Appendix 6 - NTAS Persona Development Approach

As part of Phase II of the National Transit Adaptation Strategy (NTAS), the San Francisco Municipal Transportation Agency (SFMTA) partnered with the Massachusetts Institute of Technology's (MIT) JTL Urban Mobility Lab to process survey data to define the persona descriptions included in the NTAS Phase II report. In May 2023, PhD student Nick Caros completed a two-part analysis to inform the four transit rider personas. First, systems were classified into 'Legacy' systems, 'Transformative' systems, and 'Rural and Connector' systems based on information from the American Public Transit Association's (APTA) fact book and Federal Transit Administration (FTA) National Transit Database (NTD) reports. Next, survey data collected through the Transit app of nearly 14,000 responses from over 400 transit systems was analyzed to identify rider clusters by system type.

After this analysis was completed and delivered to SFMTA, SFMTA NTAS project staff synthesized the information about the clustered rider types and developed the four transit rider personas described in the NTAS Phase II report and that inform the rider acquisition strategies developed in later NTAS project phases.

The following slides include a full explanation and detailed results of the analysis process.

NTAS Transit App Survey Analysis

MIT Transit Research Consortium

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Outline

1. System classification

2. Clustering results by system type

All code (but not survey data) available here: https://github.com/nick-caros/sfmta_survey (access upon request)

System classification

Data sources for system classification

Legacy	Transformative	Rural and Connector
A transit system operating +/- 1950.	A transit system operating after 1955.	A transit system operating after 1955.
A transit system that historically was based on a streetcar or pre-existing rail network.	A transit system that is in a mid or major U.S. metropolitan area.	A transit system that is not in a mid or major U.S. metropolitan area or is a regional connector within a major metropolitan area.
A system in a U.S. major metropolitan area.	A system that has seen significant system expansion or growth over the last 20-years.	A system that serves less than 500,000 riders annually.

Classification metric	Data source
Service opening date	APTA Fact Book Data Table 130 (and Wikipedia where needed)
Metropolitan area size	NTD 2019 Metrics
Ridership	NTD 2019 Metrics (note - I used pre-pandemic numbers)

General rules

1. Ignored ferry systems, private airport shuttles

2. Any system serving less than 500k trips annually: **Rural and Connector**

3. System in metro with population < 1M (not mid or major metro): **Rural and Connector**

4. System in metro area with population between 1M and 3M: **Transformative**

5. System in metro area with population > 3M (i.e. major metro): **Legacy**

Exceptions:

● Baltimore, St. Louis, Memphis, Pittsburgh (< 3M pop.) systems changed to **Legacy**
● Atlanta (>3M) system changed to **Transformative** due to rapid growth in recent decades
● Large, growing DC and SF suburban systems classified separately as **Transformative**

Classification results

Legacy	Transformative		Rural / Connector
- Baltimore - Chicago - Dallas - Detroit - Houston - Los Angeles - Memphis - Miami - Minneapolis - New York City - Philadelphia - Pittsburgh - San Diego - San Francisco - Seattle - St. Louis - Washington DC	- Atlanta - Austin - Charlotte - Cincinnati - Cleveland - Columbus - DC Suburbs - Denver - Hartford CT - Honolulu - Indianapolis - Inland Empire - Jacksonville - Kansas City	- Las Vegas - Milwaukee - Nashville - New Orleans - Oklahoma City - Orlando - Phoenix - Portland OR - Providence RI - Raleigh - Sacramento - Salt Lake City - San Antonio - Silicon Valley - Tampa	All other systems, including small regional connector systems in or near cities to the left.

Clustering by system type

Clustering results

- Used February 2023 survey responses, although survey data available for:

  - April, July and October 2021

  - January, April, August and November 2022

- The number of responses by agency type are as follows (13,819 total):

  - Legacy: 7,961

  - Transformative: 4,247

  - Rural / Connector: 1,656

Summary

- Cluster assignment is dominated by car ownership, regardless of system type.

- Using race and gender data identified some interesting racial differences, especially in Rural/Connector systems

- All systems have 3 clusters of car free riders (generally split into White, African American and Latinx groups) and 1 cluster of "car access but not owner" (Young Professionals and Students).

- The "Car owning transit commuters of color" is unique to Legacy systems

- Rural and Transformative systems have similar clusters, but different overall demographics (Rural clusters are generally lower income, lower age, more school trips)

Clustering results: Legacy (k=6)

