1 **Better Living Through Mobility: The relationship between access to**
2 **transportation, well-being and disability**
3
4
5 Daniel Blais
6 Master's Candidate
7 School of Urban Planning
8 McGill University
9 Suite 400, 815 Sherbrooke St. W.
10 Montreal, Quebec, H3A 2K6
11 Canada
12 Tel.: 514-398-4075
13 Fax: 514-398-8376
14 Email: daniel.blais@mail.mcgill.ca
15
16 Ahmed M. El-Geneidy
17 Associate Professor
18 School of Urban Planning
19 McGill University
20 Suite 400, 815 Sherbrooke St. W.
21 Montreal, Quebec, H3A 2K6
22 Canada
23 Tel.: 514-398-8741
24 Fax: 514-398-8376
25 Email: ahmed.elgeneidy@mcgill.ca
26
27 Word count: 4743 + 3 table (750) + 6 figures (1500) = 6993
28
31

1   **ABSTRACT**
2   Much work on making transportation accessible for people with disabilities has focused on
3   adapting environments and infrastructure. Less work has been done on understanding the
4   relationship between access to transportation, well-being and type of disability. The objective of
5   this paper is to provide a better understanding of this relationship. This is achieved through a
6   statistical analysis of Statistics Canada's 2006 Participation and Activity Limitation Survey (PALS).
7   The statistical analysis consists of descriptive methods and a factor and cluster statistical analysis.
8   Results of the statistical analysis indicate that people with mental/cognitive disabilities are younger
9   and have less income than people with sensory and physical disabilities. The statistical analysis also
10   found that people with disabilities who have access to public transit have a higher sense of well-
11   being. People who do not have access to public transit have a lower sense of well-being, and more
12   so if they cannot afford personal transportation modes such as the car. This relationship between
13   access to public transportation and well-being is more pronounced for people with mental/cognitive
14   disabilities. The results of this research indicate that people with disabilities will have a greater
15   quality of life if they live in areas that provide multiple transportation options. Built environments
16   that facilitate walking and with enough density to support reliable and frequent transit options will
17   ensure the greatest participation in society for people with disabilities. This is particularly true for
18   people with mental/cognitive disabilities, who face an added barrier of having lower incomes and
19   not being eligible for paratransit.
20
21

INTRODUCTION

A person's ability to move freely, without encountering barriers is an essential human right as transportation allows people to carry out activities essential for daily living. However, certain segments of the population encounter obstacles that restrict their mobility and accordingly their ability to carry out different activities. These obstacles include poor design of the physical environment, lack of information, negative attitudes and cost. People who live with sensory, physical, mental and cognitive disabilities may encounter these obstacles and may be at a disadvantage when it comes to using the existing transportation system. This paper focuses on trying to understand the relationship between access to transportation, well-being and type of disability. Much work on making transportation accessible has focused on accommodating sensory disabilities (sight and hearing) and physical disabilities (reduced mobility). This has been done through adaptations to existing environments and infrastructure. Despite these efforts, little work has been done in the area of understanding how access to transportation can affect the quality of life of people with mental/cognitive disabilities *(1, 2)*.

A better understanding of the relationship between access to transportation and the well-being of people with disabilities will be achieved through a review of previous research and documents and through statistical analysis of responses to the Statistics Canada 2006 Participation and Activity Limitation Survey (PALS). PALS is a post-censal survey designed to collect information on people with disabilities, whose everyday activities are limited because of a condition. The survey respondents represent approximately 5.2 million people 15 years old and over in Canada. Of those, approximately 4.2 million people indicated that they have a disability *(3)*. The research review will include research and policy documents on disability, mental/cognitive disability and transportation. The statistical analysis will consist of summary statistics, principle component factor analysis and k-means cluster analysis. The findings of the research review and statistical analysis will be synthesized in order to provide a discussion on how transportation can most effectively improve the well-being and quality of life of people with disabilities.

RESEARCH REVIEW

This section provides explanations of conceptual models, definitions of disability, descriptions of demographic trends and an explanation of the relationship between well-being and mobility. The review also presents the research covered in the area of travel limitation for people with mental/cognitive disabilities.

Concepts Definitions, and Trends

Disability can be perceived as an individual's condition (the medical model) or as a socially constructed obstacle (the social model). The medical model views disability exclusively as a problem of the individual directly caused by disease, trauma, personal tragedy and/or other health conditions. According to this model disability calls for medical or other professional treatment to 'correct' the problem, abnormality or defect. By contrast, the social model conceptualizes disability as a socially created problem that imposes socio-economic, cultural and political disadvantages and not an attribute or characteristic of an individual. According to the social model, disability demands social action, since it is created by an unaccommodating environment *(4, 5)*. There are critics of both of these models. Some say that the medical model ignores the role of the environment in the disabling process. Further, by locating the defect in the individual, that person may be defined as abnormal and biologically or mentally inferior *(4)*. This can create negative attitudes, which can also be an obstacle. Disability is not a characteristic that

should stigmatize a person or detract from their value as a human being *(6)*. Critics of the social model claim it ignores the complex reality of having a disability by making it exclusively a socially created problem *(5)*.

The World Health Organizations (WHO) subscribes to a model that synthesizes what is true and useful in the medical and social models, without reducing complex notions of disability to one aspect. This model is known as the biopsychosocial or functional limitation model. It synthesizes individual medical aspects with physical and social environment aspects *(5)*. Through this model, the WHO defines disability in terms of functioning and disability. Functioning refers to being able to complete major day-to-day activities and disability refers to the inability to perform these activities within the normal range of human ability as a result of impairment. In Canada, definitions of disability are based on the social model, considering disability from the human rights and social equity perspectives. Disabilities are complex and multi-dimensional and providing a single standard definition may not be desirable from this perspective *(4)*. The Charter of Rights and Freedoms defines disability as "any previous or existing mental or physical disability and includes disfigurement and previous or existing dependence on alcohol or a drug". Discrimination on the grounds of disability is prohibited in order to ensure the full participation of people with disabilities in Canadian society *(7)*. Within the context of transportation and mobility, the Canada Transportation Act of 1996 does not specifically define disability; rather it addresses obstacles to accessibility in order to ensure equal access to transportation services. Within a legal context in Canada, it is discriminatory and prohibited to treat people with mental/cognitive disabilities differently from those with physical or sensory disabilities *(4)*.

