

Measuring what matters:

שיטות וכלים חדשניים לזיהוי בעיות תחבורתיות

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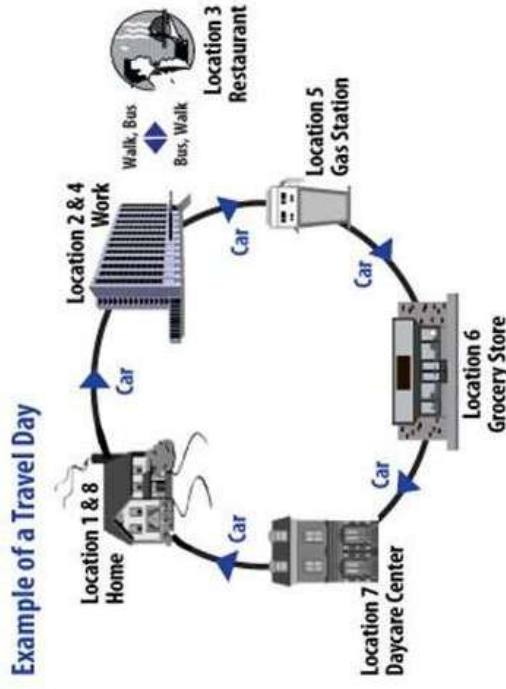


)) Introduction

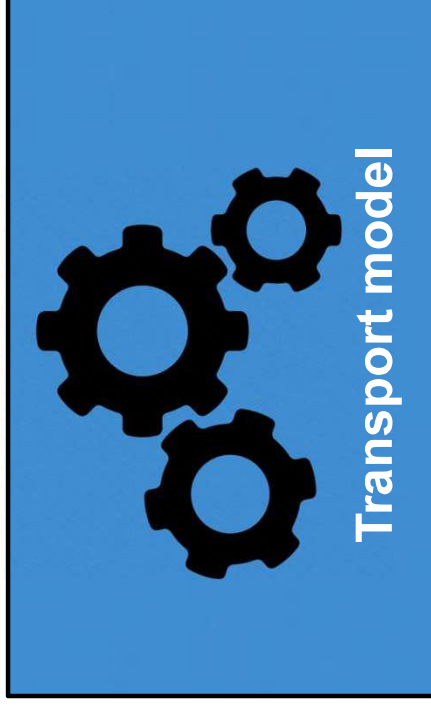
Traditional perspective on transport planning

“The field of government intervention that aims to ensure the effective and efficient movement of people and goods.”

Travel behavior survey



Travel demand model



Estimate of future travel per link = demand

‘The transport problem’

Available capacity per link = supply

Traditional perspective on transport planning

*“The field of government intervention
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People-centered perspective on transport planning:

“Transport planning is the field of governance that seeks to guarantee sufficient accessibility for all, through the regulation, operation, maintenance, and improvement of the transport system.”

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)) Method 1: Measure travel problems

