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Travel-Times Analysis and Passenger Transport Disutilities in Congested American Cities: Los Angeles, New York, Atlanta, Austin, and Chicago

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Abstract.

Travel-Times Analysis can produce biases in Urban Mobility assessments. Conversely, Disutilities Analysis fulfills the requirement to assess Urban Mobility by travel-time, monetary costs, and environmental performance. Thus, an experiment regarding Los Angeles, New York, Atlanta, Austin, and Chicago compares Automobile and Public Transportation Travel-Times with Total Disutilities Cost per Mile. Public Transportation, even with limitations, can be competitive, at least in two cities: Atlanta and New York. The results confirm the broader scope of the Disutilities Analysis in Urban Mobility appraisals.

Keywords: Disutilities, Passenger Transport, Urban Mobility, Travel-Time, American Cities.

1. Introduction

People usually consider traffic jams and variations in journey time as the cost to ‘acquire’ displacements or a kind of price for sharing progress, independently if they use Automobile or Public Transportation [1,2,3,4]. However, this issue has been comprehensively studied as a consequence of determining occurrences, by Traffic Engineering, because of vehicle excess [5], Economics, due to loss of production derived from the lost time in congestions [6], and Urban Planning, as the result of poor distribution of activities in urbanized areas [7].

On the other hand, more recently, the authors of this paper have been conducted several studies and researches regarding Passenger Transport Disutilities as a manner to evaluate mobility performance. As a matter of principle, it is supported that, despite supplying the means for people’s displacements, Passenger Transport causes losses, inconveniences, and disadvantages that can be understood as disutilities. Passenger Transport Disutilities imposed on Passengers are Time and money spending (Cost), Insecurity (unsafe conditions as to traffic accidents), and Discomfort, and, on Society, Negative Impacts on Communities. In all these studies and researches, Time appears to be one of the most critical disutilities components, as it somehow influences all the other components [8,9,10,11,12,13].

Under these conditions, the research question is, how can we assess urban mobility more comprehensively besides analyzing only travel-times? This issue allows us to state the purpose of our article, showing why the analysis of passenger transport disutilities is more comprehensive than travel-time analysis in urban mobility assessments.

Thus, a study of travel-times behavior from its standard practices [5], to a more accurate analysis of the mobility of congested American cities can be useful to more in-depth the understanding of Time and its role and influence in disutilities assessments.

In this sense, we pick among the ten top worse Corridors in the 20 most congested American cities [14], five cities (and their correspondent Corridors) to compare Automobile and Public Transportation travel-time behavior in a random weekday with a Disutilities Analysis.

There are typical differences in travel-times, particularly for Automobile, consistent with the literature [5]. This means pronounced rush-hours in the afternoon in all cities. Diversely, Public Transportation is less susceptible to variations the more protected from the general traffic it is, mainly in case of buses, but with some influence of the overcrowding along the day even in closed systems, like subways, for example [15].

On the other side, Disutilities Analysis shows less influence of travel-times variations, bringing about not so intuitive outcomes, because it considers the state of the art of Urban Mobility evaluation, by including not only travel-time, but monetary costs, and environmental performance [15]. Thus, the Automobile keeps out of rush-hours Total Disutilities Cost per Mile practically constant. Similarly, Public Transportation, even sometimes more expensive due to (the Cost of) Time, show stable values in most cities all day long and, consequently, its competitiveness.

2. Material and Methods

The scientific method is a process for conducting an investigation or study [16]. Our investigation, to answer the research question, comply with five steps:

- Stating the problem- Travel-Times Analysis produces biases in urban mobility assessments?
- Making observations - Disutilities analyses consider, in addition to travel times, travel costs, and environmental performance of transportation modes.
- Forming a hypothesis - Disutilities analysis fulfills the requirements to reduce travel-time analysis biases.
- Testing the hypothesis by conducting an experiment or a case study - Five corridors from the 20 most congested in five U.S. cities were selected, and travel-times and disutilities for Automobiles and Public Transportation were compared.
- Drawing a conclusion based on results and its discussions – In urban mobility performance evaluation, disutility analysis is more comprehensive and produces more enlightening results than a simple time-based analysis.