Mental/cognitive disabilities are defined as a pathological condition resulting from a disease, injury, or other trauma involving the cerebral hemispheres that disrupts attention, perception, memory, problem solving, calculations and reasoning and affects the ability to interpret and communicate concepts and instructions. These types of disabilities may result from neurological conditions, long-term emotional and psychological conditions and substance addiction. Mental/cognitive disabilities cover a wide variety of conditions ranging from communication, memory, learning, developmental or emotional disabilities as well as impairments resulting from brain injuries (e.g.: stroke, head injuries). The degree of severity of disability can range from mild to severe and they are often unseen *(1, 8-11)*. While there is a distinction between mental and cognitive, the two are not mutually exclusive. A mental disability is characterized by alterations in thinking, emotions and behavior. A cognitive disability will predominantly affect a person's concentration, memory and communication *(12, 13)*. Mental/cognitive disabilities can have a significant influence on activities essential for daily living such as communication, mobility, self-care, domestic life, interpersonal interaction and relationships. Addressing these types of disabilities is essential to enhance independence and quality of life *(10)*. Globally people with disabilities represent 15.6% percent of the population (ranging from 11.8% in higher income countries to 18.0% in lower income countries) and there is a trend towards an aging population at unprecedented rates in many higher income countries. There is a well-established link between older age and higher disability rates *(14)*. For Canada, projections indicate that those 65 years old and over are expected to increase from 4.2 million in 2005 to 9.8 million 2036 *(15)*. More than 40% of Canadians aged 65 and over report having a disability; this increases to 53.3% for persons 75 years old and over *(16)*. While it is established that aging brings about a decline in physical and cognitive functions, the general health of the population and life expectancies have improved significantly during the last century. As a result

1 biological decline due to old age will occur later in life. We can expect more older adults and
2 therefore more people with disabilities and reduced mobility in the future *(17)*. The relationship
3 between disability and aging is also prevalent for mental/cognitive disabilities. The WHO reports
4 that 10% of persons over 65 years old and 50% of those over 85 years old have some form of
5 cognitive disability *(10)*. The impacts of these demographics trends on the transportation sector
6 will be significant. As people age, their driving abilities diminish and in much of North America,
7 mobility is reliant upon automobile use. There is great potential for transit to increase mobility
8 for those who do not have access to a car, especially if living in an urban area *(18)*. However,
9 transit service may be unfeasible in areas with low population density, and mainly limited to
10 commuting hours. Retired seniors, (or people who do not work regular hours) require transit
11 outside of commuting hours and limited transit service can impact their well-being. Kim and
12 Ulfarsson *(19)* found that paratransit services are critical to the well-being of older people who
13 have disabilities. Planners should be aware however, that using paratransit creates a segregated
14 service that requires eligibility criteria for travelers and can reduce the incentive to make
15 mainstream transit services flexible and accessible *(20)*.
16   Research has clearly established that there is a link between people's well-being and their
17 mobility *(19, 21)*. The term well-being is synonymous with "quality of life". Measures of well-
18 being are subjective and present how an individual's life is going from their own point of view
19 *(22)*. Lack of mobility is detrimental to quality of life, as it may become a barrier to satisfaction
20 of basic needs and participation in social life *(18, 23, 24)*. Having access to transportation,
21 particularly public transportation, is crucial for ensuring access to employment and education *(6)*.
22 For people with mental/cognitive disabilities access to work can be beneficial for mental health by
23 providing the opportunity to develop skills, self-esteem and well-being. For people with
24 mental/cognitive disabilities, lack of transportation, stigma and discrimination are cited as
25 reasons for unemployment *(25)*.
26   While it is often stated that there is little research on transportation for people with
27 mental/cognitive disabilities, we found a considerable effort that has gone into studying the
28 topic. Previous research has identified a number of complex difficulties people with
29 mental/cognitive disabilities live with that can cause travel limitations. These difficulties are
30 associated with tasks including reading, concentrating, retrieving and interpreting information,
31 understanding abstract concepts, problem solving, managing time pressures and schedules, using
32 memory, ignoring irrelevant stimuli, multi-tasking, orientating, and making decisions. These
33 tasks are required in transportation contexts and they can cause anxiety, confusion and fright,
34 which can affect temper and speech *(1, 8, 9, 26, 27)*. Travel difficulties can occur both in
35 vehicles and in terminals and can include understanding announcements, dealing with
36 unexpected route changes, asking for assistance, interpreting displays, signage, schedules and
37 maps and locating public amenities *(20, 28, 29)*. These complex difficulties can negatively
38 feedback on each other, possibly resulting in the traveler unable to complete a trip or unable to
39 pursue an activity from which the trip is derived *(26)*. This can limit opportunities and create
40 social exclusion *(27)*.
41
42 **STATISTICAL ANALYSIS**
43 A statistical analysis of PALS contributes to better understanding the relationship between access to
44 transportation, well-being and type of disability. The statistical analysis consists of descriptive
45 methods to provide summary statistics and a factor and cluster analyses. Summary statistics are used
46 to provide information on disability and age, disability and income, and disability and modes of

1 transportation used for local (less than 80 km) and long distance (more than 80 km) trips. Factor
2 analysis was used to obtain an understanding of the factors that affect the mobility of respondents.
3 The factor loading is then used as an input in a K-means cluster analysis to group respondents into
4 homogeneous subgroups based on responses to survey questions *(30)*.
5

6 **About the Data**
7 PALS is a national post-censal survey designed to collect information on people who have a
8 disability or whose everyday activities are limited because of a health problem. PALS provides
9 information on supports for people with disabilities, their employment profile, their income and
10 their participation in society *(16)*. The analysis for this study was conducted on respondents who are
11 15 years or older. PALS collects information on ten types of disabilities that are listed and
12 described below:
13 • Hearing: Difficulty hearing what is being said in a conversation.
14 • Seeing: Difficulty seeing ordinary newsprint or clearly seeing someone's face from 4
15   meters away.
16 • Communication: Difficulty speaking and/or being understood.
17 • Mobility: Difficulty walking, negotiating stairs, carrying an object of 5 kg for 10
18   metres or standing for long periods.
19 • Agility: Difficulty with tasks such as bending, dressing, getting into or out of bed,
20   grasping or handling objects, reaching, etc.
21 • Pain: Activity limitation because of long-term pain.
22 • Memory: Activity limitation due to frequent periods of confusion or difficulty
23   remembering things.
24 • Learning: Difficulty learning because of a condition.
25 • Developmental: Cognitive limitations due to an intellectual disability or
26   developmental disorder.
27 • Emotional: Activity limitations due to an emotional or psychological condition.
28