Travel problems

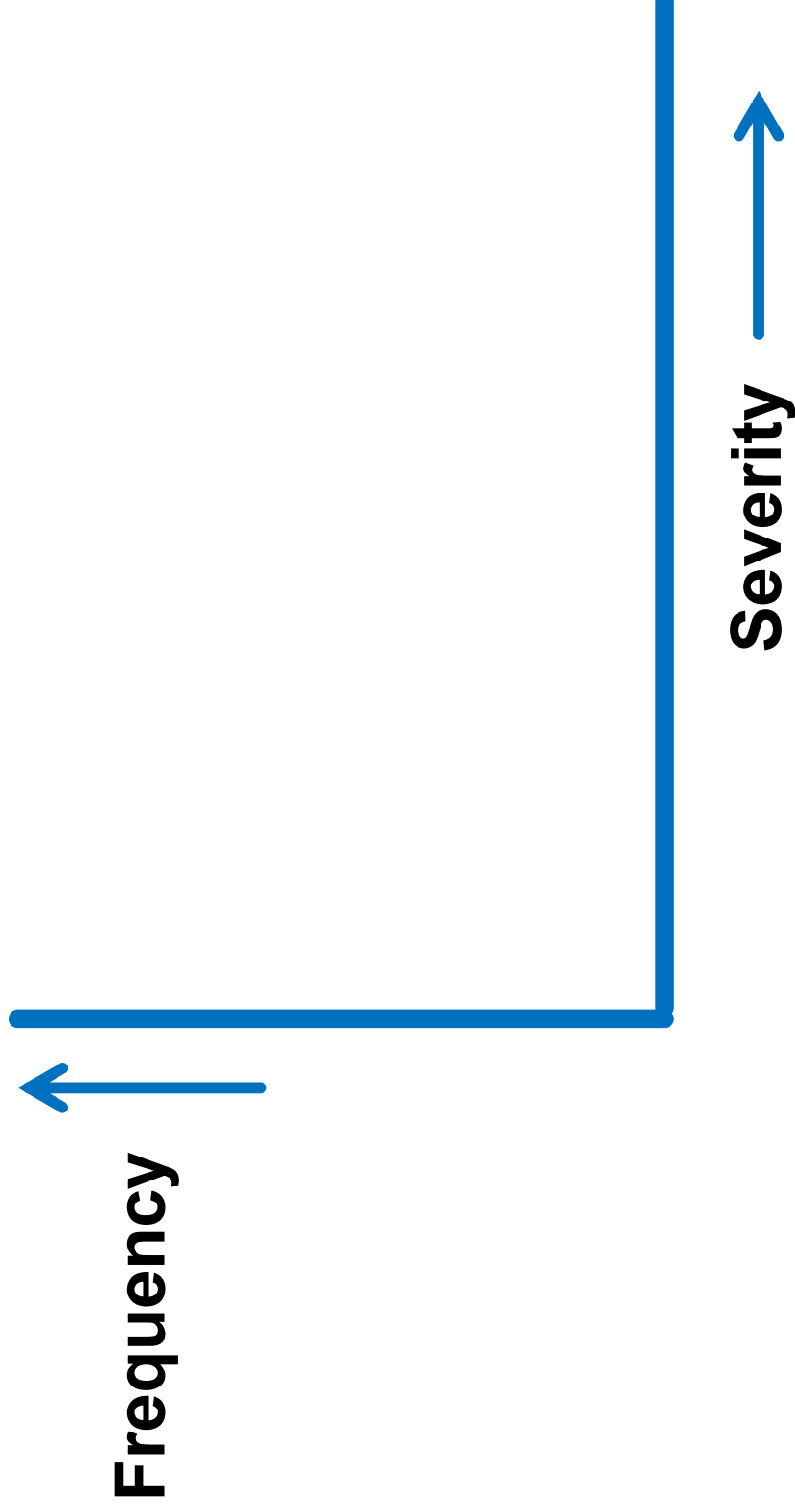
“Any difficulty a person may experience
in reaching desired destinations.”

