



## **THE RUDERMAN WHITE PAPER**

# **SELF-DRIVING CARS: THE IMPACT ON PEOPLE WITH DISABILITIES**

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## The Ruderman Family Foundation

One of our goals at the Ruderman Family Foundation is to change the public’s awareness of people with disabilities. More specifically, we make the argument that full inclusion of people with disabilities is not a matter of charity, but of civil rights. We researched this White Paper in order to further the awareness around this civil rights movement. We believe that the results we found will meaningfully contribute to the conversation around the need for technology developers to keep the disability community in mind as they continue to innovate and advance.

## Our Mission

The Ruderman Family Foundation believes that inclusion and understanding of all people is essential to a fair and flourishing community. Guided by our Jewish values, we support effective programs, innovative partnerships, and a dynamic approach to philanthropy in our core area of interest: advocating for and advancing the inclusion of people with disabilities in our society. The Foundation provides funding, leadership, expertise and insight in the U.S. and Israel, with offices in both countries. Visit us at: <http://www.rudermanfoundation.org>.

## Securing America’s Future Energy

Securing America’s Future Energy (SAFE) is a nonpartisan, not-for-profit organization committed to reducing America’s dependence on oil and improving U.S. energy security in order to bolster national security and strengthen the economy. SAFE believes that autonomous vehicles will lead to greater utilization of advanced fuels like electricity and natural gas. This will ultimately end the monopoly of and drastically reduce demand for oil in the transportation sector while virtually eliminating crash fatalities and granting new mobility to millions of Americans. SAFE has an action-oriented strategy addressing politics

and advocacy, business and technology, and media and public education. More information can be found at [secureenergy.org](https://secureenergy.org).

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## Language Disclaimer

We at the Ruderman Family Foundation want to acknowledge that language use in the context of disabilities is an important issue that generates both strong discussion and strong feelings. The most frequent point of contention is whether people-first or identity-first language should be used. While it is our policy at the Ruderman Family Foundation to use

people-first language (i.e. a person with a disability), we acknowledge that several segments of the disability community prefer identity-first language (i.e. a disabled person). The authors of this Ruderman White Paper have chosen to use person-first language which is bound not to be favored by some segments of the disability community. We are aware of these differences and, in the absence of any consensus, acknowledge and respect both perspectives. The Ruderman Family Foundation and the writers of the Ruderman White Paper denounce the use of any stigmatizing or derogatory language.

## Summary

- In the United States, approximately one in every five people, or more than 57 million, has a disability. This includes the more than 3.8 million veterans with a service-connected disability. The most recent government transport survey indicated that six million individuals with a disability have difficulty getting the transportation they need.
- Transportation is a key community-based support that allows individuals to fulfill their civic responsibilities and makes it possible to enjoy one's civil rights. When a disability limits transportation options, this can result in reduced economic opportunities, isolation that exacerbates medical conditions or leads to depression, and a diminished quality of life.
- Mitigating transportation related obstacles for individuals with disabilities would enable new employment opportunities for approximately 2 million individuals with disabilities, and save \$19 billion annually in healthcare expenditures from missed medical appointments. This is in the context of the anticipated broader impacts of autonomous vehicles: \$1.3 trillion in savings from productivity gains, fuel costs, and accident prevention, among other sources.
- As new transportation technologies such as on-demand mobility solutions and, in the near future, autonomous vehicles enter the mainstream they offer significant potential for reducing transportation obstacles for Americans with disabilities.
- Across the country, autonomous vehicle legislation is being discussed, but little attention is being given to the role this technology can play in serving individuals with disabilities. There is a need for the disability community to organize, learn more about the technology, and enhance its advocacy efforts. Additionally, there is a need for technology developers to become better educated on the need and value of designing their vehicles with the disability community in mind.

## Section 1: Transportation's Evolving Role in Society

### Transportation's Role in Society

Many Americans take reliable transportation for granted. We may complain about heavy traffic or overcrowded public transportation systems, but for the most part we get where we need to go in a manner that does not interfere with our daily activities. In the United States there is more than one car for every licensed driver.<sup>1</sup> This reflects the reality that individuals need transportation to participate effectively in the modern economy and to maintain an enriching social life. Mitchell Ross, a transportation expert at New York University, recently stated that in New York City, "it's far more important to have a MetroCard than a college degree" for economic mobility.<sup>2</sup>

The transportation sector is one of the largest in the United States, interacting with nearly every facet of the economy. To better envision this scale, it helps to realize that one in seven jobs is transportation related.<sup>3</sup> Investment in transportation technology is also directly tied to increases in national productivity and U.S. economic growth. For example, the completion of the transcontinental railroad in 1869 reduced cross-country travel times from months to days and led to the urbanization of the Midwest.<sup>4</sup> The construction of the interstate highway system in the 1950s returned more than \$6 in economic productivity for every \$1 spent.<sup>5</sup> Today, transportation's role in the economy has arguably never been more important. Last year, both personal automobile sales and U.S. vehicle miles traveled (VMT) stood at all-time highs.<sup>6</sup> However, while the United States has made great strides in increasing the accessibility of transportation, access still remains off-limits to many in the disability community.

The most recent government transport survey conducted in 2003 indicated that 15 million Americans have difficulty getting the transportation they need, including more than six million individuals with disabilities.<sup>7</sup> Problems with obtaining access to transportation

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<sup>1</sup> U.S. Census Bureau, American Community Survey.

<sup>2</sup> Gothamist, "Public Transit Helps New Yorkers Earn More Money," January 2015.

<sup>3</sup> Note: Accounting for \$1.6 trillion of spending, or 10% of the GDP, behind only housing, healthcare, and food. One in seven jobs is transportation related (Bureau of Transportation Statistics, "Economic Impact on Transportation.").

<sup>4</sup> History.com, "Transcontinental railroad completed," 2009; and Jeremy Atack, Fred Bateman, Michael Haines, Robert Margo, "Did Railroads Induce or Follow Economic Growth? Urbanization and Population Growth in the American Midwest, 1850-60," The National Bureau of Economic Research, January 2009.

<sup>5</sup> Federal Highway Administration, Public Roads, July/August, 1999.

<sup>6</sup> Federal Highway Administration, "U.S. Driving Tops 3.1 Trillion Miles in 2015, New Federal Data Show," Press Release, February 22, 2016.

<sup>7</sup> Bureau of Transportation Statistics, "Transportation Difficulties Keep Over Half a Million Disabled at Home," April 2003.

disproportionately affect individuals with disabilities, indicating that systemic barriers exist, which may, in turn, contribute to lower rates of employment, education, and income.<sup>8</sup> In particular, for a large subset of the disability community, many modes of transportation remain either inaccessible, unreliable, or ill-suited toward some or all of their transportation needs. Keith Jones' story below puts into perspective the difficulties individuals with disabilities face on a daily basis when attempting to utilize transportation services.

Keith Jones, a resident of Boston, grew up in the 1970s and witnessed a school system that, for the most part, segregated children with severe disabilities from those without. Due to his cerebral palsy, which affects his ability to control his muscles, he attended a separate school for children with disabilities. Today, even though much progress has been made with the passing of the Americans with Disabilities Act (ADA), Jones still believes that accessible transportation for individuals with disabilities lags behind.

On the topic, Jones said, "I have kids to care for. Trying to get everyone to travel somewhere together is a challenge. I can't even plan a short trip using paratransit because paratransit is only for me and my aide, **not** me, my aide, and my family. So, a family that doesn't have accessible transportation just can't go out. I can't book a reservation for a family of four and then be confident that the ride will be there. I usually plan three or four backup plans if I want to go somewhere and need to be on time."

Even seemingly mundane trips outside can be a challenge. Jones explained, "In some places, you almost have to have no fear. You have to have a daredevil mentality in some cities where the accommodations are not necessarily complete. Particularly when there is inclement weather. I have to make an assessment of whether the challenges I am going to face are worth the effort of dealing with a possible broken elevator, a bus driver that doesn't know how to accommodate my wheelchair, or a train full of people. I have to make a lot of assessments prior to making the decision to even leave my house."<sup>9</sup>

Keith Jones, President of SoulTouchin' Experiences

As new transportation technologies such as on-demand mobility solutions and, in the near future, autonomous vehicles (AVs) enter the mainstream, they offer increased potential for reducing transportation barriers for Americans with disabilities. Capitalizing on these technologies will help a large segment of the population reach its full potential and increase their contributions to society, in turn strengthening our social fabric and economy. The

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<sup>8</sup> Id.

<sup>9</sup> SAFE interview with Keith Jones on October 7, 2016.

following sections will document ways in which the current transportation system fails individuals with disabilities and outlines the potential benefits of full integration through emerging technologies.

## Section 2: Transportation Obstacles for the Disability Community

### Legal Rights to Transportation

The Americans with Disabilities Act (ADA) provides some civil rights protection for people with disabilities. It prohibits discrimination in all areas of public life, including jobs, schools, transportation, and all public and private places that are open to the general public.<sup>10</sup> The law was intended to ensure that people with disabilities have the same rights and opportunities as everyone else. In the case of transportation, Title II of the ADA states that public transportation offered by a state or local government must provide the same services to people with disabilities as those without.<sup>11</sup> If a private company offers those transportation services, Title III of the ADA ensures equal access to public accommodations and services operated by that private entity.<sup>12</sup> In other words, people with disabilities legally have a right to access the same transportation opportunities as people without.

The role of transportation in facilitating an individual's ability to exercise her or his civil rights is too important to be underestimated. Congress, in its findings when passing the ADA legislation, stated that, "...the Nation's proper goals regarding individuals with disabilities are to assure equality of opportunity, full participation, independent living, and economic self-sufficiency for such individuals."<sup>13</sup> For those in our society that cannot drive a car, the current transportation infrastructure makes it almost impossible for these individuals to realize the full promise of the ADA.

### Disability in the United States

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<sup>10</sup> DOJ, Civil Rights Division, "The Americans with Disabilities Act of 1990 and Revised ADA Regulations Implementing Title II and Title III.

<sup>11</sup> ADA National Network, "An Overview of the Americans with Disabilities Act," 2015.

<sup>12</sup> Id.