29   Respondents to PALS could select more than one disability. In fact, the prevalence of
30 multiple disabilities is quite common. In order to ensure an accurate interpretation of
31 transportation difficulties, the information presented in this paper only includes respondents who
32 selected one type of disability. Since there is a high prevalence of multiple disabilities a study on
33 the relationship between disabilities should be considered for future research, but is outside the
34 scope of the current effort.
35   For the summary statistics, the ten types of disability were re-organized according to
36 Table 1 in order to simplify presentation of information and to meet the confidentiality
37 requirements of using the PALS dataset. The ten disability types were not reorganized for the
38 factor cluster analysis, in order to ensure better statistical significance.
39
40
41
42
43
44
45
46

1   TABLE 1 Disability Typology

2

PALS 2006 Disability Types	Disability Types Used for Summary Statistics
Hearing Seeing	Sensory
Mobility Agility Pain	Physical
Emotional Communication Memory Learning Developmental	Mental/Cognitive

3

4   **Summary Statistics**

5   Figure 1 shows the age of PALS respondents by type of disability. The figure shows that younger
6   cohorts report having a mental or cognitive disability more frequently and that there is a higher
7   incidence of physical and sensory disability as people age. The amount of respondents drops off at
8   age 85 and older because there are less people in this cohort, but mental/cognitive disabilities
9   increase. Suen *(29)* states that there is a higher rate of diagnosis among the young for
10   mental/cognitive disabilities because older adults manage their disability with coping skills, and
11   may not report it as frequently.

12
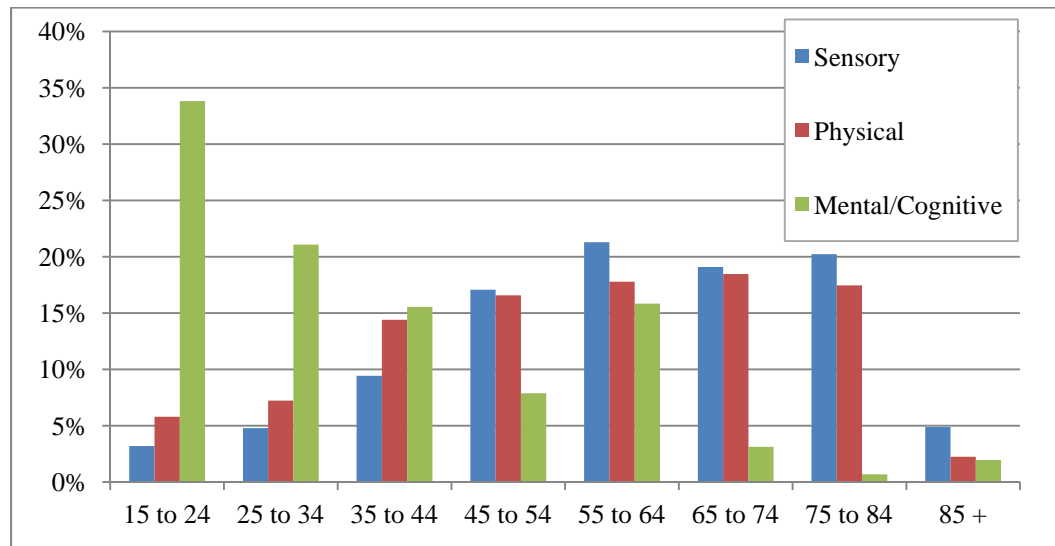
13
14
15   FIGURE 1: Age group by type of disability

16

17   Figure 2 shows total income by disability type. It shows that people with sensory and physical
18   disabilities are more likely to be in a higher income group compared to people who have a
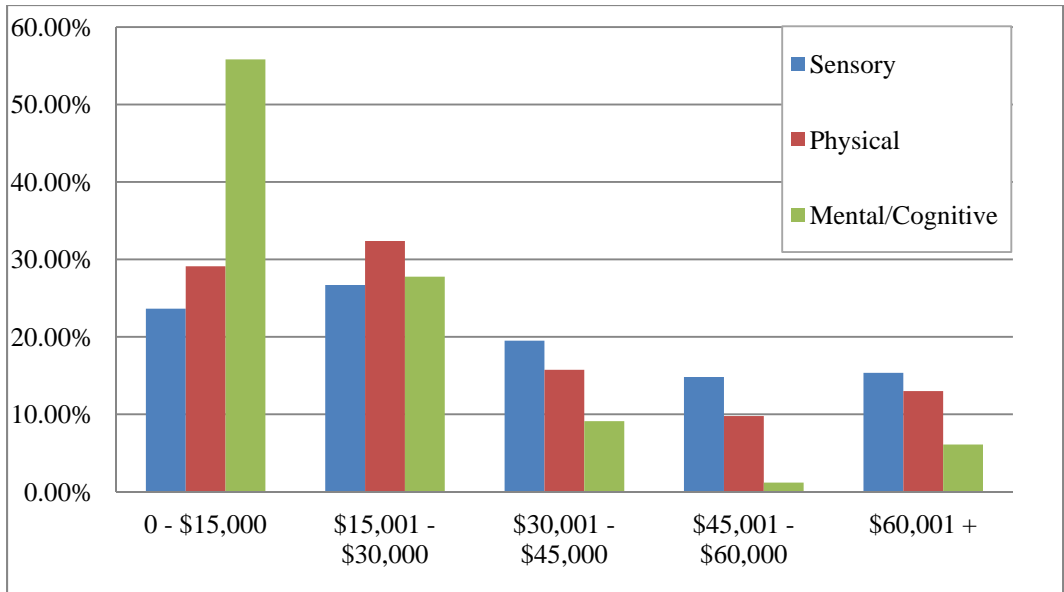19   mental/cognitive disability.