Travel problems

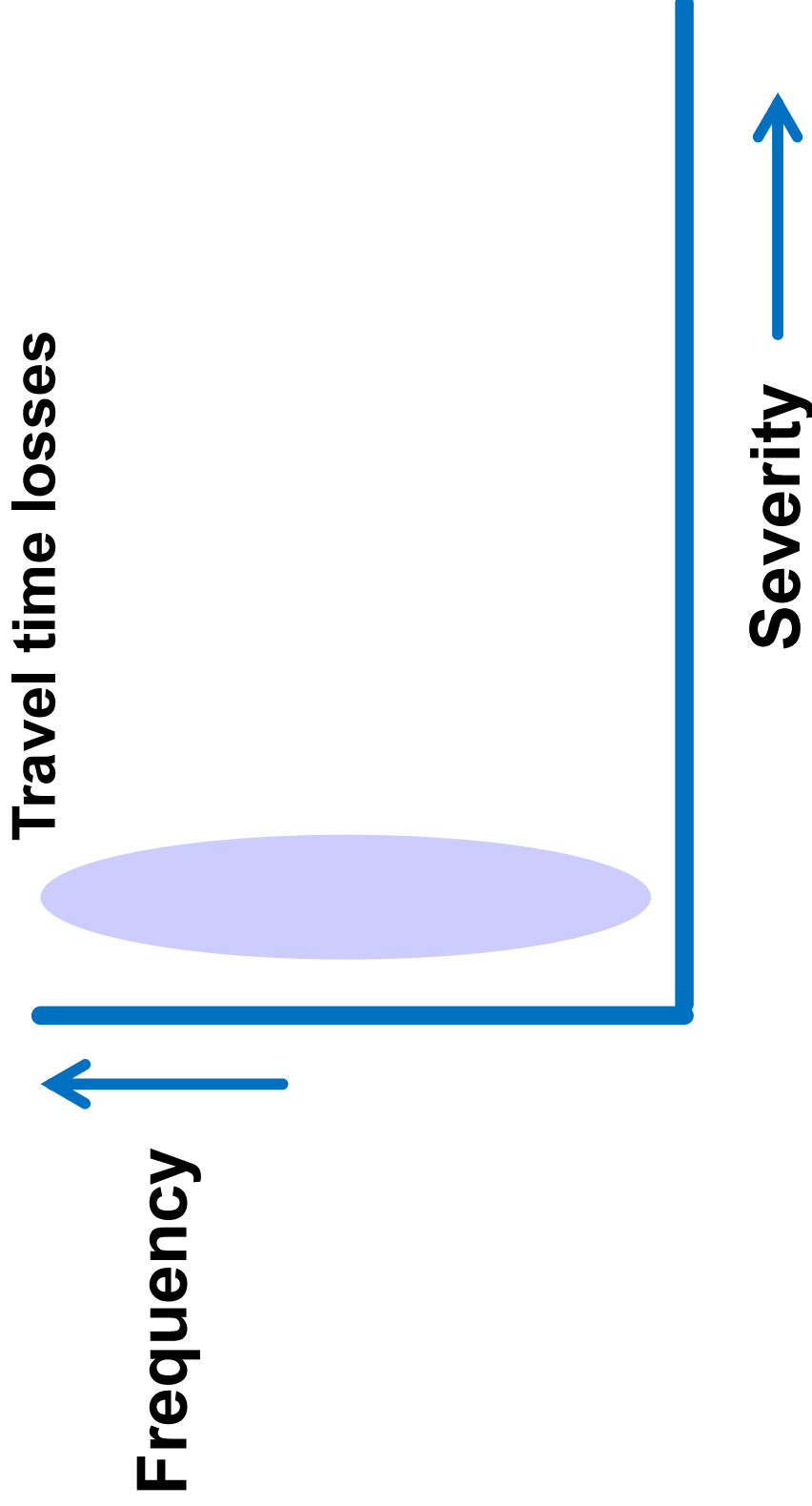
Travel problems