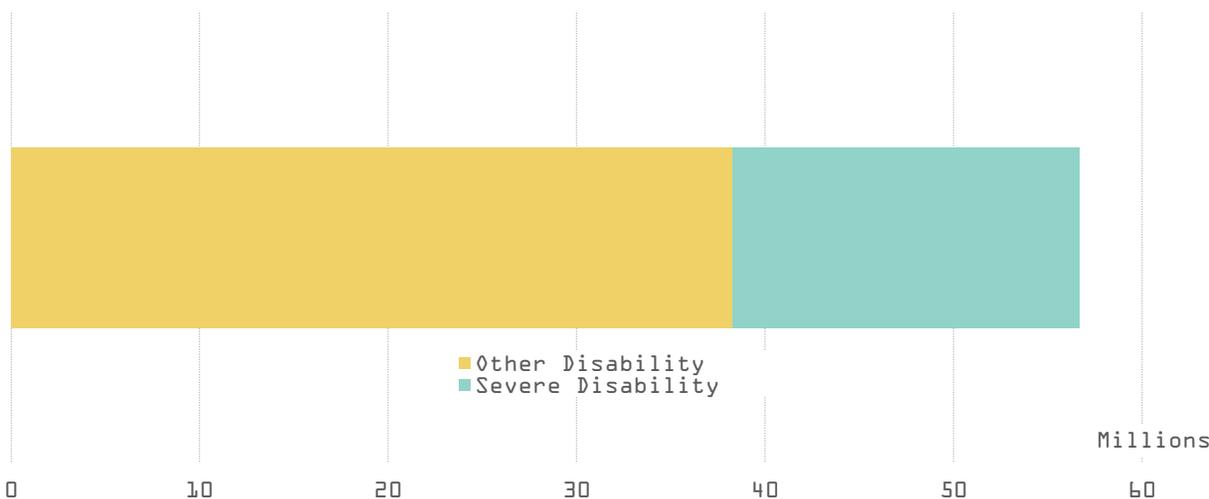
<sup>13</sup> Michael Morris, "Building a Better Economic Future: A Progress Report for Individuals with Disabilities and Their Families in America," Southern New Hampshire University and Center for Economic Development, 2008, at 10.

## The Impact On People With Disabilities

Approximately one in every five people, or more than 57 million, has a disability in the United States. This includes the more than 3.8 million veterans with a service-connected disability.<sup>14</sup> More than half of the population with a disability reports their disability “severely” limits at least one functional or participatory activity, as seen in Figure 1.<sup>15</sup> While various organizations segment those in the disability community differently, it is important to understand how prevalent each type of disability is. Figure 2 utilizes Census Bureau data to illustrate the population with each type of disability. There are six disability types: hearing difficulty, vision difficulty, cognitive difficulty, ambulatory difficulty, self-care difficulty, and independent living difficulty. Further definitions of each disability type are defined in the table on page nine.<sup>16</sup>

Individuals with disabilities often face obstacles to full integration into society that can be mitigated, reduced, or eliminated when the proper accommodations are made. Access to transportation is a key need for all Americans, and is an area where society can and should find better solutions.

Figure 1 · Population with a Disability by Severity, 2010



Source: Census Bureau, 2010

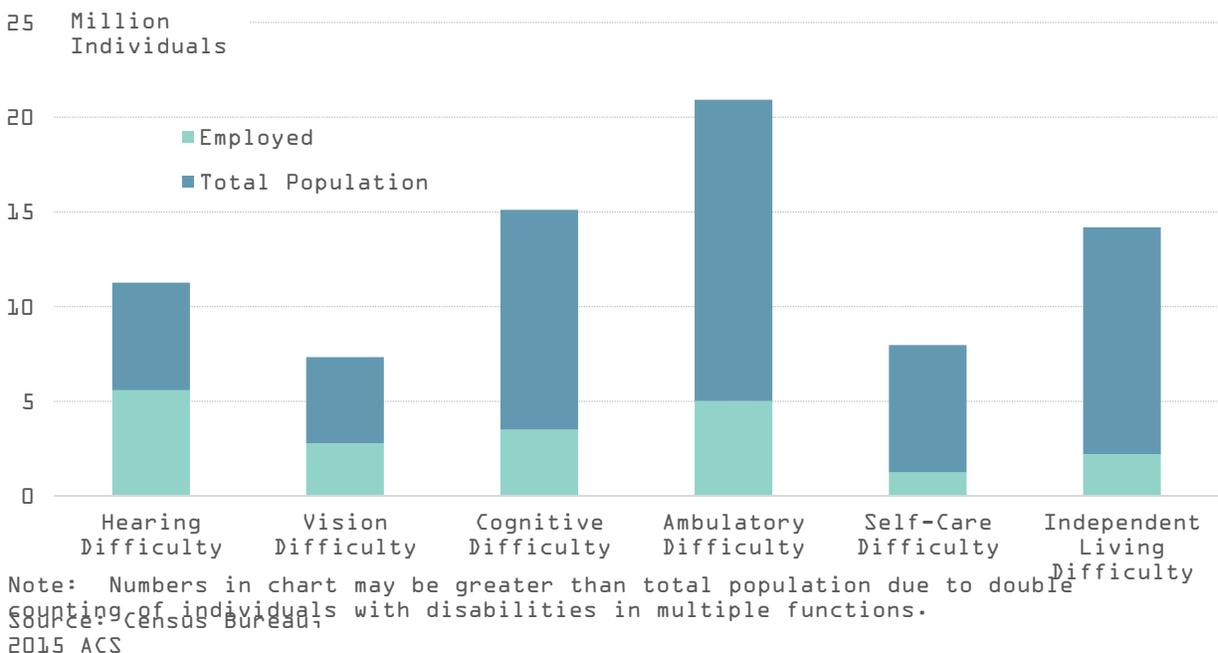
Figure 2 · Estimated Population with a Disability by Type and Employment Status,

<sup>14</sup> Census Bureau, American Community Survey, 2015 Estimate.

<sup>15</sup> Elizabeth A. Courtney-Long et. Al, CDC, “Prevalence of Disability and Disability Type among Adults — United States, 2013,” July 31, 2015.

<sup>16</sup> American Community Survey, “Disability History and Methodology.”

# The Impact On People With Disabilities



Approximately 40 percent of those who report difficulties accessing transportation are people with disabilities.<sup>17</sup> Roughly 20 percent of the population has a disability, which means a disproportionate fraction of the population with disabilities has difficulty accessing transportation, demonstrating that the civil right of equal access is not readily available to people with disabilities.

There is overwhelming evidence that individuals with disabilities experience limitations with access to transportation. While not all individuals with disabilities face transportation challenges, many of them do, particularly those with severe cognitive, mobility, or vision impairments. And while having a disability has the potential to present significant obstacles and limits options for mobility, it should not lead to reduced economic opportunities, social exclusion, or a diminished quality of life. Unfortunately for many, it does.

Table 1 · Disability Segmentation and Definitions

Current U.S. Census Disability Segmentation	
Hearing Difficulty	Deaf or having serious difficulty hearing (DEAR).
Vision Difficulty	Blind or having serious difficulty seeing, even when wearing glasses (DEYE).
Cognitive Difficulty	Because of a physical, mental, or emotional problem, having difficulty remembering, concentrating, or making decisions (DREM).

<sup>17</sup> Bureau of Transportation Statistics, "Transportation Difficulties Keep Over Half a Million Disabled at Home," April 2003.

Ambulatory Difficulty	Having serious difficulty walking or climbing stairs (DPHY).
Self-Care Difficulty	Having difficulty bathing or dressing (DDRS).
Independent Living Difficulty	Because of a physical, mental, or emotional problem, having difficulty doing errands alone such as visiting a doctor's office or shopping (DOUT).

### Social Impacts

In an ideal world, the protections of the ADA would ensure access to transportation. The reality, however, is that most forms of both public and private transportation remain far less than fully accessible, reliable, or convenient to the disability community. Such challenges lead to reduced mobility for many individuals with disabilities, which can often result in social isolation. There are approximately 3.5 million individuals who never leave their home, including 1.9 million with disabilities, as shown in Figure 3.<sup>18</sup> Many of these individuals tend to be older, have more severe disabilities, and have already expressed mobility difficulties.<sup>19</sup> Ultimately, it is to the detriment of society that the participation and contributions of such a large segment of the population are stifled.

Research has linked social isolation to increased problems with mental health and even early death.<sup>20</sup> In 2014, 44 percent of those with a disability also reported experiencing depression at least once in their lives, while only 11 percent without a disability reported the same.<sup>21</sup> While depression is often a psychological disability in and of itself, it is important to think of it as a comorbidity, as people with a significant functional impairment may live with depression due to isolation as a direct result of a lack of mobility options. While transportation is not the sole cause of social isolation, it is a major contributor.<sup>22</sup>

Figure 3 · Weekly Frequency of Trips Outside

<sup>18</sup> DOT, Bureau of Transportation Statistics.

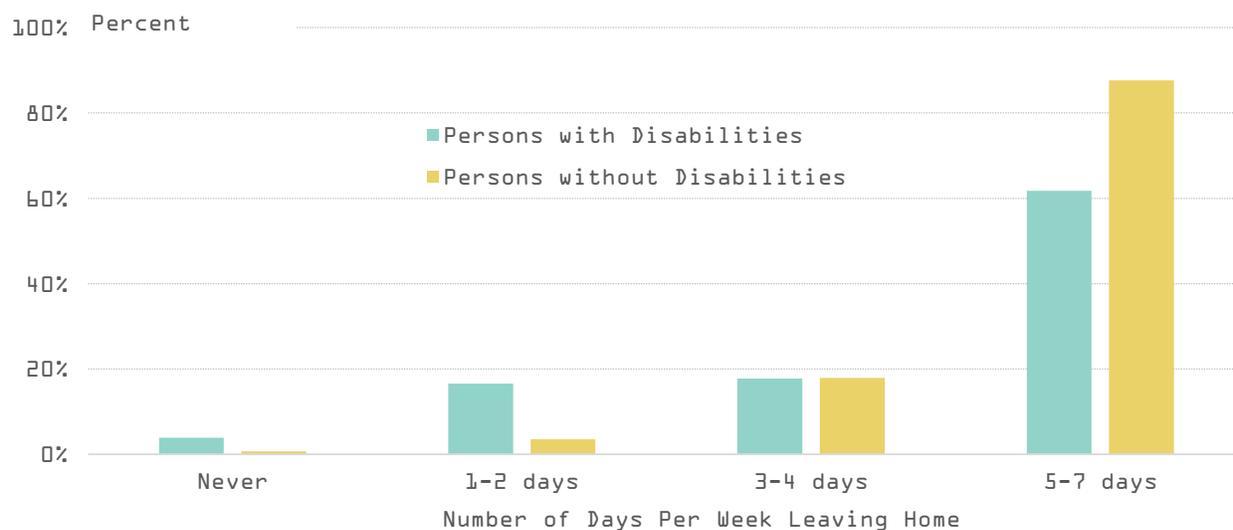
<sup>19</sup> Id.