Thus, the collection of 24 hours per day of travel-time of five Corridors/cities [14] for Automobile and Public Transportation, building up 240 numbers. The cities are Los Angeles, New York City, Atlanta, Austin, and Chicago.

2.1. Data and Information in the INRIX Global Traffic Scorecard [14]

Tab. 1 shows the five worst Corridors in the U.S. and Tab. 2 the 20 most congested cities in the country [14].

Table 1. Top 10 Worst Corridors in the U.S. (Source: Adapt [14])

<i>Rank</i>	<i>City</i>	<i>Road Name</i>	<i>From</i>	<i>To</i>	<i>Distance (Miles)</i>	<i>Daily Delay (minute)/Yearly Delay</i>
1	Los Angeles	I-5	I-10	I-605	12.7	20/80
2	New York	I-95	Bruckner Expressway	George Washington Bridge	8.3	16/64
3	Atlanta	I-85/I-75	T. Mathis Parkway	College Park	24.1	16/64
4	Austin	I-35	West Slaughter Lane	East Dean Keaton Street	13.9	16/64
5	Chicago	I-290	I-294	I-90	13.6	14/56

Table 2. Top 20 Most Congested Cities in the U.S. (Source: Adapt [14])

<i>2019 Congestion Rank</i>	<i>Urban Area</i>	<i>Hour Lost in Congestion per Year</i>
1	Boston, MA	149
2	Chicago, IL	145
3	Philadelphia, PA	142
4	New York, NY	140
5	Washington, DC	124
6	Los Angeles, CA	103
7	San Francisco, CA	97
8	Portland, OR	89
9	Baltimore, MD	84
10	Atlanta, GA	2
11	Houston, TX	81
12	Miami, FL	81
13	New Orleans, LA	79
14	Seattle, WA	74
15	Stamford, CT	74
16	Providence, RI	70
17	San Diego, CA	70
18	Austin, TX	69
19	Sacramento, CA	64
20	Dallas, TX	63

2.2. Data and Information Organization

March 12th, 2020 (before Coronavirus effects), is the weekday adopted. Google Maps® provides, for Automobile and Public Transportation (bus lines in all cities, except in Atlanta - combination fifty-fifty of bus and train), the hourly travel-time of each Corridor. **Corridors are a given element of reality. They differ as they are, e.g., Automobiles (typically) can run all the time, and Public Transportation mainly buses**

run on average 18 to 20 hours per day. The results are shown in Tab. 3, extreme values highlighted.

Table 3. Travel-Time in the Selected Cities – Automobile (Auto) and Public Transportation (PT) (Minutes) (Source: authors)

<i>Hour</i>	<i>Los Angeles</i>		<i>New York</i>		<i>Atlanta</i>		<i>Austin</i>		<i>Chicago</i>	
	<i>Auto</i>	<i>PT</i>	<i>Auto</i>	<i>PT</i>	<i>Auto</i>	<i>PT</i>	<i>Auto</i>	<i>PT</i>	<i>Auto</i>	<i>PT</i>
12 AM	16	105	20	50	30	74	24	71	24	118
1	16	105	20	50	30	80	22	71	22	137
2	16	105	20	50	30	80	22	71	20	99
3	16	105	18	50	30	80	22	71	24	104
4	16	80	20	49	30	68	24	71	20	109
5	16	83	20	59	30	68	22	71	28	105
6	22	58	35	55	35	73	24	75	20	109
7	28	82	40	54	45	72	55	81	30	113
8	16	81	50	52	55	63	60	81	22	91
9	24	87	50	52	50	71	40	81	24	109
10	26	91	45	52	45	71	30	81	20	97
11	28	97	45	53	40	71	30	83	24	125
12 PM	30	106	50	53	45	71	30	83	20	103
1	35	71	45	55	50	71	30	82	22	125
2	55	73	60	57	55	70	30	94	20	100
3	70	65	60	58	75	79	40	91	24	114
4	80	73	65	48	100	80	65	88	22	102
5	85	73	65	55	100	78	65	85	28	119
6	70	68	50	52	80	75	45	86	22	139
7	45	74	35	50	55	68	30	83	24	93
8	26	90	26	47	40	68	28	90	20	99
9	20	109	22	45	35	83	26	80	24	94
10	18	108	28	45	35	83	26	87	20	99
11	18	115	28	55	35	83	26	71	24	104

