiences. Study data will be collected in three ways: (1) baseline interviews; (2) daily diaries maintained for one month (28 days); and (3) exit interviews conducted 3 months after the daily diaries conclude.

The main component of the study is the daily diaries. For 14 days, you will be asked to use a digital tablet and app to answer a variety of open and close ended questions related to your daily transportation experiences, travel memories, and how transportation disadvantage affects your access to resources/social participation/quality of life. For the other 14 days of the study, you will be asked to record your answers using a traditional pen-and-paper travel diary with similar questions as the electronic diary. You will spend approximately 30-90 minutes completing your diary entries every day for 28 days.
All the information gathered will be de-identified by the research team and collated so that you cannot be linked to the study results. Your privacy and confidentiality will be a top priority to all members of the research team. For your participation, you will receive a $40 Wal-Mart card.

Do you have any questions or concerns?

If yes: (Address the question(s) at hand)

If no: Would you be willing to be a part of this project? If yes, please tell me when we can meet to sign the consent form for this study.

If no: Thank you for your time. Goodbye.

If yes: What day of the week and time of the day is most convenient for you? (Schedule a time for interview). May we call to confirm the appointment when the date gets closer? Is this the best number to reach you? Can you confirm your address?

Do you have any additional questions?

If yes: (Address the question(s))

If no: We look forward to meeting with you on (date of scheduled interview)

Thank you! Goodbye.

Informed Consent

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PRINCIPAL INVESTIGATOR

Noelle L. Fields, PhD, LCSW, Assistant Professor
noellefields@uta.edu
School of Social Work, The University of Texas at Arlington, 211 South Cooper Street, Box 19129, Arlington, TX 76019

CO-PRINCIPAL INVESTIGATORS

Courtney Cronley, PhD, Assistant Professor
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School of Social Work

Stephen Mattingly, PhD, Associate Professor
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Department of Civil Engineering

TITLE OF PROJECT

Transportation Mobility Among Low-Income, Transportation Disadvantaged Older Adults Living in a Low Density Urban Environment Using Innovative Data Collection Methods

INTRODUCTION

You are being asked to participate in a research study that explores the impact of transportation disadvantage on your quality of life. Transportation disadvantage means that you experience problems accessing transportation due to personal and environmental factors. Your participation is voluntary. Refusal to participate or discontinuing your participation at any time will involve not penalty or loss of rights in which you are entitled. Please ask questions if there is anything that you do not understand.

PURPOSE

The specific purpose of this research study is to explore your lived experience of having problems accessing transportation. Data will be collected an electronic diary (e.g. tablet) and a traditional pen and paper diary.

DURATION

You will be asked to complete a background questionnaire and a training on how to fill out the travel diaries. This will take approximately 60-90 minutes of your time. After your training is complete, your will be asked to maintain a pencil-and-paper transportation diary for two weeks and an electronic diary for two weeks (28 days total). It is expected that you will spend approximately 30-90 minutes each day answering questions on the pen-and-paper diary or the electronic diary. After you complete the 14 days with the electronic diary, you will be given a brief user survey that will take approximately 15 minutes to complete. Finally, you will also be

asked to complete a face-to-face exit interview 3 months later that will take approximately 30 minutes to complete.

NUMBER OF PARTICIPANTS

The number of anticipated participants in this research study is 25.

POSSIBLE BENEFITS

By participating in the study, you may not have any direct benefits but you will have the potential benefit of contributing to the development of an app to collect important data that will inform future studies of how to better meet the transportation needs of older adults. You may also learn new technological skills related to using a tablet device.

POSSIBLE RISKS/DISCOMFORTS

Should you experience any discomfort please inform the researcher, you have the right to quit any study procedures at any time at no consequence. The anticipated risks of participating in this study are minimal. However, if you experience emotional distress during the interview, members of the research team may refer you to additional services through the Area Agency on Aging. The Area Agency on Aging provides information and assistance, benefits counseling, ombudsman and case management for senior citizens: (817) 258-8081, 210 East 9th Street; Fort Worth, Texas 76102.

Your location will be tracked using the GPS in the tablet, which may pose a risk to your privacy. In order to minimize the risks posed to your privacy, you have the option to not have the location recorded for a day/time that you choose by turning off this function on the tablet or by communicating with the researchers that you do not want location data to be included on a particular day/time.

COMPENSATION

All participants will receive weekly $5 gift cards to Wal-Mart as compensation for their time in addition to $10 gift cards during the exit interviews. Total compensation for each participant will be $40.00 in gift cards. A member of the research team will bring you your gift card every week to your home. Participants will also receive information about transportation resources after the daily diary period. As a participant, you are responsible for documenting/reporting this incentive as taxable income when you file your taxes with the U.S. government.

PROCEDURES

1) On your first visit with a member of the research team, you will be asked to complete a questionnaire. Items on the questionnaire will ask you a variety of questions related to your demographics (age, gender, race etc.), and electronic/internet use. Completing the questionnaire will take approximately ten to fifteen minutes. Following the questionnaire, you will complete a face-to-face training with a UT Arlington graduate research assistant on how to use the digital diary and its features. Completing the training will take approximately 60-90 minutes.