<sup>20</sup> Maia Szalavitz, "Social Isolation, Not Just Feeling Lonely, May Shorten Lives," Time Magazine, March 26, 2013; and Ichiro Kawachi and Lisa F. Berkman, "Social Ties and Mental Health," Journal of Urban Health (2001).

<sup>21</sup> CDC, Disability and Health Data System.

<sup>22</sup> Susan Kenyon, Glenn Lyons, and Jackie Raffety, "Transport and social exclusion: investigating the possibility of promoting inclusion through virtual mobility", *Journal of Transport Geography* (2002).

## The Impact On People With Disabilities



Source: DOT, Bureau of

### Transportation Disparities

In a 2003 survey conducted by the U.S. Department of Transportation, individuals with disabilities were more likely to report obstacles with nearly every aspect or mode of the transportation system.<sup>23</sup> Nearly 20 percent reported that their disability makes transportation difficult to use, while no or limited public transportation was the most frequent complaint about the transportation system.<sup>24</sup> Furthermore, 45 percent did not have access to a passenger vehicle.<sup>25</sup>

The unsurprising result is that individuals with disabilities travel much less than individuals without disabilities. In the same Department of Transportation survey, people with disabilities reported using every mode of transportation less often, as seen in Figure 4, with the exception of taxicabs and personalized motor transportation, such as electric wheelchairs, scooters, or golf carts.<sup>26</sup>

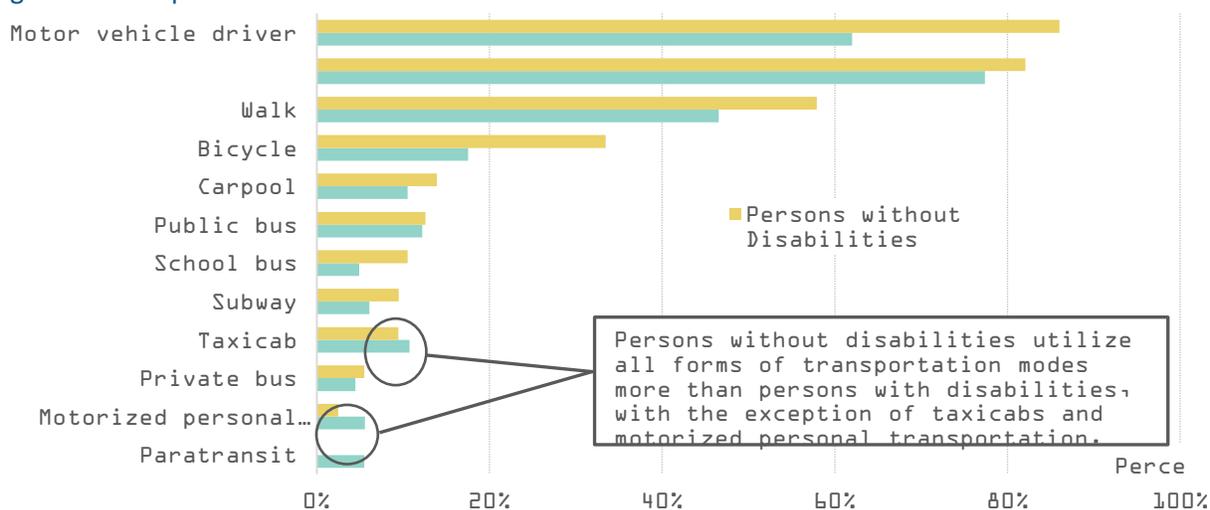
<sup>23</sup> DOT, Bureau of Transportation Statistics.

<sup>24</sup> Id.

<sup>25</sup> Bureau of Transportation Statistics, "Transportation Difficulties Keep Over Half a Million Disabled at Home," April 2003.

<sup>26</sup> DOT, Bureau of Transportation Statistics.

Figure 4 · Transportation Modes Used in the Past Month for Local Travel



Source: DOT, Bureau of Transportation

### Barriers to Transportation

In general, the availability of multiple modes of transportation allows individuals to mix and match modes based on their need for speed, reliability, and cost. For many individuals with disabilities, some or all modes present obstacles, reducing choice and making many trips impractical and excessively costly. Each mode presents unique obstacles.

#### Inability to Drive

Driving a car is not an option for many individuals with visual impairments, ambulatory difficulties, cognitive disabilities, or other disabilities. Special retrofits of vehicles allow some individuals to drive. For example, an individual with paraplegia might be able to drive with a retrofit that allows for arms-only control of the car. On the other hand, a blind individual would be unable to drive any available car right now, making them dependent on others for vehicle transportation. For some individuals who are wheelchair users, in addition to being dependent on others to drive them, vehicle retrofits are often required for them to ride as passengers. More than one third of individuals with a disability report that they are not active drivers, a rate almost triple those without a disability.<sup>27</sup>

The cost of retrofitting a car is a key factor behind lower vehicle ownership rates for some in the disability community. This is because the cost of modifying a vehicle for accessibility can range from \$20,000 on the low end up to \$80,000 for those requiring substantial modifications.<sup>28</sup> This is on top of the purchase price of the vehicle. While small grants from automakers (usually around \$1,000) and government-backed loans with favorable terms do

<sup>27</sup> Bureau of Transportation Statistics.

<sup>28</sup> NHTSA, "Adapting Motor Vehicles For People With Disabilities," December 1999.

exist for individuals needing additional support, this still represents an immense cost.<sup>29</sup> Individuals with disabilities are considerably more likely to have lower incomes or live in poverty, so for many, the cost of a vehicle retrofit, or hiring a driver through a taxi company on a regular basis, remains out of reach.

#### *Lack of Accessible Public Transportation*

While public transportation can serve those who cannot drive themselves, it again presents many obstacles for people with disabilities. For example, even though most buses are built to be accessible to individuals with disabilities, in many areas bus stops are not fully suitable for wheelchair access.<sup>30</sup> Many individuals may also experience problems with broken sidewalks, no sidewalks at all, or curb cuts that are in disrepair.<sup>31</sup> Even when a train station has accessible elevators, they are often out of service at any given stop, meaning passengers must travel an entire stop further and backtrack by other means. In New York City alone, the transit agency reported that in only a three-month span in 2014 there were 2,646 elevator outages, and 6,354 escalator outages.<sup>32</sup> Additionally, depending on geographic location, public transportation may not even be an option, particularly in rural areas.

#### *Inconsistent or Inconvenient Paratransit Services*

Paratransit, while offered to individuals with disabilities as required by the ADA, consists of small vehicles or buses that similarly run on fixed routes. In addition, most paratransit systems offer demand response services, though they can hardly be viewed as that. Paratransit services often service multiple users at once, meaning multiple hours could be added to one's trip as other passengers are dropped off or picked up. There is often no guaranteed pick up or drop off time, and the provider typically asks that a rider is ready 30 minutes before and after the assigned pickup time to allow for schedule adjustments and delays. Reliance on such services makes commuting anywhere on a regular basis quite difficult.

In many cities, transit agency operating costs are high (as seen in Figure 5) and individuals must book these demand response services well in advance.<sup>33</sup> With the cost of a paratransit trip far outstripping the cost of fixed-route transportation—and rising quickly—many transit agencies are not given the resources to provide more reliable and convenient service.<sup>34</sup> Andrew Houtenville, an expert on disabilities at the University of New Hampshire stated that,

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<sup>29</sup> National Highway Traffic Safety Administration, "Adapting Motor Vehicles For People With Disabilities."

<sup>30</sup> Luz Lazo, "Accessibility of bus stops is a 'work in progress' in the Washington region," Washington Post, July 23, 2015.

<sup>31</sup> Id.

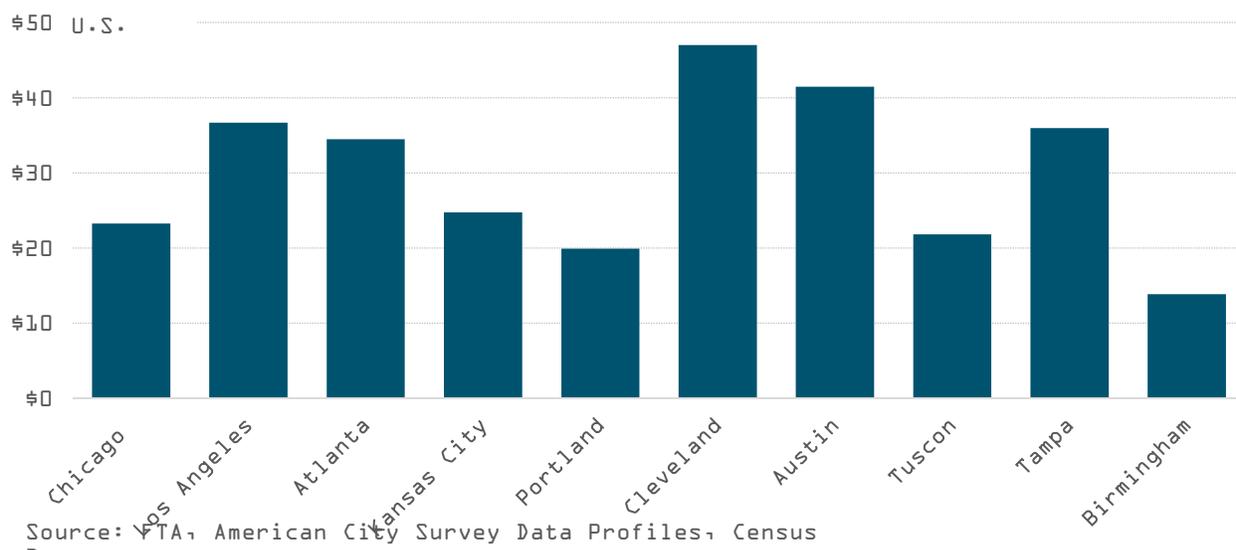
<sup>32</sup> Thomas DiNapoli and Kenneth B. Bleiwas.

<sup>33</sup> E.g., [http://www.cctaride.org/pdf/ADA%20Maps/ADA%20guide\\_web.pdf](http://www.cctaride.org/pdf/ADA%20Maps/ADA%20guide_web.pdf).

<sup>34</sup> Government Accountability Office, "ADA Paratransit Services: Demand Has Increased, but Little is Known about Compliance," November 2012.