20

1
2
3 FIGURE 2: Types of disability and total income
4
5 Figure 3 shows the mode split between car and public transportation by type of disability for
6 local trips. Public transportation includes bus, paratransit, subway and taxi. The car is the
7 preferred mode of transportation for all types of disability; however, people with
8 mental/cognitive disabilities use public transportation more than people with sensory and
9 physical disability. This may be related to the affordability of public transportation for local trips
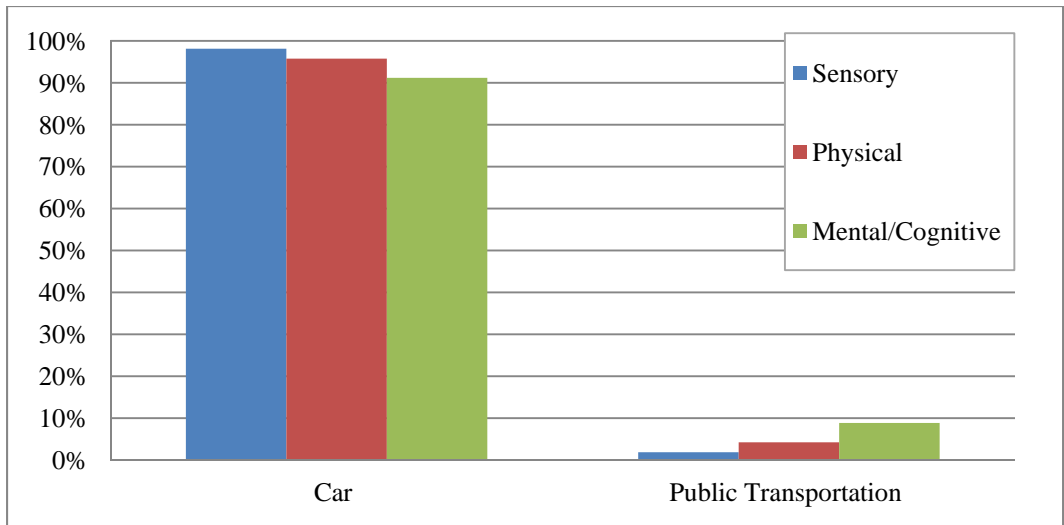10 and the fact that people with mental/cognitive disabilities have lower incomes.
11

12
13
14 FIGURE 3: Local transportation by mode and type of disability
15
16 Table 2 shows the number of observations by type of disability in relation to long distance travel.
17 Figure 4 shows the mode split between car, bus and train, airplane and other modes by disability
18 for long distance trips. Car is the preferred mode, followed by air. There are a higher percentage

1 of people with mental/cognitive disabilities who use the car, which could be related to the
2 affordability of this mode for long distance trips. This group uses the air mode less for long
3 distance trips, which is typically a more expensive mode.
4
5 TABLE 2: Number of people with disabilities who took long distance trips within the last 12
6 months
7

Disability	Frequency	%
Sensory Disability	83,210	41%
Physical Disability	152,910	40%
Mental/Cognitive Disability	26,770	43%

8
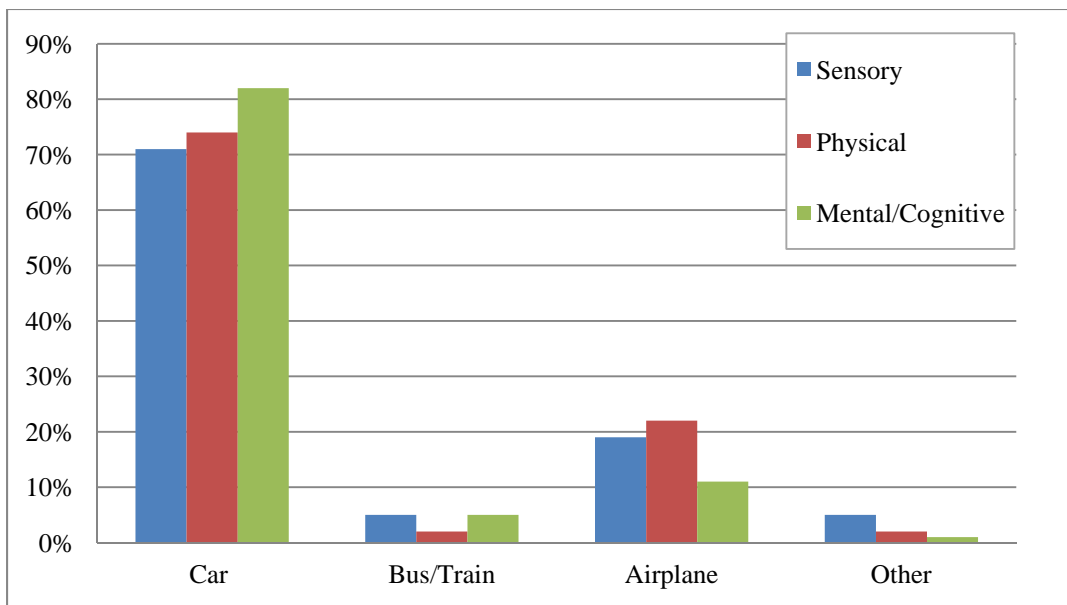
9
10
11 FIGURE 4: Long distance transportation by mode and disability type
12
13 **Factor Analysis**
14 Factor analysis is used to learn how responses to survey questions (i.e.: variables) relate to one
15 another. By doing so, it is possible to better understand how variables in one module (e.g.:
16 satisfaction with life) relate to outcomes in another module (e.g.: local transportation) *(30)*.
17 Responses to 34 variables from the local transportation, satisfaction with life, social contacts and
18 stress modules, as well as some socio-demographic modules including age, level of education,
19 total income and employment are analyzed. The analysis revealed 14 factors with Eigen values
20 greater than 1, which are all retained as part of the analysis. The results of the factor loadings are
21 displayed in Table 3. Within each of the 14 groups of variables, the high values (above about 0.5 in
22 absolute value) are indicated in bold and green highlight. These 14 factors explained 65.4% of the
23 overall variance in the data. Appropriate labels were assigned to describe each of the factors. It
24 should be noted that certain factors only contained one variable, and as such these variables became
25 standalone factors. The 14 factors are listed below:

1. **Pressures** are derived from variables measuring stress, age, employment and if parents are still living.
2. **Earning potential** include variables about having a learning disability, level of education and total income. This factor shows that if a person does not have a learning disability, they would have a higher level of education and higher income.
3. **Well-being** includes variables that measures satisfaction with life.
4. **Social interaction** includes variables about leaving the home to visit family, attend events and visit places.
5. **Transit use** includes variables that indicate that the respondent uses public transportation and does not use a car[1].
6. **Paratransit use** includes variables that indicate that the respondent used paratransit and had difficulty using paratransit.
7. **Travel barriers** includes variables about difficulties encountered while traveling by car, subway and taxi.
8. **Hearing disability** includes variables about having a hearing disability and a pain disability. There is a negative relationship between hearing disability and pain.
9. Does the respondent have a **Mobility disability**.
10. Is the respondent **Agile** (i.e.: the respondent does not have an agility disability).
11. **Mental disability** included variables asking if the respondent had a mental disability, had difficulty using the bus and if they felt they had been treated unfairly because of their condition. The high level of stigma towards mental disability explains why the question about being treated unfairly is grouped in this factor *(13)*. Further, previous research has shown that people with mental disability encounter difficulties with insensitive public transit staff *(29)*.
12. Does the respondent have a **Communication disability**.
13. Does the respondent have a **Memory disability**.
14. Does the respondent have a **Developmental disability**.

