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Understanding Technology-Based Exclusion in Emerging Smart Mobility Systems

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TRANSPORTATION RESEARCH AND EDUCATION CENTER
PORTLAND STATE UNIVERSITY

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Project team

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Public transportation providers increasingly move to payment, reservation, information, trip-planning and last/first-mile connectivity systems which require travelers to have access to ***private*** internet, smartphone and banking/credit services.

What steps can be taken to ensure universal access to these innovations?

A multi-agency funded project:

City of Eugene, OR
City of Gresham, OR
Lane Transit District (Eugene, OR)
Clevor Consulting Group, Portland, OR
RTD Denver
National Institute for Transportation and Communities (NITC)
at Portland State University

NITC
NATIONAL INSTITUTE for
TRANSPORTATION and COMMUNITIES

Motivation

- Payment technologies in a variety of contexts are rapidly evolving
- Many public transit agencies plan to adopt these new “automated payment” technologies for fare collection over the coming decade
- Will likely smooth operations and improve convenience
- What about those who cannot adopt these new payment technologies?
- Are there reasonable equity mitigations? How costly and effective are those mitigations?

Existing disparities access to automated payment “ecosystem”

Existing Research – Banking Divide

	Age	Income	Race/Ethnicity	Overall averages
Banking	Older population higher access	Higher income population higher access	White households higher access	87% use some banking resources, 67% “fully banked”
Credit	Very young and very old have lower access to credit	Higher income population higher access	White and Asian households higher access	80.3% access to some credit

FDIC (2018), Brakewood and Kocur (2013)

Existing Research – Digital Divide

	Age	Income	Race/Ethnicity	Overall averages
Smartphone Ownership	Younger, higher ownership	Higher income population higher ownership	Mixed results: FDIC: African Americans lower, and Asian higher than average Pew: African Americans and Hispanic higher than average	2017: 72.7%
Cell service data access	Younger more likely than average to let service lapse	Low-income households about twice as likely as average to let service lapse	African Americans and Hispanics are around twice as likely as whites to let service lapse	23% let cell service lap
Internet access at home	Mixed results: FDIC: High (0ver 75%) across the age groups until tapering off over 55 Pew: Higher access (more than 94%) for those over 50	Higher income population higher access	African Americans lower, and Asian higher, than average	FDIC: 72.6% have home internet access Pew: 90% have “broadband”

FDIC (2018), Pew (2015)

Existing Research – New Mobility

	Age	Income	Race/Ethnicity	Overall averages
New mobility Services, access to	No spatial deficiencies in access to TNC services in L.A. (Brown 2019)	No spatial deficiencies in access to TNC services in L.A. (Brown 2019). Bikeshare and carshare availability appears to be equitable (Schaller 2016)	No spatial deficiencies in access to TNC services in L.A. (Brown 2019). Bikeshare and carshare availability appears to be equitable (Schaller 2016)	Geography of services varies by region
New mobility Services, use of	Barriers to use due to technology proficiency (Shirgaokar 2018); Higher TNC use among younger population (Schaller 2016)	Mixed results: Schaller (2016) reports higher use of TNCs among higher income. Rayle et al. (2016) report moderate income (and collage educated) highest users of TNCs. Gehrke et al (2018) report incomes of users similar to the rest of the Boston region.	Mixed results: Higher frequency (per capita trips) of TNC use among ethnic and racial minorities (Shaheen 2017, Brown 2019, and Schaller 2016). Feigon and Murphy (2018) report is inconclusive – whiter neighborhoods generate more trips, but not in all regions studied	A few percent of all trips (varies by region) – no national data

Overall project research questions

1. What is the prevalence and types of automated fare payment systems in the U.S.?
2. How do the automated payment systems impact/exclude different riders?
   - Demographics: Different ages, incomes, race/ethnicity, etc.
   - Geography: Live or work in neighborhoods underserved by transit or other amenities
   - Technology: Do not own smartphones or have readily available internet access
   - Banking: Are under- or un-banked
   - Other.. (e.g. language, technological proficiency)
3. What mitigation strategies have agencies adopted?
4. How cost effective are they – from an agency and rider point of view?