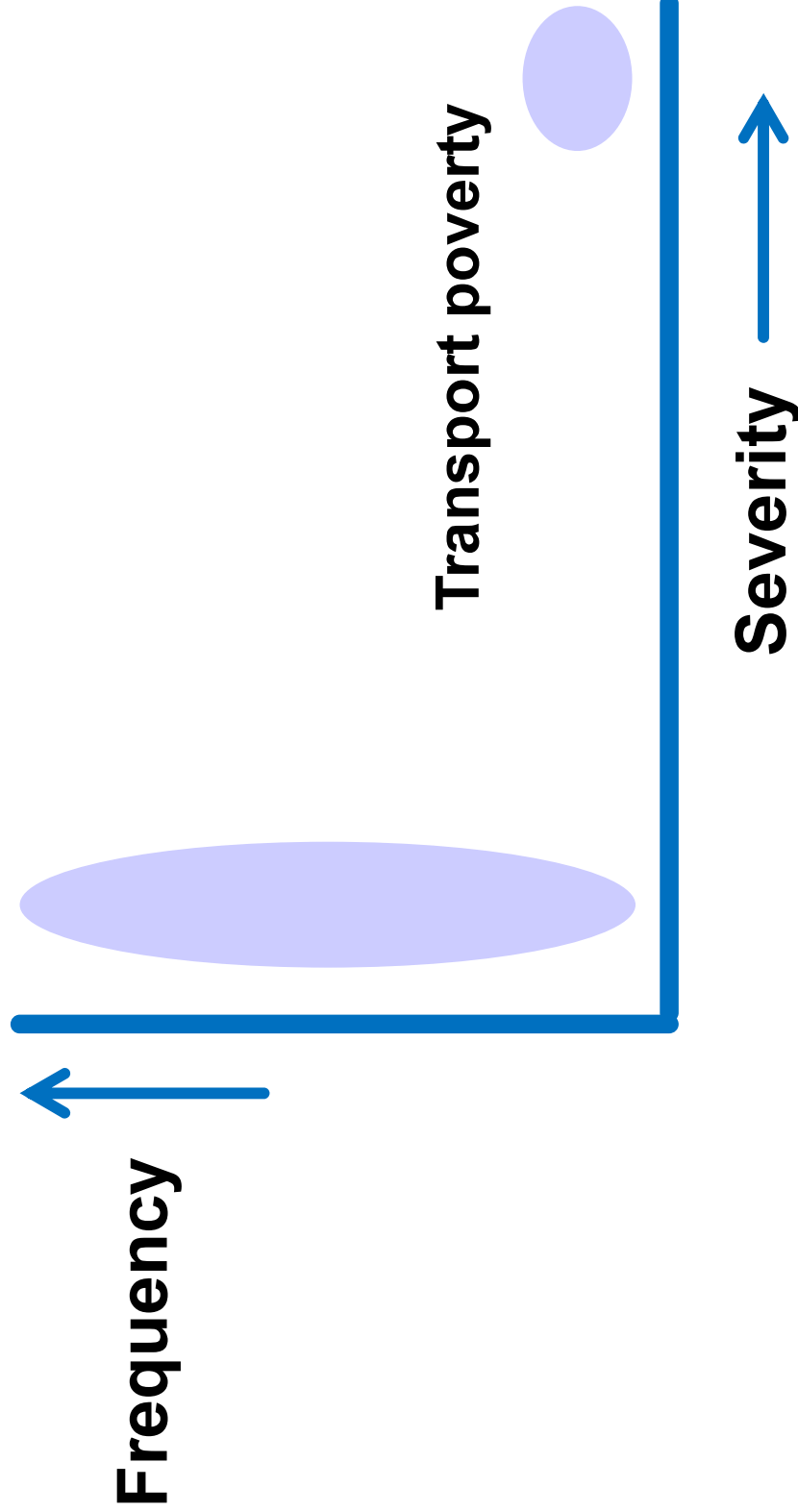
Travel problems