“there is no expectation whatsoever that paratransit will perform at the level necessary to enable individuals with disabilities to obtain and hold jobs.”<sup>35</sup>

Figure 5 · Providers' Average Cost per Paratransit Ride



#### *Taxis and Transportation Network Companies (TNCs) Wait Times and Sporadic Service*

As noted in Figure 4, a greater percentage of individuals with disabilities reported recently using a taxi than those without disabilities. Taxis are often a useful option because they can go directly to the passenger's door, the driver can assist the passenger, and in many cities there are a significant number of accessible taxis. However, the vast majority of taxis in cities are not wheelchair accessible and accessible cabs are not reliably available when needed.<sup>36</sup>

TNCs have recently emerged as a major force in the local for-hire transportation market. A TNC is a service that connects passengers with drivers, who usually provide their own vehicles, most commonly using mobile apps. Prominent TNCs include Uber, Lyft, Juno, Gett, and many others. TNCs represent a promising avenue for coordinating accessible vehicles and providing alternatives to paratransit and demand response services offered by the government. For example, Uber offers a wheelchair accessible vehicle (WAV) program in some cities. While these programs may represent an improvement over the status quo in improving accessible vehicle availability, informal analysis of TNC-based accessible programs

<sup>35</sup> Interview with Andrew Houtenville, October 5, 2016.

<sup>36</sup> Tiffany Carlson, "Accessible Taxis: A Civil Right or a Nice Bonus of a City?," Huffington Post, July 28, 2014.

found significant wait times for service, often up to 10 times longer than for the basic TNC service option.<sup>37</sup> In addition, such service is completely unavailable in many geographic areas. In some locales, the TNCs have elected to forward requests to taxicab companies that provide accessible vehicles, which does not directly add a new source of accessible vehicles to the market. In some markets, policymakers have responded by negotiating arrangements for TNCs to provide limited service for the wheelchair-using community before they are allowed to operate in their jurisdiction.

Many disability groups take the legal position that every taxi or TNC car should be fully accessible. TNCs have been the target of several lawsuits arguing that, under the ADA, their drivers are required to fully accommodate individuals with disabilities. Uber has argued, most recently in the United States District Court case *Access Living of Metropolitan Chicago, et al v. Uber Technologies, Inc., et al*, that because it is a technology company that operates a phone-based application, it is not a transportation provider bound by ADA requirements.<sup>38</sup> This is an ongoing legal battle that is not anticipated to be fully settled in the near future.

#### *Financial Constraints*

If individuals utilizing paratransit services wish to access other transportation services they often come at a significant cost.<sup>39</sup> What exacerbates this problem is that individuals with disabilities tend to have lower incomes, and therefore less ability to spend on transportation. The Census Bureau states that the median monthly earnings of working age individuals with “severe” disabilities were considerably lower than for individuals without disabilities (\$1,577 per month in 2008, compared to \$2,724).<sup>40</sup>

#### *Burden of Transportation: A Demographic Analysis*

The lower income and higher expenditures on transportation do not only impact the individual with a disability, but the entire household. U.S. Census data was used to analyze how the presence of an individual with a disability impacts the financial health of a household. While recent direct surveys of persons with disabilities are not available, demographic analyses were used to indirectly access this information. More than 200,000 neighborhoods in the United States were examined and sorted by the prevalence of households containing at least one individual with a disability. Experian plc’s estimate for transportation expenses in each neighborhood were also utilized.<sup>41</sup> The analysis showed when there are more households in a neighborhood with at least one person with a disability,

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<sup>37</sup> Note: The authors of the study requested but were denied permission to capture data from a major TNC platform to perform a quantitative analysis of wait times for its accessible option.

<sup>38</sup> See, e.g., Jen Wiczner, “Why the disabled are suing Uber and Lyft,” *Fortune*, May 22, 2015.

<sup>39</sup> National Academies of Science. *The Future of Disability in America*, 2007.

<sup>40</sup> Matthew Brault, *Americans with Disabilities: 2010*. United States Census Bureau.

<sup>41</sup> Analysis performed by a research group at the Harvard Kennedy School (HKS) in consultation with SAFE, based on data provided by Alteryx.

# The Impact On People With Disabilities

there is an associated drop in median household income and a greater share of that income is spent on transportation (Figure 6).

This data points to a “dilemma on both ends” for people with disabilities and their families. Households impacted by a disability earn far lower incomes than those without, and at the same time, transportation costs eat further into their household budget. Analysis showed that while other factors explain some of the disparity in Figure 6, the presence of a person with a disability in a household accounts for both significantly reduced income and increased burden of transportation as a share of household expenses.

Even as the share of income spent on transportation increases for households (with a person with a disability), the actual amount spent on transportation decreases, demonstrating that persons with disabilities are traveling less. Households with a person with a disability tend to own fewer vehicles than those without, likely because of the expense involved in car ownership and difficulties with driving.<sup>42</sup>

Figure 6 · Disability and Transportation Expense Burden by Disability Prevalence



Source: American Community Survey, Experian, HKS/SAFE Analysis

<sup>42</sup> HKS/SAFE analysis of U.S. Census Bureau data.

### Section 3: Benefits of Better Transportation Access

Ideally, the development and adoption of autonomous vehicles will help break down the barriers to transportation for individuals with disabilities. While there are other factors holding back this population from full community integration, mitigating transportation related issues would have a very significant impact. This section examines the impacts of significantly better transportation for employment and medical care in the disability community. The analysis found that approximately 2 million individuals with disabilities would have new employment opportunities, while \$19 billion could be saved annually in healthcare expenditures.

#### Greater Employment

A significant factor in the reality of people with disabilities' lower average incomes is the inability to procure the reliable transportation necessary to obtain full-time or steady employment.<sup>43</sup> It is difficult to obtain exact numbers on individuals with disabilities who cannot obtain employment because of transportation difficulties.<sup>44</sup> However, in consultation with experts, a model was developed to examine the linkage between employment rate and those with disabilities that have trouble accessing transportation services.

Several interviewed experts agreed with the estimate that transportation is likely the primary barrier for approximately one quarter of working-age adults with disabilities who are not

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<sup>43</sup> Lisa Schur, Douglas Kruse, Peter Blanck, *People with Disabilities: Sidelined Or Mainstreamed?*, 2013.

<sup>44</sup> National Academies of Science.

working.<sup>45</sup> While we cannot estimate how many will choose to work, new opportunities for employment would extend to about 2 million people. Additionally, cheaper, more reliable, and more accessible transportation can give individuals access to better employment opportunities and lead to higher salaries more in line with the general population. Increased earning power would help individuals with disabilities cover household expenses, gain greater independence and spend more in their local economies, helping them to fully integrate into their communities.

### Transportation and Community Living

For an individual with a functional limitation (e.g., thinking, working, or reading) or a disability that prevents them from driving, access to regular and reliable transportation helps them exercise their basic rights and maximize their independence.

This is true for people of all ages. Older adults often express a strong desire to remain in their own homes and receive any necessary services and support in their community. This preference is shared by younger people with disabilities as well. Under the ADA, the Department of Justice established an integration mandate to include individuals with disabilities in their communities.

Furthermore, the Supreme Court found in *Olmstead v. L. C.* that unjustified segregation of persons with disabilities violates Title II of the ADA.<sup>46</sup> In practice, this decision means that state and local governments must offer services in the most integrated setting appropriate to the need for individuals with disabilities.<sup>47</sup> Although case law clearly attempts to secure civil rights protection for the disability community, vast disparities still exist. Clearly, transportation makes it possible for those that rely on long-term care and related support to lead their lives as members of their community instead of leaving them segregated from the rest of society in a nursing home or other institution.

New transportation technologies have the potential to help those with disabilities enjoy the activities that those without disabilities take for granted. Additional access to transportation will also create more opportunities for individuals with disabilities to integrate into their communities. One potential impact of additional transportation would be civic participation: a 2013 study found that there would have been 3 million more voters in the 2012 elections had those with disabilities voted at the same rate as those without.<sup>48</sup> The disparity between voting disappears when comparing employed individuals with disabilities, a population with

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<sup>45</sup> SAFE interviews with industry experts.

<sup>46</sup> OLMSTEAD v. L.C. 1999; and ADA.gov, "Olmstead: Community Integration for Everyone."

<sup>47</sup> Minnesota Departments of Transportation, Human Services, and State Council on Disability, "Olmstead Transportation Forum Final Report," June 12, 2014, at 2.

<sup>48</sup> Lisa Schur, Meera Adya, Douglas Kruse, "Disability, Voter Turnout, and Voting Difficulties in the 2012 Elections," Research Alliance for Accessible Voting, July 18, 2013.

better access to transportation.<sup>49</sup> Enabling better access to transportation has considerable potential to drive increased voter turnout among the disability community.

One out of every four 20-year-olds will experience at least a temporary disability in their lifetime, and the incidence of disability increases with age.<sup>50</sup> As aging individuals naturally experience functional and cognitive decline, new transportation options will provide the elderly and those in poor health with reliable travel options after driving becomes too difficult or dangerous. It will also help family members soften the emotional blow that comes with the very difficult conversation when an elderly relative needs to stop driving, and will help them to stay in their own home even as their need for support increases.

### Transportation and Health Spending

Individual health management often requires travel to service providers. For individuals with a disability who lack full access to reliable transportation, it can be difficult to ensure treatment for chronic conditions and follow treatment plans.<sup>51</sup> On average, this leads to higher costs as lack of care for chronic conditions turns small problems, which could have been handled at a low cost, into an expensive medical intervention.<sup>52</sup> Transportation is an especially important factor for individuals with disabilities, particularly American veterans, who have a higher prevalence of chronic conditions that require close health care management.<sup>53</sup>

The National Academies of Sciences (NAS) conducted a cost-benefit analysis of non-emergency transportation in 2005.<sup>54</sup> They created a tool to analyze the potential benefits of offering better non-emergency transportation for individuals whose access to medical care is compromised through lack of access to transportation.

SAFE and the Ruderman Family Foundation updated the NAS model to estimate that approximately 4.3 million individuals with a disability face significant transportation barriers when attempting to travel to their medical appointments. For several categories of chronic conditions (e.g., COPD, Diabetes, Renal Failure, Congestive Heart Failure, Hypertension, and Mental Health) and preventive medical procedures (e.g., cancer screenings, obstetric care, dental care, and vaccination) the report estimated the prevalence of these conditions amongst the population of individuals reporting poor transportation access. This led to an

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<sup>49</sup> Id.

<sup>50</sup> U.S. Social Security Administration, Fact Sheet February 7, 2013.

<sup>51</sup> Transportation Research Board, *Cost Benefit Analysis of Providing Non-Emergency Medical Transportation*, Washington, DC, 2005.