2) For the following 14 days, you will be participating in interviews with a member of the research team through the app to discuss your experiences with transportation. You will be asked to record your interview answer using the digital diary. Interview questions will include questions about the methods you use to travel then what daily issues you experience during your time of travel. You will also be asked about the importance of your daily travel (both planned and unplanned trips). Finally, through the app, a member of the research team will send you specific interview questions to answer about how your experiences with transportation affects your access to resources (e.g. shopping, visiting with friends/family, and your overall quality of life). The interview time will vary in time but will take no longer than 90 minutes per day. With your permission, the interview will be audio recorded using the app. Because audio recording your responses is vital to the study, if you do not want to be audio recorded then you may decline participation in this study. All interview recordings and interview transcriptions will remain confidential and will only be accessed by the members of the research team. The location feature (i.e. GPS) will be turned on while you use the digital diary in order to help you identify the precise location of your daily travels- for example, if you don't know the address of the grocery store the app will provide you with the location of the grocery store. We would like for you to take the tablet with you when you travel so that we will be able to better understand your transportation experiences using the GPS feature of the digital tablet.

3) We will ask you to take photos or videos during the 14 days that you are using the digital diary of any transportation barriers that you may encounter in your environment such as a pot hole or missing sidewalk.

4) During the 14 days with the digital diary, we will ask you to answer open-ended questions about your travel memories (e.g. first car, first road trip). You will record your answers using the app. It is expected that the travel memories will take approximately 60-90 minutes total time to record at your convenience during the 14 days that you have the tablet device. After completion of the 14 days using the digital diary, you will be asked to return the device to a member of the UT Arlington research team.

5) We would ask that you complete a brief 10-15 minute user-feedback survey at the end of the 14 days that you use the digital diary.

6) As part of the study, you will be asked to use a pen-and-paper diary to share about your experiences with transportation for 14 days. During these 14 days, you will be given a notebook with pages that ask you questions related to your transportation experiences that are similar to what you will be asked during the 14 days that you use the electronic diary.

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7) Three months after you have finished both the electronic and pen-and-paper diaries, you will be asked to complete a 30 minute face-to-face exit interview with a member of the research team. We will ask you questions about your transportation experiences over the past three months since completing the diaries.

ALTERNATIVE PROCEDURES
There are no alternative procedures offered for this study. However, you can elect not to participate in the study or quit at any time at no consequence.

VOLUNTARY PARTICIPATION
Participation in this research study is voluntary. You have the right to decline participation in any or all study procedures or quit at any time at no consequence. Should you choose not to complete all study procedures, you will still receive the gift card for the part of the interview that you completed. Your participation in this research study will not impact any services that you are currently receiving or may receive in the future from any social service or healthcare agencies. The members of the UTA research team are not formally affiliated with Meals On Wheels.

CONFIDENTIALITY
Every attempt will be made to see that your study results are kept confidential. A copy of this signed consent form and all data collected from this study will be stored in the locked offices of Noelle Fields, PhD, LCSW in the University of Texas at Arlington School of Social Work for at least three years after the end of this research. The data collected from your tablet device will be temporarily stored on the Amazon Cloud, AWS. All of the data will be anonymized, password protected and encrypted. Only your participant study ID will be used and none of your personal user information will be stored (no names, no social security numbers, etc.). Data will not be stored, on the cloud service provider, AWS, for more than a few hours and it will then be downloaded to UTA encrypted laptops for further analysis.

The results of this study may be published and/or presented at meetings without naming you as a participant. However, the results of the study will only provide a summary of the findings and will not include any information that will identify you as a study participant. Additional research studies could evolve from the information you have provided, but your information will not be linked to you in anyway; it will be anonymous. Although your rights and privacy will be maintained, the Department of Social Work at the University of Texas at Arlington (UTA) and the Department of Civil Engineering at UTA, the Department of Computer Science at UTA, the UTA Institutional Review Board (IRB), and personnel to this research have access to the study records. Your records will be kept completely confidential according to current legal requirements. They will not be revealed unless required by law, or as noted above. The Institutional Review Board (IRB) at UTA has reviewed and approved this study and the information within this consent form. If in the unlikely event it becomes necessary for the IRB to review your research records, the University of Texas at Arlington will protect the confidentiality of those records to the extent permitted by law. By law, social workers are mandated reporters of suspected elder abuse or neglect. The only exception to confidentiality in this study is if there is a

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suspicion of elder abuse or neglect and the researchers will be mandated to report this to the Texas Department of Adult Protective Services.

CONTACT FOR QUESTIONS
Questions about this research study may be directed to Noelle Fields at (614) 947-9783. Any questions you may have about your rights as a research participant or a research-related injury may be directed to the Office of Research Administration; Regulatory Services at 817-272-2105 or regulatoryservices@uta.edu.

As a representative of this study, I have explained the purpose, the procedures, the benefits, and the risks that are involved in this research study:

_____
Signature and printed name of principal investigator or person obtaining consent **Date**

CONSENT

By signing below, you confirm that you are 18 years of age or older and have read or had this document read to you. You have been informed about this study's purpose, procedures, possible benefits and risks, and you have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree to participate in this study. By signing this form, you are not waiving any of your legal rights. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or loss of benefits, to which you are otherwise entitled.

_____
SIGNATURE OF VOLUNTEER **DATE**