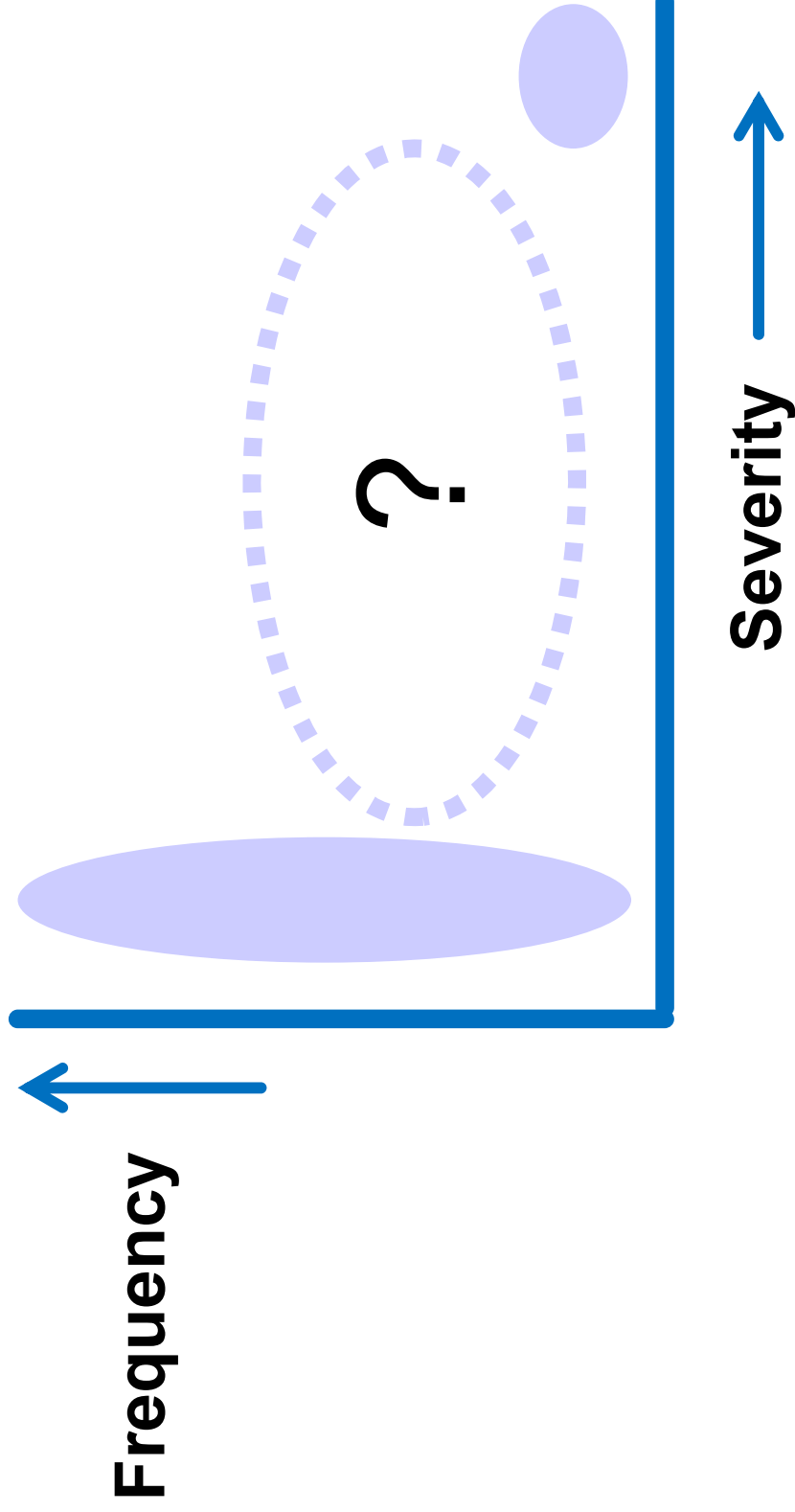
Travel problems in professional practice