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3. What mitigation strategies have agencies adopted?
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Data collection methods

- Portland, Denver and Eugene case studies
- Two focus groups in East Portland and one in Eugene
- Larger sample surveys in the three cities

Case cities

	Lane County Transit District (Eugene, Oregon)	Denver Regional Transportation District	Tri-County Metro Transportation (TriMet) (Portland-Gresham, Oregon)
Urbanized Area Population	247,421	2,374,203	1,849,898
Service district population	302,200	2,920,000	1,551,531
Annual Boardings (Unlinked) (M/year)	10.7	104.8	97
Vehicles Operated in Max Service	Bus-89, BRT-18	Bus-1043, LRT-172	Bus-670, LRT-145

Focus groups

- Gresham: low-income, mix of English language proficiency, and age
- Eugene: low income – mostly transit dependent

Concerns discussed by participants:

- Transit affordability, access, time of day/scheduling, etc.
- Trust
  - Fear of tracking, loss, theft, data privacy, battery power
  - Discomfort using new payment systems (call-in, web, apps)
  - Identity theft can be devastating for low-income households
- Understanding fare media and policy
- Lack of access to data and internet
- Diverse uses of smartphones
- Worried about losing cash as “backup” or for tourists

Large sample survey

- Short intercept surveys at transit stops in Portland, Gresham, Eugene and Denver in July to September 2019

Equity analysis – comparing the experience of groups of riders

- Millennials are those under 35, Generation X is 35 to 55 and Boomers are those over 55
- Race/ethnicity – NHW or POC
  - Non-Hispanic Whites (NHW) = Not Hispanic *and* selecting White for their race *Or* those skipping the Hispanic question but selecting White for their race
  - No response to both questions were classified as “missing”
  - Persons of color selected Hispanic and/or a race other than White
- Low-Income were those with incomes below 50,000 dollars per year

	Denver	Eugene	Gresham/Portland	Composite
N	514	1240	549	NA
Race/Ethnicity group:				
Missing	10%	11%	17%	13%
NHW	36%	63%	44%	41%
POC	54%	26%	40%	46%
Age Group:				
Boomer	14%	21%	16%	15%
Generation X	26%	25%	26%	26%
Millennial	46%	40%	41%	43%
Missing	14%	14%	18%	16%
Income Group:				
High Income	19%	7%	15%	17%
Low Income	44%	60%	43%	44%
Missing	36%	33%	42%	39%
Income:				
(blank)	12%	11%	16%	14%
Less than $14,999	17%	29%	19%	18%
$15,000 to $24,999	8%	15%	9%	9%
$25,000 to $34,999	9%	8%	8%	8%
$35,000 to $49,999	11%	8%	7%	9%
$50,000 to $74,999	6%	4%	7%	6%
$75,000 to $99,999	5%	1%	3%	4%
$100,000 to $149,999	4%	1%	3%	4%
$150,000 or more	3%	1%	2%	2%
Prefer not to say	25%	22%	26%	25%
Gender:				
(blank)	8%	7%	12%	10%
Female	35%	45%	37%	36%
Male	56%	45%	48%	52%
Non-Binary / Third Gend	0%	2%	1%	1%
Prefer not to say	1%	1%	1%	1%

Overall results for cities and composite ridership:

	Denver	Eugene	Gresham/Portland	Composite
N	514	1240	549	
Share of riders with current fare payment practice:				
Employer provided	27	35	16	22
Social service provider	6	0	8	7
Cash on bus	33	29	24	29
Cash at TVMs	29	19	25	27
Cash at retail/agency	19	15	13	16
Apple/Android Pay	NA	NA	6	6
Credit/debit at TVM	21	10	15	18
Smartphone app	23	5	31	26
Credit/debit at retail/agency	13	14	11	12

Overall results for cities and composite ridership:

	Denver	Eugene	Gresham/Portland	Composite
N	514	1240	549	
Share of riders lacking access to banking and internet:				
Unbanked (No savings, checking, credit, debit accounts)	13	14	14	14
Lacks smartphone	12	19	14	13
No Internet	6	8	6	6
Only Wi-Fi for internet	28	38	28	29
Share of riders experincing phone data limitations:				
No data use on phone	11	14	13	12
Somewhat or very concerned about data limits	19	26	21	20
Share of riders completely or somewhat uncomfortable using the following payment practices:				
Website - One Time Payment	26	30	21	24
Website - Recurring payments	36	45	29	33
Smartphone - Recurring payments	32	NA	25	28
Purchase by phone	NA	49	40	40
Share of current cash-on-board users who will switch to the following practices:				
Some form of Credit/Debit (Online, Phone, etc.)	33	36	39	35
Some form of Cash (TVM, Retail, etc.)	43	63	35	41
Unable to Ride	22	13	23	22

Results by income group:

	Denver			Eugene			Gresham/Portland			Composite		
	High	Low	Miss.	High	Low	Miss.	High	Low	Miss.	High	Low	Miss.
Total	99	228	187	89	743	408	82	234	233	17%	44%	39%
Share of riders with current fare payment practice:												
Employer provided	35	24	26	27	37	34	29	14	13	33	21	20
Social service provider	3	9	5	0	0	0	1	11	7	2	9	6
Cash on bus	21	36	36	28	30	28	9	27	27	16	32	31
Cash at TVMs	24	31	30	26	20	15	15	29	24	20	29	27
Cash at retail/agency	12	23	18	17	17	12	7	17	12	10	20	15
Apple/Android Pay	NA	NA	NA	NA	NA	NA	6	11	2	6	11	2
Credit/debit at TVM	26	21	18	16	12	5	23	18	10	25	19	13
Smartphone app	38	24	15	7	6	2	35	35	25	36	27	19
Credit/debit at retail/agency	16	14	12	19	16	10	12	13	9	15	14	10