---

[1] It should be noted that the variable *Do you use a car* scored a coefficient of -0.469 and related to the Transit use factor variables. The *Do you use a car* variable was not included in the final factor analysis, but it could be assumed that those who use public transit are not using a car and those who do not use public transit are using a car.

TABLE 3: Results of factor analysis

Factor Groups	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Pressures	Are you employed	**.689**	.241	-.024	.007	-.060	-.013	.042	.001	-.109	.052	-.127	-.091	-.070	-.045
	Is your mother still living	**.794**	-.043	-.068	.174	.051	.038	.016	-.024	-.010	.033	.072	.049	-.003	.023
	Is your father still living	**.732**	-.074	-.015	.122	.096	-.003	.080	-.077	-.034	.019	.144	.126	-.002	.034
	AGE	**-.829**	.176	.107	-.123	-.133	.037	-.052	.120	.050	-.063	-.094	-.071	-.022	-.036
	Amount of stress - most days (1 to 5)	**.540**	.327	-.253	-.090	.026	-.058	-.009	-.060	.028	.014	.142	-.087	.079	-.015
Earning potential	Do you have a learning disability	.342	**-.522**	-.054	.183	.009	-.065	-.022	.363	.097	-.025	-.143	-.109	.007	-.112
	Highest certificate, diploma or degree	.102	**.645**	-.042	.254	.202	-.022	-.017	-.086	-.041	.049	-.029	.010	.026	-.021
	Total Income - amount	.025	**.718**	-.071	.138	-.063	-.030	.056	.143	.020	-.014	-.090	-.069	-.038	-.050
Well-being	Feelings about relationships - family (1 to 10)	-.033	.210	**.659**	-.089	.018	.021	-.062	-.096	.098	-.217	-.025	.032	-.033	.060
	Feelings about relationships - friends (1 to 10)	.032	.076	**.692**	-.046	-.029	.038	.027	-.057	.176	-.095	-.045	.055	.082	.027
	Feelings about your health (1 to 10)	-.038	-.178	**.602**	.053	.046	.078	-.016	.281	-.134	.141	-.170	.010	-.039	-.033
	Feelings about job or main activity (1 to 10)	-.163	-.116	**.666**	.070	-.139	-.011	.005	.006	-.108	.115	.051	-.118	-.043	-.042
	Feelings about way spend time (1 to 10)	-.154	-.160	**.730**	.070	-.075	-.107	-.075	.047	-.028	.108	-.069	.004	.008	-.031
Social interaction	Do you visit family outside your home	.063	.139	.062	**.506**	-.073	.046	-.003	-.020	.199	.093	.071	.007	-.402	-.024
	Do you attend events outside your home	.199	.128	.022	**.731**	.105	.005	.037	-.109	.001	-.015	.057	-.084	.018	.012
	Do you visit places outside your home	.105	.068	.002	**.684**	.179	.033	.063	.025	-.237	.002	-.001	.006	.039	.021
Transit use	Do you use the bus	.070	-.132	-.037	.039	**.809**	.100	-.017	-.020	-.037	-.034	.116	.039	.028	-.013
	Do you use the subway	.074	.124	-.095	.008	**.756**	-.064	.054	-.002	-.070	.095	-.061	-.054	-.120	-.036
	Do you use the taxi	.050	.124	-.039	.264	**.627**	.027	.025	.005	.174	-.047	.097	.048	.079	.055
Paratransit user	Do you use paratransit	-.123	-.050	-.010	.130	.145	**.632**	-.031	.009	.186	-.015	-.087	.069	.084	-.005
	Did you have difficulty using paratransit	.073	.015	.008	-.058	-.074	**.812**	-.005	.005	-.108	.001	.063	-.053	-.056	.001
Travel barriers	Did you have difficulty traveling by car	.104	.040	-.013	.057	-.075	-.009	**.659**	-.148	-.002	-.054	-.055	.004	.160	-.003
	Did you have difficulty traveling by subway	.061	-.003	.047	-.121	.191	.034	**.677**	.018	-.063	.047	.229	-.140	-.166	-.032
	Did you have difficulty traveling by taxi	-.009	.016	-.098	.112	-.013	-.060	**.673**	.058	.068	.004	-.056	.119	.020	.031
Hearing disability	Do you have a hearing disability	-.202	.238	.073	-.078	-.054	-.012	-.062	**.566**	-.503	.363	-.065	.020	-.021	.033
	Do you have a pain disability	.200	.052	-.041	.116	.009	-.024	.062	**-.882**	-.160	.179	-.150	-.042	-.034	-.033
Mobility disability	Do you have a mobility disability	-.204	-.010	.064	-.139	.019	.048	.009	.119	**.834**	.169	-.025	-.035	-.039	.003
Agile	Do you have an agility disability	-.164	-.030	-.016	-.029	-.028	.011	.007	.085	-.122	**-.928**	-.027	-.021	-.032	-.011
Mental disability	Do you have an emotional disability	.139	.032	-.082	.024	.029	-.086	-.113	.042	.070	-.027	**.756**	-.068	-.003	.014
	Have you had difficulty traveling by bus	.022	-.089	-.007	-.030	.154	.214	.397	-.044	-.113	.073	**.666**	-.120	-.098	-.024
	Have you been treated unfaily due to your condition	.083	-.071	-.149	.142	.024	-.044	.010	.089	-.034	.016	**.604**	.368	.129	-.022
Cognitive com	Do you have a communication disability	.069	-.022	.018	-.084	.017	.012	.019	.013	-.025	.017	.004	**.901**	-.058	-.018
Cognitive mem	Do you have a memory disability	.008	.018	.019	-.006	-.037	.026	.047	.014	.009	.047	.036	-.040	**.880**	-.016
Cognitive dev	Do you have a developmental disability	.029	-.033	-.009	.020	-.006	-.004	.006	.021	-.003	.010	-.013	-.021	-.011	**.983**

Cluster Analysis

All factors loadings are saved to be used in a cluster analysis. A cluster analysis is used to identify groupings of respondents with similar characteristics based on the factor loadings from the 14 different factors identified in the previous step. The clustering process uses the K-means statistical routine and these groupings are based on transit use and disability type. The routine allows the researcher to specify the number of clusters that are created, and an output of 4 clusters was selected. The decision to use 4 clusters was based on the statistical output, the manner in which the output is interpreted, and precedents from previous research. Cluster membership and values associated to factor loading are displayed in Figure 5. Examining the defining characteristics and preferences of each cluster reveals four distinct groups. These groups split as those who use transit and those who do not use transit. Transit users and non-transit users breakdown into two subgroups, those who reported having a mental disability and those who reported have a sensory or physical disability.