<sup>52</sup> Commonwealth Fund. *Primary Care: The First Line of Defense*.

<sup>53</sup> William Horner-Johnson et al., "Disparities in chronic conditions and health status by type of disability", *Disability and Health Journal* 6 (2013) 280e286.

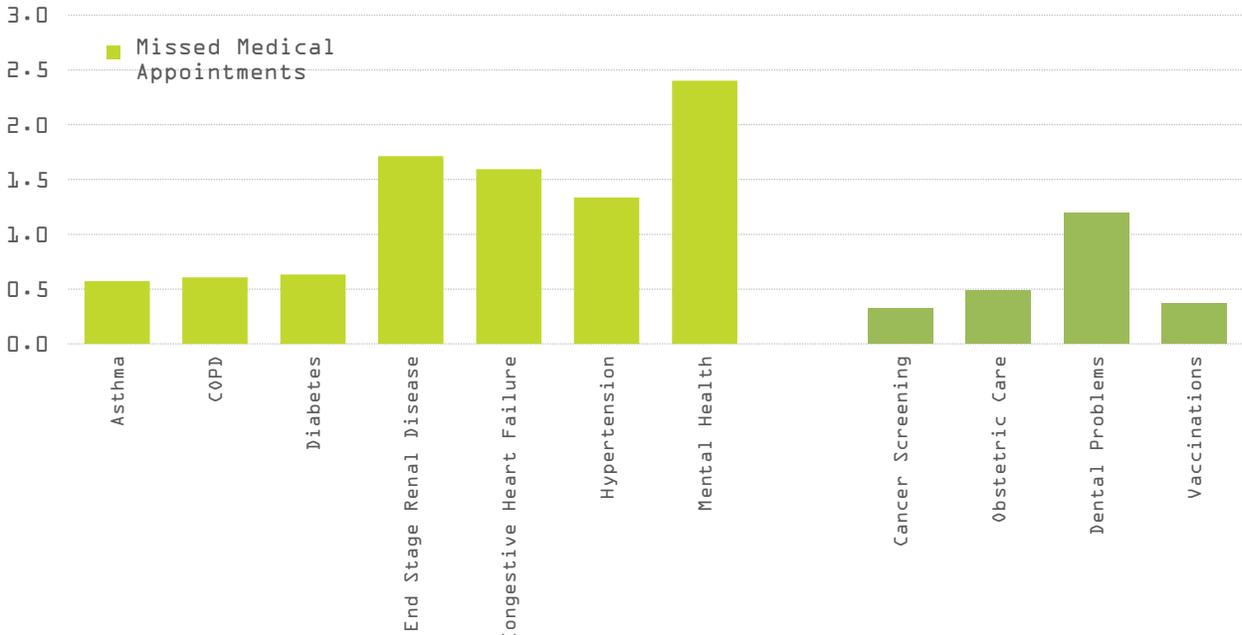
<sup>54</sup> National Academies of Sciences, Engineering, and Medicine; Transportation Research Board, *Cost Benefit Analysis of Providing Non-Emergency Medical Transportation*, October 2005.

estimate of the health care expenditures that could be avoided through more proactive care of these conditions. For example, regular visits to a primary care doctor might enable an individual to keep their diabetes under control, and the cost of these doctor visits pales in comparison to the cost incurred when a complication related to diabetes necessitates hospitalization.

In total, the analysis leads to a conservative estimate that more than eleven million medical appointments (see Figure 7) are missed annually by individuals with disabilities due to inadequate transportation. Since the gains considered in this model are economic, it does not fully quantify the quality of life gains from making individuals healthier. For example, far more missed appointments were for mental health care than any other cause, yet the NAS did not consider increased access to mental health care to be a cost saving intervention. Such “invisible” disabilities should not be dismissed and are likely to bring additional benefits not captured in this model. Additionally, the NAS did not complete the necessary analysis to project medical savings from early cancer detection, although evidence suggests that the benefits would be at least several billion dollars. Even using this limited, conservative lens, an estimated \$19 billion (see Figure 8) in health care expenditures, mostly from public entitlement programs, could be saved annually through improved access to medical care for individuals aged 18 to 64.

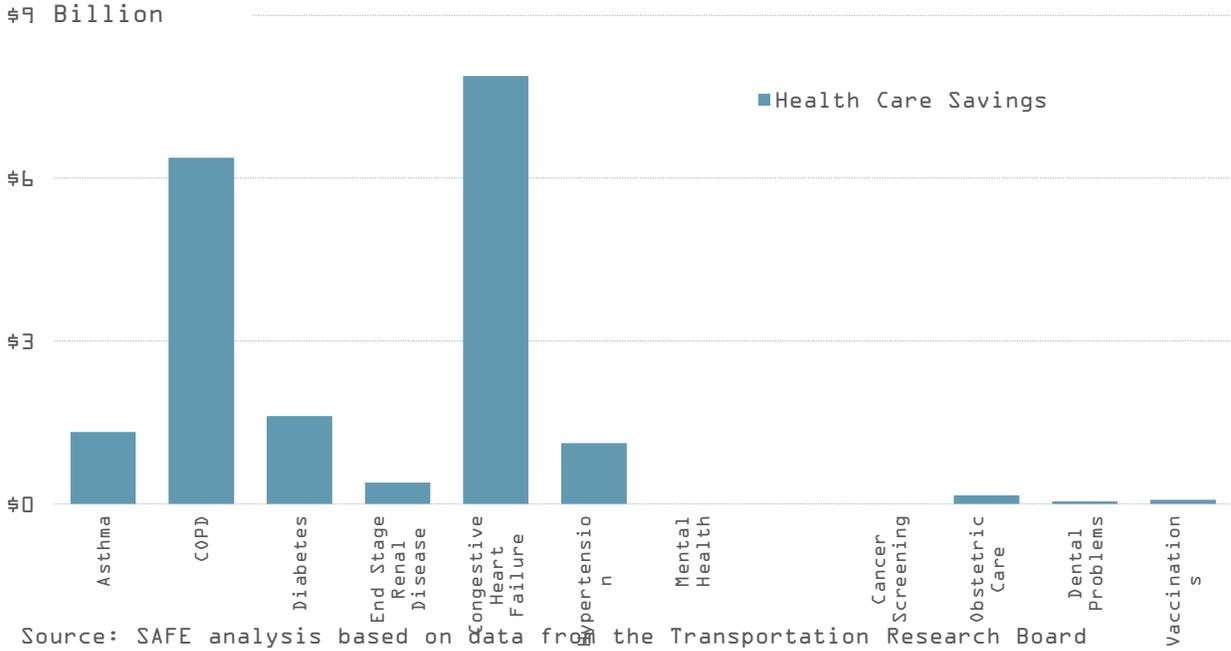
Figure 7 · Estimated Missed Health Care Appointments Due to Insufficient Transportation

# The Impact On People With Disabilities



Source: SAFE analysis based on data from the Transportation Research Board

Figure 8 · Health Care Savings Due to Non-Emergency Medical Transportation



Source: SAFE analysis based on data from the Transportation Research Board

## Section 4: Current Developments

### New Opportunities – Autonomous Vehicles

Mary Barra, the CEO of General Motors, said of the transportation industry, “There’s going to be more change in the next five to ten years than there’s been in the last fifty.”<sup>55</sup> These changes will arise from the “digitization” of transportation technology, which combines computer science and software development with cars and the broader transportation system. One major example has been the emergence of TNCs such as Uber and Lyft, which offer ridesharing through location-based applications. The rapid increase of these services has generated speculation that this business model could largely replace personal vehicle ownership.<sup>56</sup>

Even more significant is the emerging availability of vehicles capable of fully autonomous operation. Several companies are testing autonomous vehicle prototypes. The speed of this transition has been remarkable. For example, Mark Fields, CEO of Ford Motor Company said in August, “If someone had told you 10 years ago, or even five years ago, that the CEO of a major American car company is going to be announcing the mass production of fully autonomous vehicles, they would have been called crazy or nuts or both.”<sup>57</sup> However, Steve Mahan’s (CEO of Sana Clara Valley Blind Center) story below illustrates that the technology may soon be deployed commercially.

When Google chose to publicly introduce its self-driving car to the world, it chose to highlight the impact that it would have on Steve Mahan’s life through a video the company posted on YouTube in 2012.<sup>58</sup> Mahan is blind, and trips that a sighted person would take for granted represent a major investment of time and effort.

Mahan lives two miles from the nearest bus stop and frequently needs to rely on paratransit services.<sup>59</sup> When Google offered Mahan a ride in a self-driving car—one of the earliest members of the public to be afforded that opportunity—the Google team was prepared for any number of exotic requests. Yet, Mahan requested to go to the dry cleaners and to get a meal from Taco Bell.

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<sup>55</sup> Matthew DeBord, “General Motors CEO Mary Barra: ‘We are disrupting ourselves, we’re not trying to preserve a model of yesterday,’” Business Insider, November 16, 2015.

<sup>56</sup> Pavithra Mohan, “Uber is Even Bigger Than You Realize,” Fast Company, September 8, 2015; and Valerie Carranza, Kenyon Chow, Huyen Pham, Elizabeth Roswell, Peilun Sun, “Life Cycle Analysis: Uber vs. Car Ownership,” UCLA, June 2, 2016.

<sup>57</sup> Neal Boudette, “Ford Promises Fleets of Driverless Cars within Five Years,” New York Times, August 16, 2016.

<sup>58</sup> Google, “Self-Driving Car Test: Steve Mahan.” YouTube, March 28, 2012.

<sup>59</sup> Jonathan Bloom, “Blind Man Chosen As First Person To Test Google's Driverless Car,” ABC7News, February 10, 2016.

"Where this would change my life is to give me the independence and the flexibility to go to the places I both want to go and need to go when I need to do those things," said Mahan.<sup>60</sup> He highlighted that the most important benefit a self-driving car could offer him was the possibility—and the dignity—to perform his daily errands on his own schedule.