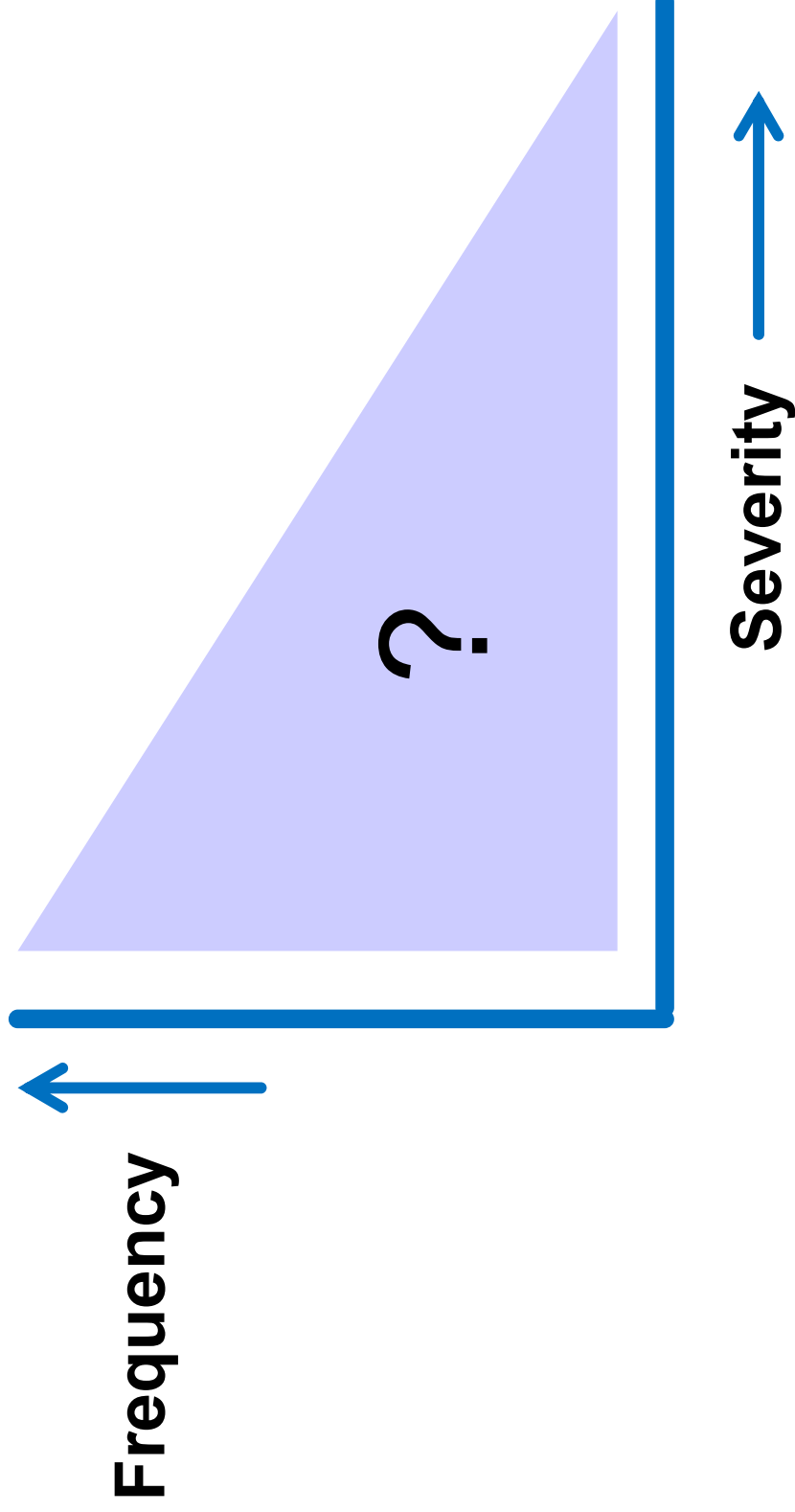
Travel problems in the academic literature



Travel problems to be identified



Possible frequency of travel problems



Inspiration: Health Status Research

- Multiple measurement instruments
- Short, straightforward, questions
- Result: health status for each respondent
- Uses:
 - Comparing health status between population groups
 - Tracking changes in health status over time (e.g., COVID-19)
 - Assessing the benefits of policies ('sugar tax', health campaigns, ...)

Freedom of Mobility Survey

- Hardship: Do people experience trip-related difficulties?
- Autonomy: Are people dependent on others for trip-making?
- Freedom: Do people forgo necessary or desired trips?

Survey set up

- Easy to administer
- Retrospective survey (past three days)
- Short, general questions

Hardship - example question

When you think of all your trips over the past three days, how often did you feel you were spending an excessive amount of money to reach your destination?

For none of my trips

For a small part of my trips

For more than half of my trips

For almost all my trips

I do not know/I do not remember

Dependence on others - example question

Over the last three days, how often have you had to rely on people in your household for your trips?

For none of my trips

For a small part of my trips

For more than half of my trips

For almost all my trips

I do not know/I do not remember

Trips foregone - example question

In the last three days, how many times did you want to go somewhere but you gave up on it because you felt it would be too expensive to reach your destination?