The breakdown of clusters is the following: transit users represent 46.7% of which 3.7% have a mental disability and 43% have a sensory or physical disability; non-transit users represent 53.3% of which 27% have a mental disability and 26.3% have a sensory or physical disability. The height and direction of each bar in Figure 5 graphically presents the value of the cluster center for each of the 14 factors. Color-coding was used to identify categories of factors. Orange shades represent social and demographic factors, blue shades represent transportation factors and green shades represent disability factors.

Upon closer inspection, several defining characteristics stand out. Both types of transit users tend to have slightly lower pressures than the non-transit users and much lower earning potential. However, both types of transit users have higher levels of well-being than non-transit users. Transit users with mental disabilities score much lower on the social interaction factor compared to transit users with sensory or physical disabilities. Transit users with mental disabilities use transit less and paratransit much less than transit users with sensory or physical disabilities. This could be due to eligibility criteria for using paratransit. Transit users with mental disabilities encounter more travel barriers than transit users with sensory or physical disabilities. For non-transit users, those with mental disabilities have a very low level of well-being and social interaction and experience much higher travel barriers. The non-transit users with sensory or physical disabilities have a much higher earning potential, well-being and social interaction and lower travel barriers. This could be related to the fact that they can afford to personal transportation and are therefore more mobile. Overall the non-transit user with sensory or physical disabilities cluster fares the best inter terms of social and demographic factors.

In summary the results of this analysis show that transit users with disabilities have lower income and lower level of education overall, yet this does not necessarily affect their sense of well-being. It shows that non-transit users have higher levels of income and education, yet lower levels of well-being than transit users. The results of the data analysis indicate that people with low socio-economic status, a limited social network and limited transportation options will have a lower quality of life. The results will be discussed further in the next section.

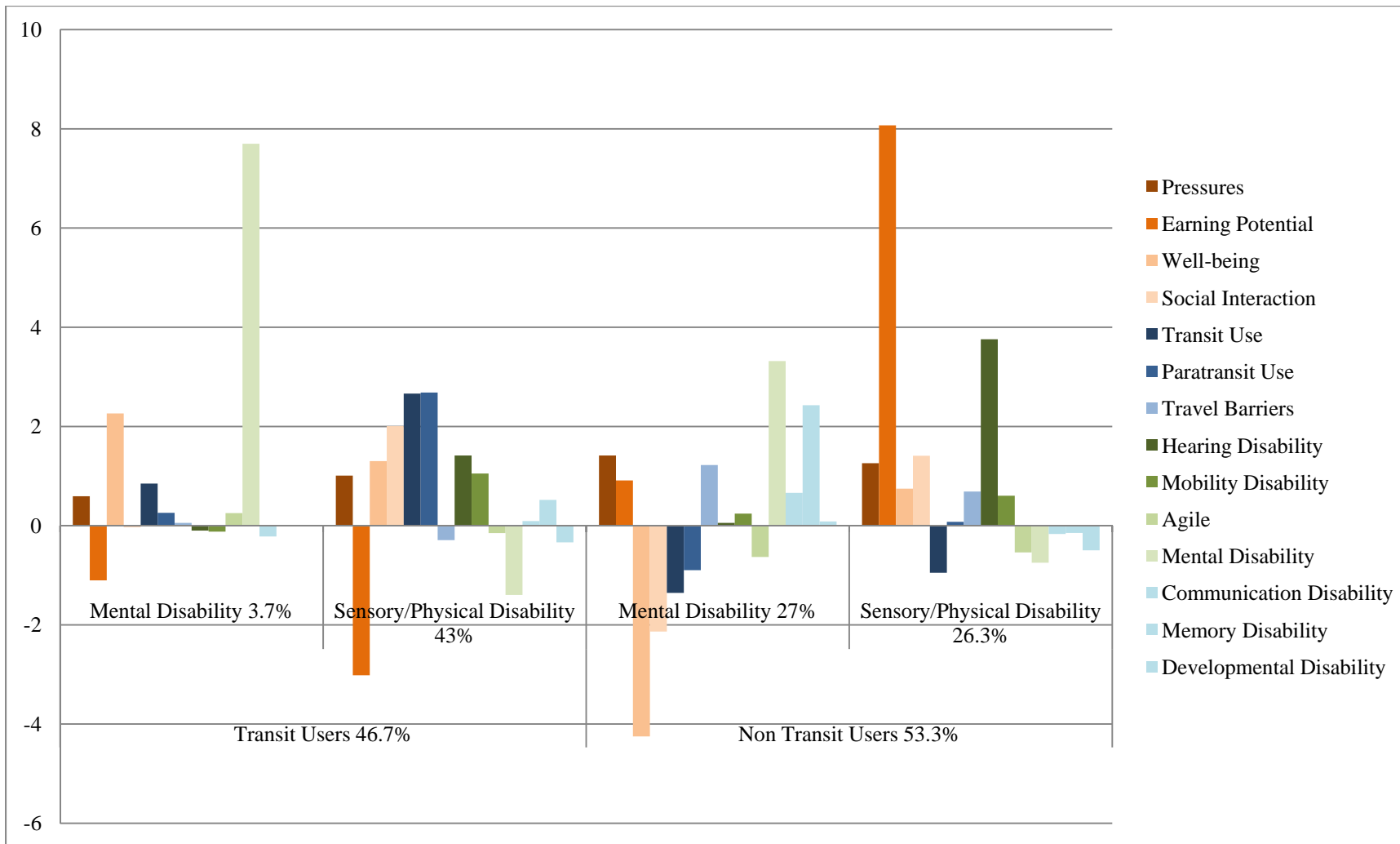FIGURE 5: Graphic display of cluster analysis

DISCUSSION

The results of the factor/cluster analysis are consistent with existing research. The analysis indicates that transit users have slightly lower pressures and much lower earning potential. Previous research has shown that transit users are often seniors, or have disabilities and have lower incomes *(31)*. However, transit users tend to have a higher sense of well-being than non-transit users. Transit availability is much higher in denser urban environments. While incomes for transit users may be lower than non-transit users, there are more potential opportunities for interaction in denser urban areas, which could explain the higher well-being. For non-transit users with mental/cognitive disabilities, not having access to transit could significantly affect well-being and hinder social interaction, particularly for individuals without access to a car living in sub-urban environments. Having a higher income and being able to afford personal transportation, or being eligible for paratransit will improve well-being and social interaction. A quantitative study undertaken by Kim and Ulfarsson *(19)* confirms these findings. Their results show that lack of transportation in general is found to be a significant factor negatively associated with quality of life and that a built environment, which facilitates walking, is found to be positively associated. Duarte et al. *(22)* also find a significant relationship between mode choice and well-being. Like the present study, they found happier people more prone to using public transportation. Having access to public transportation, is crucial for ensuring access to employment and education *(6)*. For the people with mental/cognitive disabilities the use of public transportation is linked to living independently, holding a job and socializing *(16, 18, 20)* and well-being.