In December, Google announced the creation of Waymo—a new company designed to commercialize autonomous vehicle technology. During the release, the company's engineers revealed that Mahan had again played an important role in testing the technology. In October 2015, Mahan was able to ride around Austin, Texas for ten minutes in a vehicle with no steering wheel, pedals, or other humans present.<sup>61</sup>

### Autonomous Vehicles – No Longer Science Fiction

In the mid-2000s, Dr. Erik Brynjolfsson, an expert on the economics of automation, declared that "self-driving cars were beyond the capability of computer science."<sup>62</sup> About 10 years later, he and his colleagues now acknowledge the rapid advancement of autonomous vehicles and believe they will have a massive impact—although disagreements remain over the timeframe for these changes.<sup>63</sup> Financial analysts believe that the emergence of autonomous vehicles will likely alter business models in many industries, generate new opportunities for consumers, and disrupt one of the largest sectors of the U.S. economy. The market for these new vehicles is expected to reach \$560 billion and could contribute \$1.3 trillion in annual savings to the United States' economy through savings on fuel, accident avoidance, increased productivity, among other sources.<sup>64</sup>

Indeed, the buzz surrounding autonomous vehicles has developed rapidly. An exploration on Google Trends (Figure 9) showed that interest in "autonomous vehicles" recently reached its highest point and is nearly quadruple what it was just two years ago.

Figure 9 · Interest in Autonomous Vehicles Over Time

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<sup>60</sup> Google, "Self-Driving Car Test: Steve Mahan." YouTube, March 28, 2012.

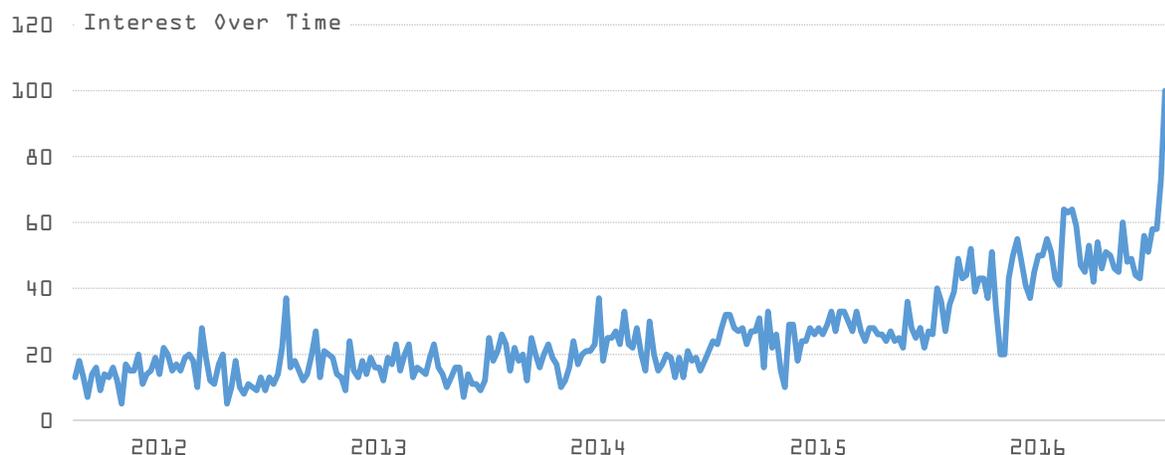
<sup>61</sup> Alex Davies, "Google's Self-Driving Car Company Is Finally Here," Wired, December 13, 2016.

<sup>62</sup> Steve Rosenbush, "Brynjolfsson Says Self-Driving Cars Developing Faster Than Expected," Wall Street Journal, February 28, 2014.

<sup>63</sup> Id.

<sup>64</sup> A.T. Kearney, "How Automakers Can Survive the Self-Driving Car Era," 2016 & Morgan Stanley, "Autonomous Cars: The Future Is Now," Jan 23, 2015.

## The Impact On People With Disabilities



Note: Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means as popular. Likewise a score of 0 means the term was less than 1% as popular.

Source: Google

This buzz has tracked closely with the emergence of autonomous driving technology. In August 2016, nuTonomy deployed the first driverless taxi pilot program in Singapore, with hopes of deploying a full complement of autonomous electric taxis by 2018.<sup>65</sup> A few weeks later in the United States, Uber introduced a small fleet of autonomous vehicles in Pittsburgh.<sup>66</sup> Google, GM, Volkswagen, and Ford have all announced plans to deploy fully autonomous vehicles in the coming few years.<sup>67</sup>

While the technology for a fully autonomous vehicle that can drive between any two points without a driver may not be here for a decade or more, vehicles that can operate autonomously at low speeds or within small geographic areas already exist. Low-speed driverless pods (see Graphic 1) are already operating on public roads in the United Kingdom, including in places where they encounter pedestrians.<sup>68</sup> Pilot programs like these have the added benefit of educating and familiarizing the public with autonomous vehicles.

In short, even if the technology to replace conventional cars with autonomous vehicles is not fully ready, there is technology available today that can help some individuals with disabilities.

#### Graphic 1 · Transport Systems Catapult Self-Driving Pod

<sup>65</sup> Andreas Illmer, "Self-driving taxi trial kicks off in Singapore," BBC, August 25, 2016.

<sup>66</sup> Mike Isaac, "What It Feels Like to Ride in a Self-Driving Uber," New York Times, September 14, 2016.

<sup>67</sup> Lee Gomes, "Google Self-Driving Car Will Be Ready Soon for Some, in Decades for Others," IEEE Spectrum, March 18, 2016; and Alexandria Sage and Paul Lienert, "Ford plans self-driving car for ride share fleets in 2021," Reuters, August 16, 2016; and John Stoll, "GM Executive Credits Silicon Valley for Accelerating Development of Self-Driving Cars," Wall Street Journal, May 10, 2016.

<sup>68</sup> See, e.g., Catapult Transport Systems, "Driverless pods," 2016.



Photo Credit: Transport Systems Catapult

Yet, there is relatively little discussion of the use of autonomous vehicles to serve individuals with disabilities. This is not due to the pace of technological development—which is well underway—but more of a function of the community’s ability to organize and articulate a demand for products that are both feasible and impactful. Useful applications will require creativity on the part of technology developers and the automotive industry, advocacy on the part of stakeholders, and a supportive policy framework from the government.

Closer to home, in an experiment with important implications for American veterans and other underserved populations, the U.S. Army is trialing a driverless shuttle at Fort Bragg that will help wounded soldiers, especially those with a traumatic brain injury, reach the clinic and make their medical appointments.

The U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) is currently running the experiment at Fort Bragg where specially equipped Cushman Shuttles—modified golf carts—will pick up injured soldiers at their barracks and transport them about half a mile to the medical center.<sup>69</sup>

### Awareness and Political Concern

The stark reality is that there is no guarantee that autonomous vehicles will be accessible to the broader disability community when they are deployed. This could result from a combination of narrow technological development and inflexible, restrictive policies. There have been numerous examples of newly developed technologies that did not consider the needs of individuals with disabilities. Susan Henderson of the Disability Rights and Education

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<sup>69</sup> Richard Truett, “Army develops autonomous vehicles for use on bases first, battlefields next,” *Automotive News*, August 22, 2016.

Fund (DREDF) pointed out that, “Equal access to the internet for people who are blind and deaf and have other disabilities was not considered by web developers at first, and many people with disabilities experienced unnecessary obstacles to information—and still do.”<sup>70</sup> In terms of restrictive policies, California has already proposed draft regulations that would require autonomous vehicles to have a licensed driver in the vehicle at all times when the vehicle is in use, although they appear to be partially backing away from this requirement.<sup>71</sup> Such a requirement would disqualify many with disabilities from taking full advantage of autonomous vehicles. These obstacles highlight the stakes and the important role advocacy will play in ensuring that the vehicles are made accessible to all individuals with disabilities.

One of the most important policy debates that will impact the ability of the disability community to realize the benefits of autonomous vehicles is whether regulations will require a licensed “driver” in the vehicle. Many who have a “severe” disability, whether it be because of epilepsy, blindness, intellectual disability, or other physical limitation, would benefit from autonomous vehicles but are not able to obtain a driver’s license.

Several states and the federal government have weighed in on this issue. It is highlighted here because of the core importance of this policy issue and how broadly applicable it is to the disability community. If a restrictive policy is put in place on this front, it will prevent a significant portion of the disability community from realizing the benefits of new transportation technologies.

### Stakeholder Views

The disability community is comprised of individuals that have an extremely diverse set of needs, preferences, and requirements when it comes to transportation. However, to ensure hurdles to both accessibility and social inclusion are overcome when deploying autonomous vehicles, it will be imperative that the broader disability community coalesces around a constrained set of policy recommendations. This is especially true as the states and federal government continue to issue guidance and regulation in an effort to keep pace with the rapid development of the technology.<sup>72</sup> The diverse needs of the community were highlighted as an obstacle to accessible autonomous vehicles by Stephen Shladover at the University of California, who argued that “each person has different impairments and it will be nearly

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<sup>70</sup> Johana Bhuiyan, “Disability advocates to regulators: Consider us when making self-driving laws,” Recode, April 27, 2016.

<sup>71</sup> Id.; and See, e.g., California Department of Motor Vehicles, *Express Terms Title 13, Division 1, Chapter 1 Article 3.7 – Autonomous Vehicles*.

<sup>72</sup> See, e.g., NHTSA, “U.S. DOT issues Federal Policy for safe testing and deployment of automated vehicles,” September 20, 2016.

impossible to create a car that will accommodate everyone in the disabled community.”<sup>73</sup> While it may be a tough proposition, the task is not impossible. It will require regulations that are accommodating enough to take individual needs into account, such as the current guidelines for homes and conventional cars.

The earlier the community makes its priorities known, the easier it will be to influence the development of autonomous vehicle technology. This creates an urgency in forming a common agenda at the intersection between autonomous vehicles and disability policy. Without intervention, the technologies and regulations may develop in a way that does not foster inclusion and will necessitate significant modification in the future to allow access, likely delaying benefits for years. SAFE and the Ruderman Family Foundation conducted numerous interviews with stakeholders in the disability community in order to jump-start this process and ultimately provide recommendations for technology companies, regulatory agencies, and other policymakers involved in this space.

These interviews resulted in feedback from various sub-communities and veterans’ groups, which highlighted different issues as being of particular importance as automakers and technology companies consider when developing the technology. These issues are described in more detail below.

#### *Blind and Visually Impaired Community*

The community has identified several key issues that need to be resolved. For example, Parnell Diggs of the National Federation of the Blind argues that, “these technologies and their user interface need to be accessible. The cars may require refreshable braille and an auditory system that notifies the driver where the car is at any given time, and the progress of their trip. Without these modifications the vehicles could be difficult to use.”<sup>74</sup> Other things to consider include oral notifications or alerts as to whether their vehicle requires maintenance or refueling.