Cluster #1	Cluster #2	Cluster #3	Cluster #4	Cluster #5	Cluster #6
Car-free rider who uses transit for all trips	Car-free Latinx riders who use transit for work and school	High-income, car owning, infrequent transit user	Car-free, low income, African-American riders	Young professionals and students	Car-owning transit commuters of color
1694 respondents	1842 respondents	884 respondents	1762 respondents	866 respondents	913 respondents
• No car access • Moderate age • Moderate income • Moderate number of trips • Mostly male (63%) • Largely white (85%) • Frequent bus rider	• No car access • Moderate age • Low income • High number of trips • Gender balance • Mostly Latinx ethnicity • Unlikely to use transit for recreation	• Owns car • Moderate age • High income • Lowest number of trips • Mostly male (70%) • Almost entirely white • Uses light rail and commuter rail more than others	• No car access • Moderate age • Low income • High number of trips • Slightly more female than male (55%) • 99% African American • Uses the bus	• Car access but not owner • Lowest age • Moderate income • Moderate number of trips • Slightly more male than female • Very racially diverse • Uses transit for all trip purposes	• Owns car • Highest age • Moderate-high income • Moderate number of trips • 58% male • Largely African-American or Latinx • Uses transit for work

Clustering results: Transformative (k=5)

Cluster #1	Cluster #2	Cluster #3	Cluster #4	Cluster #5
Car-free, low income, white transit dependent rider	Car-free, low income, Latinx frequent transit rider	Young professionals and students	Car-free, low income, African-American commuters	Car-owning, high income discretionary transit rider
1289 respondents	787 respondents	407 respondents	840 respondents	918 respondents
• No car access • Highest age • Low income • Moderate number of trips • 61% male • 94% white • Uses transit for all trip purposes; most likely cluster to use transit for errands and recreation	• No car access • High age • Very low income • Highest number of trips • 57% male • 84% Latinx, 10% AAPI • Uses transit for work and school more than #1, but less for other trips	• Access to a car but not owner • Lowest age • Moderate income • Moderate number of trips • 61% male • Ethnically diverse • Uses transit more for school than other clusters	• No car access • Moderate age • Low income • High number of trips • Mostly female (52%) • Over 99% African-American • Uses transit more for work than other clusters, but also for other purposes	• Car owner • Moderate age • Highest income • Lowest number of trips • Mostly male (69%) • 69% white, 16% Latinx, 14% African-American • Uses transit for work, recreation more than average

Clustering results: Rural / Connector (k=5)

Cluster #1	Cluster #2	Cluster #3	Cluster #4	Cluster #5
Car-free, young, low income frequent transit riders of color	High income, car owning, discretionary transit riders	Car-free, low income, white transit dependent riders	Car-free, low income, African American transit dependent riders	Young professionals and students
273 respondents	399 respondents	517 respondents	231 respondents	160 respondents
• No car access • Low age • Low income • Highest trip frequency • 59% male • 60% Latinx, 26% AAPI, 9% Native American • Mostly likely to use transit for school, least likely to use transit for work relative to other clusters	• Owns car • Moderate to low age • Highest income • Lowest trip frequency • 61% male • 77% white, 13% Latinx, 10% African American • Uses transit for all trip purposes, least likely to use it for errands relative to other clusters	• No car access • Moderate age • Low income • Moderate trip frequency • 59% male • 100% white • Uses transit for errands much more than other clusters, also highest usage of transit for work trips	• No car access • Moderate age • Low income • Moderate trip frequency • 50% male • 100% African American • Similar trip purposes to Cluster #3, but half as likely to use transit for recreation, and less likely for errands	• Car access but not car owner • Low age • Moderate income • Moderate trip frequency • 61% male • Diverse ethnicities • Uses transit for all trip purposes at high rates

Appendix: Full clustering results for Legacy systems

	cluster_1_mean	cluster_2_mean	cluster_3_mean	cluster_4_mean	cluster_5_mean	cluster_6_mean
Weekly Trips	5.128099	5.608578	3.847285	5.376844	5.028868	4.685652
Connection	0.163518	0.144951	0.099548	0.118048	0.147806	0.123768
Errands	0.763872	0.458198	0.388009	0.618615	0.594688	0.399781
Recreation	0.628099	0.306189	0.471719	0.342225	0.501155	0.278204
School	0.142267	0.244843	0.113122	0.166288	0.287529	0.143483
Work	0.691263	0.804017	0.781674	0.750851	0.741339	0.832421
Bus	0.933294	0.883279	0.821267	0.930193	0.934180	0.824754
Metro	0.563164	0.509229	0.496606	0.489784	0.584296	0.590361
Light Rail	0.244982	0.104235	0.272624	0.162883	0.222864	0.139102
Commuter Rail	0.144038	0.128122	0.150452	0.081725	0.152425	0.140197
Micromobility	0.141677	0.042888	0.176471	0.047673	0.113164	0.055860
Drive	0.017710	0.020087	0.692308	0.021566	0.285219	0.447974
Taxi/TNC	0.391972	0.180239	0.273756	0.286606	0.347575	0.184009
Eth. MENA	0.024793	0.010858	0.016968	0.005108	0.006928	0.021906
Eth. AAPI	0.128099	0.078176	0.039593	0.022134	0.147806	0.205915
Eth. Other	0.031877	0.021173	0.011312	0.026674	0.031178	0.037240
Eth. Latin	0.044864	0.889794	0.049774	0.045970	0.295612	0.368018
Eth. White	0.849469	0.023344	0.988688	0.021566	0.301386	0.012048
Eth. Native Am	0.030697	0.019001	0.013575	0.047673	0.055427	0.028478
Eth. Afr Am	0.027745	0.022801	0.019231	0.986379	0.356813	0.418401
Female	0.362456	0.466341	0.296380	0.557889	0.435335	0.418401
Income	53.155254	28.887079	107.392534	32.783768	60.294457	68.337897
Age	40.969894	40.337676	40.472851	43.496027	33.974596	44.422782
No Car	1.000000	1.000000	0.000000	1.000000	0.000000	0.000000
Car Access	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
Owns Car	0.000000	0.000000	1.000000	0.000000	0.000000	1.000000