Figure 6 illustrates the different characteristics of the four clusters in relation to levels of well-being, income, social interaction, social exclusion and access to transit. The figure highlights the relationship that access to transit has on well-being. Having access to transit has a more significant influence on well-being than having a higher income. People with higher incomes who do not have access to transit may be able to afford personal transportation as indicated by the non-transit user with sensory or physical disabilities cluster. However, their level of well-being is not as high as transit users with sensory or physical disabilities. Further, non-transit users require a much higher income to have a slightly higher well-being. Both transit users and non-transit users with sensory or physical disabilities have positive levels of social interaction, but it is higher for transit users. For people with mental disabilities the impacts of having access to transit are drastic. Transit users with mental disabilities have the highest level of well-being. Non-transit users with mental disabilities have the lowest levels of well-being and social interaction. They are also found to have the highest travel barriers. Providing non-transit users with mental disabilities access to transit will greatly enhance their quality of life, social interaction and independence.
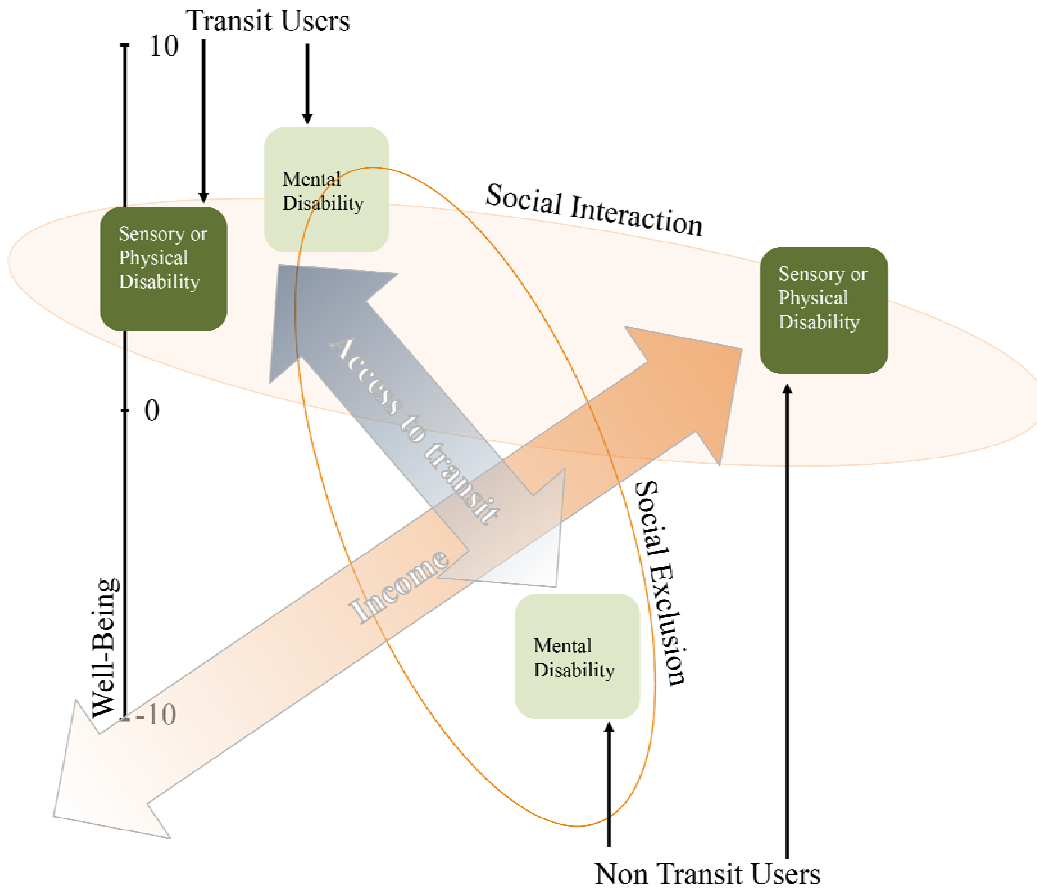
Figure 6: Schematic diagram of type of disability, mode choice, access to transit, income, social exclusion and well-being

CONCLUSION

The research behind this paper has uncovered a wealth of information on transportation, well-being and disability. The review of definitions, concepts and trends has shown that there are two ways to define disability. It can be defined a) as an individual's condition or impairment affecting the ability to complete essential activities; or b) or as socially imposed barriers that create exclusion. From the human rights perspective, it is important to ensure that all members of society are treated equally. The objective should not be to treat everyone the same, but to recognize and accommodate differences in order to ensure equal treatment and equal access to opportunities. This can be complex when trying to accommodate the transportation needs of a people with mental/cognitive disabilities.