#### *Ambulatory and Physical Disability Community*

Individuals that use wheelchairs would benefit if manufacturers designed fully autonomous vehicles in such a way that a ramp or lift system could be integrated into the body of the car. Alternatively, manufacturers could design autonomous vehicles so that they could be easily and affordably fitted with a wheelchair ramp or lift system as an aftermarket modification. Another issue facing those that rely on a wheelchair for mobility has to do with stowing the wheelchair while the individual rides in the car. For individuals that transfer from a

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<sup>73</sup> Roland Reznik, “Disability Advocates See Opportunity in Self-Driving Cars,” KD Healthcare Company USA, May 19, 2016.

<sup>74</sup> SAFE interview with National Federation of the Blind (NAB).

wheelchair into a seat in the car, there is a need to get the wheelchair into the car and secured so it does not move about when the vehicle is in motion.

Furthermore, wayfinding, the methods and information individuals use to navigate their physical environment should also be considered. For example, cities should begin to think about how to incorporate technology into infrastructure so that autonomous vehicles can notify people with disabilities of potential infrastructure barriers, such as a corner under construction or with no curb cut. This way wheelchair users, or other people with disabilities, can navigate efficiently to the nearest accessible sidewalk, even if it slightly further from their intended destination.

### *Deaf Community*

While individuals who are deaf are fully capable of driving today's vehicles, user interface design for autonomous vehicles should consider their needs. For example, an individual who is deaf may be unable to hear voice commands. This could present difficulties unless there are sufficient visual cues or text equivalents for audio communication in vehicles. Zainab Alkebsi of the National Association for the Deaf expressed concern that information in "autonomous vehicles would be communicated [exclusively] aurally." Her organization would "advocate for any audible information to be conveyed visually as well."<sup>75</sup>

### *Intellectual and Developmental Disability Community*

Those with intellectual and/or developmental disabilities (IDD) currently rely on a mix of public transportation and provider arranged group transportation for most of their travel needs. For those individuals that receive residential services, often referred to as a group home, it is common for the administrator of those services to provide transportation to those enrolled in a day program or supported employment arrangement. Mobility and orientation training enables certain individuals to find their way from their home to public transportation—such as a bus stop to get to their job or day program with a significant degree of independence. However, others in the IDD community are more reliant on support to navigate the challenges of traveling from one place to another.

Successful navigation is not the only challenge individuals with IDD face. Many would benefit from controls that are designed to have an option that provides a user interface with minimal complexity to increase the ease of use. Mobile phones play a role in allowing an individual to get and receive remote support, so it is reasonable to anticipate that new mobile platforms will play an enhanced role in facilitating travel for individuals with and without disabilities. The vehicle's ability to provide supervision and tracking in the form of video cameras and GPS would also be helpful for caregivers responsible for the safety and well-being of those with IDDs. For example, if one's family can help the individual into a vehicle, the system may help

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<sup>75</sup> Interview with Zainab Alkebsi from National Association of the Deaf.

ensure the individual is not lost or in danger, which may ultimately provide more independence.

In addition to potential vehicle changes, it will also be important for many in various disability sub-communities to effectively navigate the challenge of leaving one's house in order to get to a desired location. If such challenges are not addressed, even the advent of autonomous vehicles may not be enough for many in the disability community to take advantage of the benefits these vehicles will bring.

### Stakeholder Coordination

Incorporating the needs of all these groups is a challenging but necessary task. It is likely to require collaboration and compromise, but a strong and united voice will be needed to make inroads with those designing and regulating the vehicles. Fortunately, the disability community as a whole has experience achieving success by working together in the past.

For example, long before the monumental Americans with Disabilities Act was signed in 1990, the fight for inclusion and the civil rights of people with disabilities started at the local level. In the 1970s, people with disabilities sat in federal buildings, obstructed the movement of inaccessible buses, and marched in the streets as part of the disability rights movement.<sup>76</sup> After securing recognition as a minority group in Section 504 of the 1973 Rehabilitation Act, which banned discrimination on the basis of disability, the disability community faced removal of some protections under the Reagan Administration. Sensing the threat to progress, a diverse group of officials from the disability community advocated at the highest levels, including at the White House, to explain why protections must continue.<sup>77</sup> These efforts culminated in an announcement from the Reagan Administration that all efforts to deregulate Section 504 would be halted.<sup>78</sup> In the years that would follow, many of the groups came together to demonstrate and defend the ADA's value, which was signed in 1990.<sup>79</sup> The same level of determination and public debate will be required to ensure the transportation system of the future is more accessible than the one we have today.

### Universal Design

In 1989, Ron Mace founded the Center for Accessible Housing, now the Center for Universal Design at North Carolina State University and coined the term "universal design," which he described as, "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design."<sup>80</sup> Many disability advocates have pointed to universal design as a useful principle to guide the future

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<sup>76</sup> Arlene Mayerson, "History of the Americans with Disabilities Act," DREDF, 1992.

<sup>77</sup> Id.

<sup>78</sup> Id.

<sup>79</sup> Chai Feldblum, "Archive ADA: The Path to Equality," Georgetown Law.

<sup>80</sup> North Carolina State University, "About UD," 2008.

design of autonomous vehicles. A universally designed vehicle would encompass the needs of all individuals, including those with any type of disability. Under such a design, vehicles would have alterable user interfaces to accommodate its rider with the touch of a button or a voice command.

Disability advocates urge that autonomous vehicles be designed for inclusion as early as possible in the design and manufacturing process. By incorporating accessibility in the front-end of development, the community will not be forced to fight for accessibility on the back-end. Many disability advocates promote a universal design philosophy and suggest this standard remain the guiding principle for developers of autonomous vehicle technology to the greatest extent possible.

Industry experts have responded that developing a fully autonomous vehicle to be universally accessible will be nearly impossible. Instead, they point to the “dispatch” model of TNCs, which meets the individual needs of a rider with a vehicle that is designed appropriately. The TNC model can, in theory, increase accessibility by allowing any potential rider access to a broad range of vehicle designs that, while not universally accessible, meet the needs of various segments of the disability community.

### Technology Developer Views

Since autonomous vehicle technology is being developed, for the most part, by private companies, their views significantly impact the speed at which solutions will be developed for the disability community. While more can be done, accessibility is part of the agenda for some automakers. Many automakers have mobility access programs and commit funds toward retrofits of vehicles, although those programs are usually insufficient for meeting the needs of individuals requiring such services.<sup>81</sup> For example, Ford recently noted that in 2015 it assisted 716,000 military veterans in reaching their medical appointments, while also donating 207 vehicles to the Disabled American Veterans (DAV) organization over the last 20 years, amongst other work.<sup>82</sup> Uber has worked to increase the accessibility of its platform for both passengers and driver. Recently, for example, Uber included a feature on its application that notifies passengers when their driver is deaf.

While there is a diversity of opinion, there is considerable openness and receptiveness to the idea that autonomous vehicles will enable mobility for underserved populations. Many companies are tailoring development to allow for this to occur. For example, Toyota has stated its autonomous vehicle testing is partially focused on developing a “chauffeur” mode, which would not require a human driver and would likely be utilized by those with vision loss or other physical limitations.<sup>83</sup>

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<sup>81</sup> The Mobility Resource, “Adaptive Equipment Rebate Programs,” 2016.

<sup>82</sup> Ford, Ford expands mobility options for disabled military veterans with vehicle donations across the U.S.,” August 1, 2016.

<sup>83</sup> Stephanie Beasley, “Older, Disabled Drivers Pose Challenge for Driverless Car Makers,” Bloomberg, May 6, 2016.

To date, no major automaker or technology company has committed to making universal design a central pillar of their philosophy—for either autonomous or conventional vehicles. The fact that a new policy framework will need to be negotiated for autonomous vehicles presents an important opening for the disability community to advocate for new and more inclusive policies and vehicle design changes that may meet the community's needs.

### Political Organization

There is an urgent need to develop a common agenda at the intersection between autonomous vehicles and disability policy. This agenda will require broad political organization, and eventually action, in order to make progress and ensure the voices of individuals with disabilities is heard. Already, some groups have begun to mobilize efforts in this space, though so far with mixed results.

One example at the state level is a group called Self-Driving US, which started by attempting to build community interest and involvement to help bring autonomous vehicles to the state of Minnesota under the name Self-Driving MN. The group has stated that its goal is to support and advocate for “legislation and other policy and community actions to promote the development of autonomous vehicle technology to provide equitable, accessible, and affordable transportation independence for Minnesotans with disabilities and older Minnesotans who are currently unable to drive.”<sup>84</sup> The group drafted legislation to establish a task force and technology demonstration project.<sup>85</sup> The technology demonstration was later dropped as concerns surrounding the liability, in the case of an accident, surfaced among potential sponsors of the bill. The bill passed a number of committees, but ultimately was rejected when the Minnesota legislature failed to pass a broader transportation bill.<sup>86</sup> While their recommendations did not become law, grassroots advocacy helps ensure that the voice of the community is heard on critical issues and paves the way for future legislative and regulatory experience. Their experience in Minnesota has the organization looking to expand nationally as Self-Driving US.

In December 2015, California's Department of Motor Vehicles (DMV) released draft deployment regulations for autonomous vehicles. The proposed regulations were seen as overly restrictive, requiring every autonomous vehicle to be occupied by a licensed driver, among other restrictions on the technology. The DMV subsequently held two public workshops that allowed an opportunity for public input. Many disability groups attended to make clear to regulators that the proposed regulations were too restrictive and would leave them behind. Teresa Favuzzi, Executive Director of the California Foundation for Independent

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<sup>84</sup> Self-Driving MN, TIM's Bill Briefing Memo, 2016.

<sup>85</sup> Id.

<sup>86</sup> Eric Schnell, “Oh it's ON!,” Self-Driving MN, May 23, 2016.

Living Centers, said at the meeting, “We look at the potential as nothing short of revolutionary for the disability community...Don’t keep us out of the revolution.”<sup>87</sup>

The input of advocacy groups has been crucial in developing policy for autonomous vehicles. An early position was staked out by a November 2015 report by the National Council on Disability (NCD), an independent federal agency. The NCD submitted a report to President Obama making specific recommendations on autonomous vehicles. This represented one of the first official statements on how policy could shape the deployment of autonomous vehicles to be more inclusive.<sup>88</sup>

A major success occurred in September 2016 when the U.S. Department of Transportation, through the National Highway Traffic Safety Administration, released policy guidance on autonomous vehicles. The policy guidance indicates dividing autonomous vehicle regulation between the federal government and the states. In particular, the policy made clear the federal government’s view that a licensed operator need not be present in fully autonomous vehicles once the technology is ready, and that states should not impose such a requirement. This represented an important milestone on the pathway towards the use of autonomous vehicles to improve access to mobility. These early successes and efforts are a strong signal that the strength and organization of the disability community will play a key role in ensuring that autonomous vehicles are developed in a way that embraces the civil rights of all.