Results by income group:

	Denver			Eugene			Gresham/Portland			Composite		
	High	Low	Miss.	High	Low	Miss.	High	Low	Miss.	High	Low	Miss.
Total	99	228	187	89	743	408	82	234	233	17%	44%	39%
Share of riders lacking access to banking and internet:												
Unbanked (No savings, checking, credit, debit accounts)	0	11	22	4	10	23	4	9	24	2	10	23
Lacks smartphone	5	14	14	16	17	24	2	15	17	4	14	16
No Internet	1	6	10	1	7	11	2	5	8	2	6	9
Only Wi-Fi for internet	19	35	26	26	41	35	16	29	31	18	32	29
Share of riders experincing phone data limitations:												
No data use on phone	2	13	12	7	12	18	2	15	14	2	14	13
Somewhat or very concerned about data limits	17	19	20	25	27	25	29	19	20	22	20	20
Share of riders completely or somewhat uncomfortable using the following payment practices:												
Website - One Time Payment	19	27	29	30	28	32	15	20	26	18	24	28
Website - Recurring payments	33	36	38	44	48	42	20	27	33	28	33	36
Smartphone - Recurring payments	29	31	34	NA	NA	NA	16	24	28	24	28	31
Purchase by phone	NA	NA	NA	53	50	45	41	36	42	42	38	42
Share of current cash-on-board users who will switch to the												
Some form of Credit/Debit (Online, Phone, etc.)	62	34	24	28	42	26	43	37	40	57	36	31
Some form of Cash (TVM, Retail, etc.)	29	40	50	80	62	61	29	40	31	31	41	42
Unable to Ride	10	24	22	4	13	16	29	24	21	13	23	21

Results by race / ethnicity:

	Denver			Eugene			Gresham/Portland			Composite		
Row Labels	NHW	POC	Miss.	NHW	POC	Miss.	NHW	POC	Miss.	NHW	POC	Miss.
Total	184	279	51	785	322	133	240	217	92	41%	46%	13%
Share of riders with current fare payment practice:												
Employer provided	25	29	22	36	35	32	17	18	7	22	25	13
Social service provider	5	8	0	0	0	0	7	10	3	6	9	2
Cash on bus	28	38	25	28	39	15	20	30	21	24	35	22
Cash at TVMs	25	34	22	19	24	8	24	29	17	24	32	19
Cash at retail/agency	16	23	12	15	19	8	15	12	10	16	19	10
Apple/Android Pay	NA	NA	NA	NA	NA	NA	6	9	1	6	9	1
Credit/debit at TVM	27	17	20	10	12	2	13	19	11	19	18	14
Smartphone app	26	24	8	4	7	1	36	29	22	29	26	16
Credit/debit at retail/agency	15	13	8	15	15	8	13	10	10	14	12	9

Results by race / ethnicity:

	Denver			Eugene			Gresham/Portland			Composite		
Row Labels	NHW	POC	Miss.	NHW	POC	Miss.	NHW	POC	Miss.	NHW	POC	Miss.
Total	184	279	51	785	322	133	240	217	92	41%	46%	13%
Share of riders lacking access to banking and internet:												
Unbanked (No savings, checking, credit, debit accounts)	8	12	35	11	14	28	10	13	27	9	13	30
Lacks smartphone	13	13	10	19	15	27	14	11	20	14	12	16
No Internet	5	6	10	8	4	17	6	4	11	6	5	11
Only Wi-Fi for internet	28	31	16	37	42	34	28	27	29	29	30	24
Share of riders experincing phone data limitations:												
No data use on phone	13	10	4	15	8	21	14	12	13	13	11	10
Somewhat or very concerned about data limits	15	20	25	24	34	25	18	24	21	17	22	23
Share of riders completely or somewhat uncomfortable using the following payment practices:												
Website - One Time Payment	26	26	29	31	25	33	20	22	24	24	24	26
Website - Recurring payments	38	36	35	47	41	47	28	28	32	34	33	34
Smartphone - Recurring payments	34	30	35	NA	NA	NA	24	25	26	28	28	30
Purchase by phone	NA	NA	NA	51	44	50	39	40	39	41	40	40
Share of current cash-on-board users who will switch to the												
Some form of Credit/Debit (Online, Phone, etc.)	47	26	38	39	32	20	34	48	16	41	34	26
Some form of Cash (TVM, Retail, etc.)	33	50	23	64	67	30	40	32	32	39	44	28
Unable to Ride	20	23	15	11	15	25	26	20	26	21	22	22