Never

Once

Several times

Many times

I do not know/I do not remember

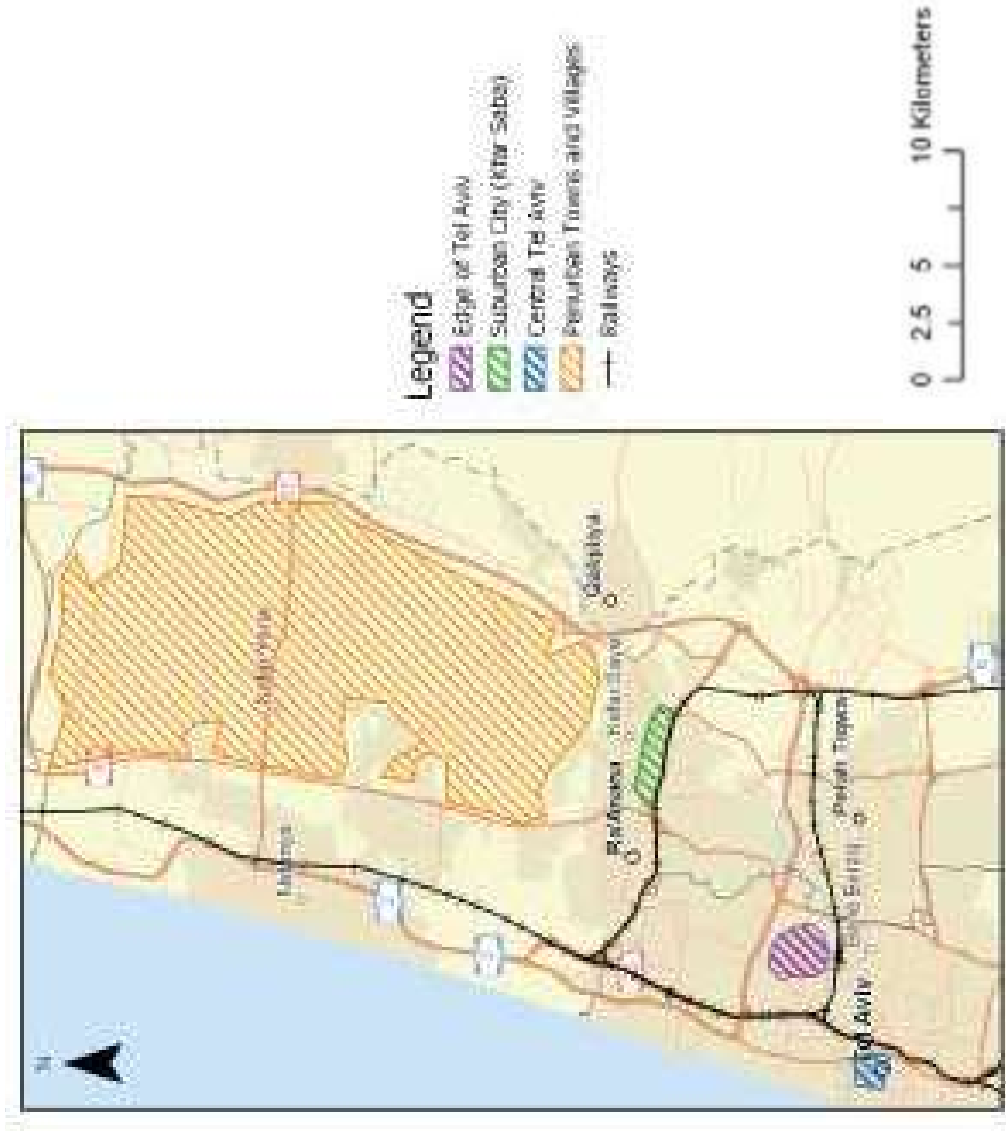
Overview of questions

- **General:** How convenient is your travel overall?
- **Hardship:** Trip difficulties because of (1) time, (2) cost, (3) effort, (4) comfort
- **Autonomy:** Dependence on (1) household members, (2) family or close friends, (3) others
- **Freedom:** Forgoing trips because of (1) time, (2) cost, (3) effort, (4) comfort, (5) not being able to return on same day