## Section 5: Recommendations

SAFE and the Ruderman Family Foundation believe the following recommendations should be adopted and implemented so that the disability community, government, and industry all work together to ensure that when autonomous vehicles are deployed they will provide increased access to mobility and transportation services, ensure greater opportunity for increased economic participation, and ultimately enrich the lives of those with disabilities.

### Disability Community

*The disability community should begin engaging immediately in the debate around autonomous vehicles, establishing a coalition of aligned interests.*

SAFE and the Ruderman Family Foundation strongly encourage the development of a coalition, comprised of all segments of the disability community, which is able to nimbly react to developments and provide direction to both policymakers and industry. It will be imperative over the coming months that all interested actors and representatives organize to speak boldly and with a clear and singular voice whenever possible.

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<sup>87</sup> Tony Bizjak, “Sacramento Bee’s transportation reporter puts Google’s self-driving car to the test,” The Sacramento Bee, February 6, 2016.

<sup>88</sup> National Council on Disability, *Self-Driving Cars: Mapping Access to a Technology Revolution*, November 2, 2015, at 13.

This coalition should organize immediately, and work swiftly toward several key objectives. First, it will be necessary to enhance the public's understanding of potential government actions on autonomous vehicles policy, and the implications of those actions for the disability community at the state and federal levels. In addition, a coalition of disability advocacy organizations would engage industry actors on an 'as-needed' basis to provide feedback on specific technical issues relating to the design, testing, and development phases. Furthermore, the coalition should work with state departments of motor vehicles to allow for local input from the disability community. Finally, the coalition should evaluate and form a research agenda that aims to further evaluate the transportation needs and challenges of those with disabilities. The research should result in recommendations on how to increase universal access in both the current and future transportation systems.

## Government

### *Highly automated vehicles should not require a licensed driver.*

Many individuals with disabilities are unable to obtain a valid driver's license. Some will never be able to obtain a license under the current regulatory structure, while others, such as those with epilepsy, may experience temporary restrictions on driving until an improvement is seen in that condition. In either case, requiring autonomous vehicle passengers to hold a valid driver's license is a needless restriction that would significantly inhibit the potential benefits of autonomy to those in the disability community. While driver's license strictures may be necessary in today's environment, a dramatic change in technology that allows autonomous vehicles requires the development of an updated regulatory paradigm.

Highly automated vehicles, those classified as Society of Automotive Engineers (SAE) level 4 or 5, provide tremendous safety benefits and may well eradicate most of the more than six million accidents that occur on U.S. roads every year. The National Highway Traffic Safety Administration recently released its policy on autonomous vehicles and agreed that no specific licenses or operators should be required for those riding in highly automated vehicles. If regulators maintain such a position, or concretize it, the disability community would benefit dramatically through enhanced mobility, a notion that, for many, long seemed impossible. However, this policy is not currently binding, and the National Highway Traffic Safety Administration's (NHTSA) policy guidelines are likely to undergo substantial changes in the coming months and years.

SAFE and the Ruderman Family Foundation encourage the federal government to solidify its stance that highly automated vehicle systems should not require a driver's license. In addition, states should similarly follow suit and should not attempt to override this policy and require a licensed person in the vehicle when no human operator is necessary. This is because the car is in fact the driver, and not the person riding inside. Therefore, this position

does not infringe on the states' ability to regulate licensing of human operators. If necessary, Congress should intervene and clarify with updated legislative language.

*Federal, state, and local governments should encourage entities to develop pilot programs for autonomous vehicles with a focus on fostering independence and enhanced mobility for the disability community and aging population.*

The broad autonomous vehicle testing and deployment activities currently underway is an encouraging sign of progress. New programs all over the country are being launched by technology companies, traditional car companies, startups and other players. There is no question that autonomous vehicle technology is advancing rapidly.

The potential for autonomous vehicles to deliver increased mobility is immense, and while full autonomy may be years away, now is the time to begin considering creative ways to utilize and apply the technology. Already, pilot programs such as those seen in Fort Bragg have shown that this technology can and should be utilized in its current state. While the technology will undoubtedly improve over time, there is no need to wait until level 5 autonomy is reached.

To this end, all levels of government, especially at the local level, should encourage autonomous vehicle pilots for underserved populations, such as those with disabilities and the aging population. These pilots will demonstrate the economic value to government actors and the private sector, and set the stage for capturing massive societal benefits as the technology matures. If some states do not take necessary steps to include underserved groups in AV deployment, the federal government has important levers that should be considered to encourage compliance, such as limiting eligibility for certain grants under the Highway Trust Fund.

## Industry

*Manufacturers of the technology should design SAE level 4 products that offer access as soon as technically feasible, while also gathering input from the disability community during pilot programs.*

As documented earlier, various locales are experimenting with the deployment of autonomous vehicles. A broad range of additional experiments and deployment exercises are planned in the coming months and years. Technology developers should seek and include feedback from a diverse range of members from the disability community and aging population while planning trial and early-stage deployments. This feedback should be solicited through regular and ongoing workshops that allow for public input. Such a dialogue should continue during the various phases of public testing and continue after deployment.

SAFE and the Ruderman Family Foundation encourage the deployment of level 4 functionality as soon as technically feasible to accelerate benefits to underserved communities. A subset of test deployments should be designed, with the input of stakeholders, to prove the economic and social benefits of increased access to mobility.

### Collaborative

*The U.S. Department of Transportation should create a center to facilitate an ongoing dialogue around the design, testing, and deployment of highly automated vehicles.*

The U.S. Department of Transportation, through NHTSA, should sponsor a resource center to support public understanding of the *Federal Automated Vehicles Policy* document. Such a center would promote a substantive dialogue with the public on the important issues addressed by the policy and address how new transportation technologies will be safely integrated onto U.S. roads as advances occur. Such a center would also develop model practices for consumer education and training on the operation and utilization of new technologies by individuals with disabilities and older adults. Finally, the resource center should develop and continue to refine a document that describes best practices for how manufacturers should respond to certain areas of the Safety Assessment Letter to NHTSA, as described in their *Federal Automated Vehicles Policy* document.

In addition to a resource center, SAFE and the Ruderman Family Foundation recommend the U.S. Department of Transportation facilitate a public-private partnership (PPP) aimed at developing vehicles with universal design principles whenever economically and technologically feasible. Such a program should be authorized by Congress.

The program will work with automakers and technology developers to build accessibility into vehicles' design and human-machine interfaces whenever possible to benefit those with disabilities and older adults. For wheelchair users, engineering changes may make it easier and cheaper to retrofit vehicles in the future. Those who are blind or deaf may benefit from specific oral, tactile, or visual cues that help them interact with the vehicle. This PPP should work with manufacturers to specifically develop further guidance on how principles of universal design can be implemented into vehicles with level 4 and level 5 functionality.

*The U.S. Department of Transportation should conduct further research on the transportation needs of people with disabilities.*

As demonstrated earlier in this report, people with disabilities spend a significantly higher percentage of income on transportation than those without disabilities. Many also utilize public programs such as Medicaid to procure transportation services, though unreliable or unavailable services are often a source of severe frustration to the user. Autonomous vehicles could in the future be used to complement or replace paratransit services or other public

transportation programs. However, to better understand the economic implications and feasibility, we need up-to-date data. Currently much of the data on this subject is out of date.

The U.S. Department of Transportation should conduct a market analysis of current public and private spending on transportation for people with disabilities. As part of the process, the Department of Transportation's *2002 National Transportation Availability and Use Survey* should be updated and enhanced. The final market analysis should be published and made available to state and local agencies that provide transportation services. Such an analysis should evaluate public spending on programs that operate outside of regular public transportation programs and paratransit services. It should segment by disability type whenever possible and include out-of-pocket spending on transportation services. It should also aim to make a distinction between spending on individual and group transportation. The private costs of retrofitting vehicles to make them accessible as well as the cost of assistive technology and equipment should also be considered.

In addition, the Department of Transportation should charge the Federal Transit Administration with further studying this issue and to determine how autonomous vehicles could be utilized in public fleets that provide accessible transportation services.

## Methodology

SAFE and the Ruderman Family Foundation began research for this issue brief by examining publicly available data sources and research on the topic of transportation accessibility for individuals with disabilities. Data that was out of date was supplemented through qualitative interviews to confirm validity. To add substantive analysis to the conversation, SAFE and the Ruderman Family Foundation utilized two quantitative models.

The first updated a National Academies of Science model to analyze the potential benefits of offering better non-emergency transportation to individuals with disabilities whose access to medical care is compromised through lack of access to transportation. This analysis led to a conservative estimate that almost 11.2 million medical appointments are missed annually by individuals with disabilities due to inadequate transportation. In addition, \$19 billion in health care expenditures, mostly from public entitlement programs, could be saved annually through improved access to medical care.

The second model was developed by SAFE to estimate the employment impacts increased transportation access may present to individuals with disabilities. The model showed that mitigating transportation related obstacles for individuals with disabilities would enable new employment opportunities for approximately 2 million individuals with disabilities.

In addition, SAFE conducted numerous interviews with stakeholders in the disability community to gain a broader understanding of the various transportation challenges and obstacles that each sub community faces. The individuals and organizations that provided input or were interviewed can be found below.

## Experts Interviewed

Zainab Alkebsi  
Policy Counsel, National Association of the Deaf

Heather Ansley  
Associate General Counsel for Corporate and Government Relations, Paralyzed Veterans of America

Garry Augustine  
Executive Director, Disabled American Veterans

Kelly Buckland  
Executive Director, National Council on Independent Living

Parnell Diggs  
Director of Government Affairs, National Federation of the Blind

Virginia Dize  
Program Director & Co-Director, National Aging and Disability Transportation Center, National Association of Area Agencies on Aging

Teresa Favuzzi  
Executive Director, California Foundation for Independent Living Centers

Sandy Finucane  
Senior Advisor, Epilepsy Foundation

Scott Hoesman  
CEO, Inquest Consulting

Dr. Andrew Houtenville  
Director of Research, University of New Hampshire, Institute on Disability

Keith Jones  
President, SoulTouchin' Experiences

John Kleindienst  
National Director of Voluntary Services, Disabled American Veterans

Lee Page  
Senior Associate Advocacy Director, Paralyzed Veterans of America

Eric Schnell

Board Chair, Self-Driving US

Marianne Stock  
Rural Program Manager, Federal Transit Administration

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