Appendix: Full clustering results for Transformative

	cluster_1_mean	cluster_2_mean	cluster_3_mean	cluster_4_mean	cluster_5_mean
Weekly Trips	4.931730	5.266836	4.641278	5.130952	3.855120
Connection	0.086113	0.125794	0.110565	0.091667	0.130719
Errands	0.740109	0.520966	0.523342	0.577381	0.323529
Recreation	0.536074	0.219822	0.437346	0.329762	0.334423
School	0.117145	0.162643	0.280098	0.169048	0.188453
Work	0.633825	0.716645	0.697789	0.759524	0.713508
Bus	0.969744	0.964422	0.928747	0.972619	0.862745
Metro	0.046548	0.111817	0.076167	0.083333	0.059913
Light Rail	0.190846	0.085133	0.164619	0.069048	0.263617
Commuter Rail	0.062839	0.059720	0.093366	0.042857	0.167756
Micromobility	0.138092	0.048285	0.132678	0.045238	0.159041
Drive	0.026377	0.031766	0.366093	0.033333	0.675381
Taxi/TNC	0.311094	0.205845	0.329238	0.333333	0.225490
Eth. MENA	0.012413	0.012706	0.009828	0.009524	0.013072
Eth. AAPI	0.048875	0.102922	0.127764	0.016667	0.089325
Eth. Other	0.023274	0.034307	0.031941	0.027381	0.023965
Eth. Latin	0.039566	0.841169	0.223587	0.052381	0.160131
Eth. White	0.935609	0.045743	0.484029	0.059524	0.687364
Eth. Native Am	0.042669	0.049555	0.063882	0.064286	0.033769
Eth. Afr Am	0.019395	0.007624	0.277641	0.995238	0.141612
Female	0.384794	0.429479	0.390663	0.521429	0.309368
Income	32.732739	22.547649	46.124079	24.985119	72.156863
Age	43.973623	43.749682	34.078624	41.447619	40.985839
No Car	1.000000	0.977128	0.000000	0.964286	0.000000
Car Access	0.000000	0.000000	1.000000	0.000000	0.000000
Owns Car	0.000000	0.022872	0.000000	0.035714	1.000000

Appendix: Full clustering results for Rural/Connector

	cluster_1_mean	cluster_2_mean	cluster_3_mean	cluster_4_mean	cluster_5_mean
Weekly Trips	5.054945	4.035088	4.798839	4.887446	4.500000
Connection	0.117216	0.070175	0.075435	0.069264	0.100000
Errands	0.512821	0.293233	0.729207	0.640693	0.568750
Recreation	0.336996	0.315789	0.470019	0.242424	0.431250
School	0.373626	0.358396	0.195358	0.199134	0.356250
Work	0.608059	0.621554	0.640232	0.636364	0.618750
Bus	0.970696	0.949875	0.986460	0.961039	0.968750
Metro	0.128205	0.072682	0.040619	0.095238	0.093750
Light Rail	0.058608	0.055138	0.029014	0.038961	0.075000
Commuter Rail	0.032967	0.060150	0.027079	0.025974	0.068750
Micromobility	0.043956	0.125313	0.087041	0.051948	0.193750
Drive	0.032967	0.676692	0.029014	0.047619	0.375000
Taxi/TNC	0.245421	0.165414	0.251451	0.281385	0.268750
Eth. MENA	0.014652	0.017544	0.011605	0.012987	0.018750
Eth. AAPI	0.260073	0.060150	0.013540	0.008658	0.093750
Eth. Other	0.054945	0.022556	0.017408	0.030303	0.037500
Eth. Latin	0.597070	0.130326	0.042553	0.082251	0.200000
Eth. White	0.036630	0.769424	1.000000	0.064935	0.600000
Eth. Native Am	0.091575	0.045113	0.058027	0.060606	0.050000
Eth. Afr Am	0.018315	0.102757	0.023211	1.000000	0.243750
Female	0.406593	0.388471	0.413926	0.502165	0.393750
Income	29.368132	67.268170	27.519342	23.463203	44.203125
Age	34.996337	36.759398	39.957447	41.510823	32.556250
No Car	0.989011	0.000000	1.000000	0.948052	0.000000
Car Access	0.000000	0.000000	0.000000	0.000000	1.000000
Owns Car	0.010989	1.000000	0.000000	0.051948	0.000000