Time, Cost, Insecurity, and Discomfort, as disutilities imposed on Passengers, and Infrastructure, Noise, Local Gases, and GHG (greenhouse gases), imposed on Society, are calculated in line with [10], updated some sources [17,18,19,20]. By adding Time (as a function of income), to Cost (proportional to expenses and fares), and pollution (related to the distance of displacement), and dividing by the correspondent distances of displacement in each Corridor, one obtains Total Disutilities Cost per Mile. Insecurity, Discomfort, and Infrastructure as non-monetary values are, therefore, disregarded in the calculations. Tab. 4 displays the results, extremes values underlined.

3. Results and Discussions

Automobile travel-time behaves as usual in American cities, with the ‘traditional’ afternoon peak from 03:00 to 08:00 PM. New York is crowded all day, from 06:00 AM, and Austin also has a morning rush-hour, as well as Atlanta, albeit more discreetly. The differences between the highest and lowest values are in Los Angeles (5.31), New York (3.61), Atlanta (3.33), Austin (2.95), and Chicago (1.50).

Public Transportation rush-hours can hardly be characterized, and travel-times usually oscillate less than with Automobile. Here we have in Los Angeles (1.98), Chicago (1.53), Atlanta and Austin (1.32), and New York (1.31). Public Transportation is faster than Automobile in the afternoon rush hour in Los Angeles, New York,

and Atlanta (slower in Austin and Chicago). The relations are in Los Angeles (6.56), Chicago (6.32), Austin (3.35), New York (2.95), and Atlanta (2.67).

Table 4. Total Disutilities per Mile (US Dollars/Mile) – Auto and PT (Source: authors)

<i>Hour</i>	<i>Los Angeles</i>		<i>New York</i>		<i>Atlanta</i>		<i>Austin</i>		<i>Chicago</i>	
	<i>Auto</i>	<i>PT</i>	<i>Auto</i>	<i>PT</i>	<i>Auto</i>	<i>PT</i>	<i>Auto</i>	<i>PT</i>	<i>Auto</i>	<i>PT</i>
12 AM	1.10	2.91	1.59	2.66	1.07	1.15	1.43	2.44	1.44	3.94
1	1.10	2.91	1.59	2.66	1.07	1.22	1.37	2.44	1.38	4.55
2	1.10	2.91	1.59	2.66	1.07	1.22	1.37	2.44	1.32	3.34
3	1.10	2.91	1.50	2.66	1.07	1.22	1.37	2.44	1.44	3.50
4	1.10	2.26	1.59	2.61	1.07	1.07	1.43	2.44	1.32	3.66
5	<u>1.06</u>	2.32	<u>1.57</u>	<u>3.05</u>	<u>1.06</u>	1.04	<u>1.34</u>	<u>2.42</u>	1.55	3.51
6	1.24	<u>1.67</u>	2.25	2.87	1.12	1.10	1.40	2.54	<u>1.30</u>	3.64
7	1.39	2.29	2.47	2.82	1.25	1.09	2.36	2.73	1.62	3.77
8	1.08	2.27	2.93	2.73	1.38	<u>0.97</u>	2.52	2.73	1.36	3.07
9	1.29	2.42	2.93	2.73	1.32	1.07	1.90	2.73	1.43	3.64
10	1.34	2.53	2.70	2.73	1.25	1.07	1.59	2.73	1.30	3.26
11	1.39	2.68	2.70	2.78	1.19	1.07	1.60	2.79	1.43	4.15
12 PM	1.44	2.91	2.93	2.78	1.25	1.07	1.60	2.79	1.30	3.45
1	1.57	2.01	2.70	2.87	1.32	1.07	1.60	2.76	1.36	4.15
2	2.08	2.06	3.38	2.96	1.38	1.06	1.60	<u>3.13</u>	1.30	3.35
3	2.48	1.85	3.38	3.00	1.63	1.18	1.91	3.04	1.43	3.80
4	2.73	2.06	<u>3.61</u>	2.55	<u>1.96</u>	1.19	<u>2.67</u>	2.95	1.36	3.42
5	<u>2.88</u>	2.06	<u>3.61</u>	2.87	<u>1.96</u>	1.17	<u>2.67</u>	2.85	<u>1.55</u>	3.96
6	2.47	1.93	2.93	2.73	1.70	1.13	2.05	2.88	1.36	<u>4.59</u>
7	1.85	2.11	2.28	2.66	1.40	1.07	1.61	2.81	1.44	3.15
8	1.36	2.52	1.87	2.52	1.20	1.07	1.55	3.03	1.32	3.34
9	1.20	3.01	1.68	<u>2.43</u>	1.14	<u>1.26</u>	1.49	2.72	1.44	<u>3.18</u>
10	1.15	2.99	1.96	<u>2.43</u>	1.14	<u>1.26</u>	1.49	2.93	1.32	3.34
11	1.15	<u>3.17</u>	1.96	2.89	1.14	<u>1.26</u>	1.49	2.44	1.44	3.50