Mental/cognitive disabilities cover a wide range of conditions that are often unseen. These types of disabilities can significantly impact an individual's ability to completed essential daily activities. Strong social support networks and positive attitudes as well as access to transportation can help to enhance independence and quality of life for people with mental/cognitive disabilities. Results of the statistical analysis of the present study indicate that people with mental/cognitive disabilities are younger and have less income than people with sensory and physical disabilities. The statistical analysis also found that access to transit has a

1 significant impact on well-being, especially for people with mental/cognitive disabilities. Access to
2 transit has a greater impact on well-being than level of income. Not having access to transit and not
3 being able to afford personal transportation is detrimental to well-being and can lead to social
4 exclusion. Built environments that facilitate walking and with enough density to support reliable
5 and frequent transit options will ensure the greatest participation in society for people with
6 disabilities. This is particularly true for people with mental/cognitive disabilities, who face an added
7 barrier of having lower incomes and not being eligible for paratransit. Accommodating the
8 transportation needs of people with mental/cognitive disabilities by providing access to transit will
9 go a long way in ensuring their full and equal participation in society.
10
17

18 **REFERENCES**
19 1.   Hunter-Zaworski, K. *Improving bus accessibility systems for persons with sensory and*
20   *cognitive impairments*. Publication DOT-T-94-04 Federal Transit Administration,
21   Washington, DC, 1993.
22 2.   Risser, R., S. Iwarsson and A. Ståhl. How do people with cognitive functional limitations
23   post-stroke manage the use of buses in local public transport? *Transportation Research*
24   *Part F*, Vol. 15, 2012, pp. 111-119.
25 3.   Statistics Canada. *Participation and activity limitation survey public use microdata file*
26   *user guide*. 12M0021G. Statistics Canada Health Statistics Division Ottawa 2011.
27 4.   Human Resources Development Canada. *Defining disabilit: A complex issue*. RH37-4/3-
28   2003E. Human Resources Development Canada, Gatineau, Canada 2003.
29 5.   Ustun, T., S. Chatterji, J. Bickenbach, N. Kostanjsek and M. Schneider. The international
30   classification of functioning, disability and health: A new tool for understanding
31   disability and health. *Disability and Rehabilitation*, Vol. 25, No.11-12, 2003, pp. 565-
32   573.
33 6.   McCluskey, M. Rethinking equality and difference: Disability discrimination in public
34   transportation. *The Yale Law Journal*, Vol. 97, No.Yale L.J. 863, 1988, pp. 863-881.
35 7.   Department of Justice Canada. *Constitution act*. Minister of Justice, Ottawa, Canada,
36   1982.
37 8.   Turnbull, A. and J. McKenzie. *Technologies for travellers with Sensory or Cognitive*
38   *Disabilities* Publication TP13247E Transport Canada Montreal, Canada, 1998.
39 9.   Rutenberg, U., A. Arnold and U. Wallersteiner. *Assessment of in-cabin information*
40   *technologies for passengers with sensory and cognitive impairments*. Publication TP
41   13152E Transport Canada, Transportation Development Centre, Montreal, Canada, 1999.
42 10.   Arthanat, S., S. Nochajski and J. Stone. The international classification of functioning,
43   disabilities and health and its application to cognitive disorders *Disability and*
44   *Rehabilitation*, Vol. 26, No.4, 2004, pp. 235-245.
45 11.   Scheid, T. Stigma as a barrier to employment: Mental disability and the Americans with
46   disabilities act. *International Journal of Law and Psychiatry*, Vol. 28, 2005, pp. 670-691.

12. International Transport Forum. *Cognitive impairment, mental health and transport: Design with everyone in mind*. Publication International Transport Forum, Paris, France, 2009.

13. Health Canada. *A report on mental illnesses in Canada*. Publication 0-662-32817-5 Health Canada Ottawa, Canada 2002.

14. World Health Organization and World Bank. *World report on disablity* Publication World Health Organization and World Bank, Geneva, Switzerland 2011.

15. Turcotte, M. and G. Schellenberg. *A portrait of seniors in Canada*. 89-519-XIE. Statistics Canada, Ottawa, Canada, 2006.

16. Statistics Canada. *Participation and activity limitation survey 2006: Analytical report* Publication 89-628-XIE Statistics Canada Ottawa, 2007.

17. Waara, N. and A. Ståhl. the need for information in public transport. Presented at International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED 2004), Hamamatsu, Japan, 2004.

18. Davies, D., S. Stock, S. Holloway and M. Wehmeyer. Evaluating a GPS-based transportation device to support independent bus travel by people with intellectual disability. *Intellectual and Developmental Disabilities*, Vol. 48, No.6, 2010, pp. 454-464.

19. Kim, S. and G. Ulfarsson. Transportation in an aging society: The linkage between transportation and quality of life. Presented at Annual Meeting of the Transportation Research Board, Washington DC, 2013.

20. Fischer, G. and J. Sullivan. Human centered public transportation systems for persons with cognitive disabilities: Challenges and insights for participatory design Presented at Participatory Design Conference Malmo, Sweden, 2002.

21. Kim, T., S. Choo, Y. Shin and S. You. Identifying differences of travel time budgets between the elderly and the non-elderly groups using PSL-structural equation models: A case Study for Seoul metropolitan area. Presented at Annual Meeting of the Transportation Research Board, Washington DC, 2013.

22. Duarte, A., C. Garcia, G. Giannarakis, S. Limão, A. Polydoropoulou and N. Litinas. New approaches in transportation planning: happiness and transport economics. *NETNOMICS: Economics Research and Electronic Networking*, Vol. 11, No.1, 2009, pp. 5-33.

23. Wasfi, R., D. Levinson and A. El-Geneidy. Measuring the transportation needs of people with developmental disabilities. Presented at Annual Meeting of the Transportation Research Board, Washington DC, 2006.

24. Sammer, G., T. Uhlmann, W. Unbehaun, A. Millonig, B. Mandl, J. Dangschat and R. Mayr. Identification of mobility impaired persons and analysis of their travel behaviour as well as their needs. Presented at Annual Meeting of the Transportation Research Board, Washington DC, 2012.

25. An, S., R. Roessler and B. McMahon. Workplace discrimination and Americans with psychiatric disabilities: A comparative study. *Rehabilitation Counseling Bulletin*, Vol. 55, No.1, 2011, pp. 7-20.

26. Suen, L., P. McInerney and B. Barkow. Travel difficulties related to vision, hearing and cognitive/emotional disability. Presented at International Conference on Mobility and Transport for Elderly and Disabled Persons, Lyon, France, 1992.

27. Lamont, D. Understanding and addressing dyslexia in transport provision. Presented at International Conference on Mobility and Transport for Elderly and Disabled Persons, Hong Kong, 2010.

28. Rosenkvist, J., K. Wendel, A. Stahl, R. Risser and S. Iwarsson. Public transport planning from the perspective of people with cognitive functional limitations. Presented at International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED 2007), Montreal, Canada, 2007.

29. Suen, L. and H. Chan. Mobility for travelers with attention deficit hyperactivity disorder and learning disabilities: Challenges and solutions. Presented at Annual Meeting of the Transportation Research Board, Washington DC, 2013.

30. Krizek, K. and A. El-Geneidy. Segmenting preferences and habits of transit users and non-users. *Journal of Public Transportation*, Vol. 10, No.3, 2007, pp. 71-95.