Results by age:

	Denver				Eugene				Gresham/Portland				Composite			
Row Labels	Boomer	Gen-X	Millenn.	Miss.	Boomer	Gen-X	Millenn.	Miss.	Boomer	Gen-X	Millenn.	Miss.	Boomer	Gen-X	Millenn.	Miss.
Total	73	132	237	72	263	315	492	170	86	140	225	98	15%	26%	43%	16%
Share of riders with current fare payment practice:																
Employer provided	19	20	33	26	44	24	40	28	12	21	17	10	17	21	26	18
Social service provider	11	5	6	4	0	0	0	0	7	13	7	2	8	8	6	3
Cash on bus	25	32	38	28	17	38	32	24	27	17	31	15	25	25	35	21
Cash at TVMs	16	31	34	24	9	25	22	15	35	23	26	17	25	27	30	20
Cash at retail/agency	25	21	16	19	16	21	13	10	28	19	6	9	26	20	11	14
Apple/Android Pay	NA	NA	NA	NA	NA	NA	NA	NA	3	6	8	3	3	6	8	3
Credit/debit at TVM	19	23	20	21	5	13	13	4	15	12	19	11	16	18	19	15
Smartphone app	10	26	30	13	5	4	5	4	21	25	43	20	15	24	34	16
Credit/debit at retail/agency	14	17	12	11	17	17	12	9	26	19	2	9	20	18	8	10

Results by age:

	Denver				Eugene				Gresham/Portland				Composite			
Row Labels	Boomer	Gen-X	Millenn.	Miss.	Boomer	Gen-X	Millenn.	Miss.	Boomer	Gen-X	Millenn.	Miss.	Boomer	Gen-X	Millenn.	Miss.
Total	73	132	237	72	263	315	492	170	86	140	225	98	15%	26%	43%	16%
Share of riders lacking access to banking and internet:																
Unbanked (No savings, checking, credit, debit accounts)	14	10	8	32	10	17	10	24	9	11	13	27	11	11	11	29
Lacks smartphone	41	8	5	17	40	18	6	25	37	11	5	17	39	10	5	17
No Internet	22	4	1	13	19	7	2	10	16	2	1	12	19	3	1	12
Only Wi-Fi for internet	26	36	27	22	28	43	40	39	30	30	26	27	28	34	27	25
Share of riders experincing phone data limitations:																
No data use on phone	38	8	4	8	32	13	4	15	33	10	7	12	35	9	5	11
Somewhat or very concerned about data limits	7	20	21	24	16	30	30	26	21	19	24	19	14	20	22	22
Share of riders completely or somewhat uncomfortable using the following payment practices:																
Website - One Time Payment	42	25	23	22	40	35	19	35	35	24	14	22	39	25	19	23
Website - Recurring payments	52	36	35	28	51	51	39	44	40	34	19	34	46	36	28	32
Smartphone - Recurring payments	47	32	28	28	NA	NA	NA	NA	35	28	16	30	41	30	23	29
Purchase by phone	NA	NA	NA	NA	56	52	44	46	43	45	36	37	45	46	37	37
Share of current cash-on-board users who will switch to the																
Some form of Credit/Debit (Online, Phone, etc.)	39	38	32	25	35	33	42	22	13	38	53	13	26	38	40	20
Some form of Cash (TVM, Retail, etc.)	44	43	43	40	72	66	60	56	52	42	27	33	50	44	38	38
Unable to Ride	17	19	24	20	9	14	15	12	35	21	20	20	25	19	22	20

Some punchlines

- Transit riders are similarly resourced to the general population
  - Still, significant barriers exist for many current transit riders to transition to emerging payment systems
- A significant number (~30%) still rely heavily on paying cash-on-board buses
  - Most appeared able to switch to other cash and non-cash options, though a significant number will continue with cash
- Overall, smartphone ownership is high (over 80%) for all groups other than Boomers
  - A small but significant number (~20%) are concerned about reaching data limits
  - A significant number (~30%) depend solely on public Wi-Fi for Internet connectivity
- A small but significant number (~14%) have no access to formal banking services
- There is general unease storing credit information in websites or smartphones
- There are some important and troubling disparities:
  - Low income respondents had a lower access to smartphones, Internet, and banking.
  - Older respondents had significantly lower access to smartphones and Internet connectivity
  - Some of these disparities differed slightly from city to city

Implications for practice

- Age and income-related exclusion most troubling
- Local conditions may vary from city to city
- Education and training will be key to lower anxiety and improve understanding of new systems
- Public Wi-Fi may be an important link
- Free or subsidized smartphones (like energy and telecom) and internet?

Next Steps

- Case studies of equity mitigations
  - Retaining pieces of cash payment systems
- Develop cost-effectiveness evaluation
- Which mitigations make sense?

Questions?