Regarding Total Disutilities per Mile, the relations remain when compared to travel-times, but with lower values: Los Angeles (2.71), New York (2.25), Austin (1.96), Atlanta (1.85), and Chicago (1.24). The same happens with Public Transportation, as we have: Los Angeles (1.89), Chicago (1.50), Atlanta (1.30), Austin (1.29), and New York (1.25). The relation between Public Transportation with Automobile is 3.37 in Chicago, 2.65 in Los Angeles, 1.96 in Austin, 1.77 in New York, and 1.14 in Atlanta.

Table 5 shows the relation between extreme values.

Table 5. Rates of Extreme Values (Source: authors)

<i>Mode of Transportation</i>	<i>Method of Analysis</i>	<i>Los Angeles</i>	<i>New York</i>	<i>Atlanta</i>	<i>Austin</i>	<i>Chicago</i>
Auto	Travel-Time	5.31	3.61	3.33	2.95	1.50
	Disutilities	2.71	2.25	1.85	1.96	1.24
	Dis/Travel	0.51	0.62	0.56	0.66	0.83
PT	Travel-Time	1.98	1.31	1.32	1.32	1.53
	Disutilities	1.89	1.25	1.30	1.29	1.50
	Dis/Travel	0.95	0.95	0.98	0.98	0.98
PT x Auto	Travel-Time	6.56	2.95	2.67	3.35	6.32
	Disutilities	2.65	1.77	1.14	1.96	3.37
	Dis/Travel	0.40	0.60	0.43	0.59	0.53

Here there are appealing findings. Total Disutilities Cost per Mile consistently represents by 51 to 83% of Automobile travel-time and 40 to 59% in the comparison of

Public Transportation versus Automobile. The same does not happen in the case of Public Transportation, for which the influence, even consistent, is a small one.

4. Conclusions and Outlook

From the Travel-Time Analysis, we could (wrongly) understand that if Automobile ‘suffered’ less in traffic jams, everything would be settled, and Public Transportation would remain in a secondary plan. Conversely, Disutilities Analysis strengthens the idea that there is only one way to improve Passenger Transport, both Automobile and Public Transportation: by the reduction of their disutilities.

Atlanta, followed by New York, has currently in their Corridors, Public Transportation, even with limitations, competitive concerning Automobile. Automobile remains convenient only in the late hours of the night, and the dawn, when Public Transportation does not work or works bad or little, once Automobile follows the money (demand), and Public Transportation is a ‘supply’s slave.’

If we established conclusions only based on the analysis of travel times, we could propose as public policy the eradication of Public Transportation by bus in all cities, because, except at peak-hours, Automobiles are usually faster than buses and trains. Disutility Analysis, however, shows that Public Transportation is competitive concerning the Automobile in Atlanta, and New York, and needs to improve more in Los Angeles, Austin, and Chicago.

This paper points out that Urban Mobility evaluation, only from Travel-Time Analysis, can produce biases as an inherent risk of any societal or economic approach. Diversely, Disutilities Analysis, besides travel-time, introduces monetary costs and environmental performance. Although there are vast (and expected) differences in Automobile travel-times, it is understandable that a more comprehensive method (focused on Passengers and Society), such as Disutilities Analysis, can and should be strengthened and refined. Further studies are needed to confirm the main findings of this paper. In the meantime, it is hoped that Disutilities Analysis can drive the use of Passenger Transport with fewer disutilities in the next future.

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