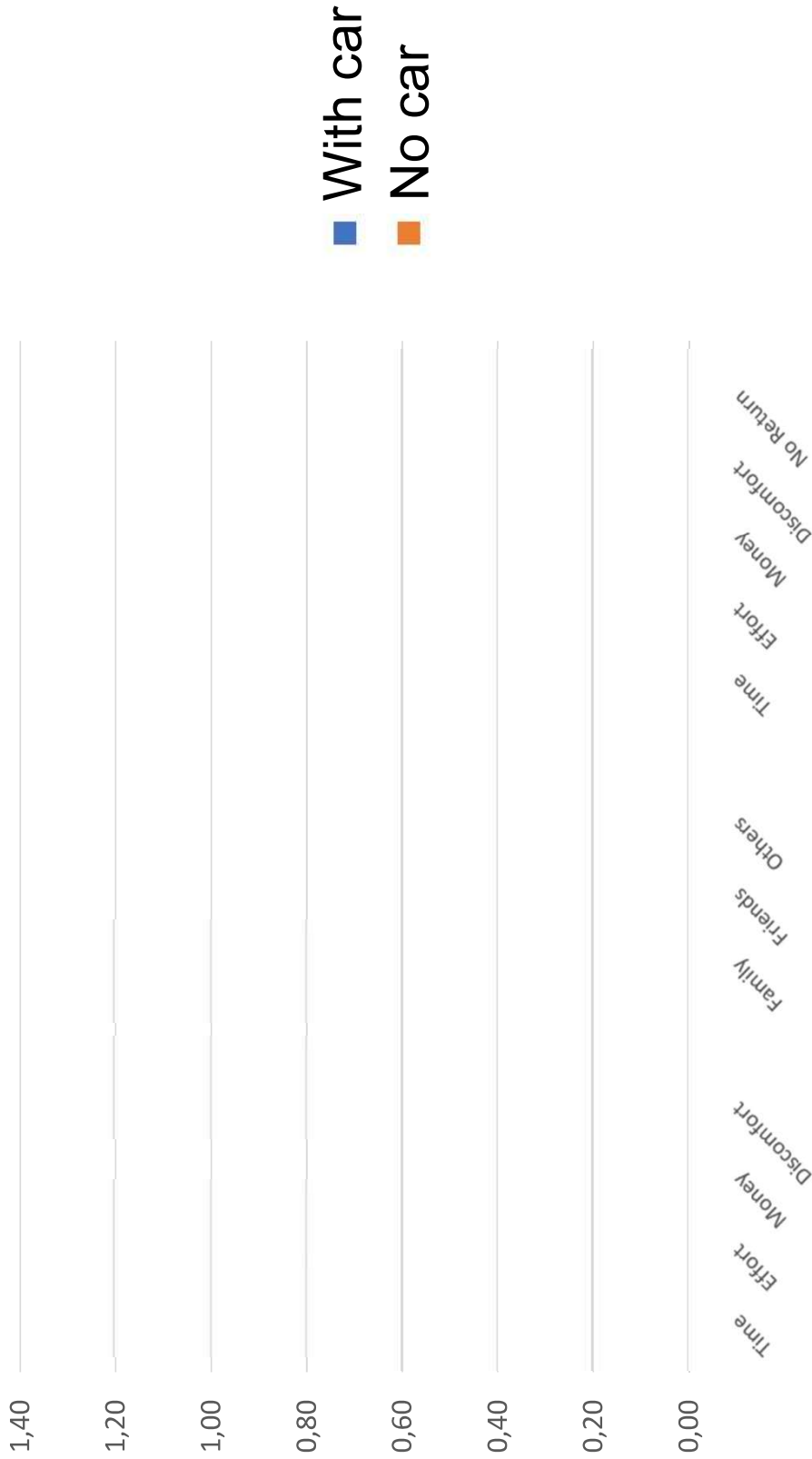
Survey in Tel Aviv metropolitan area

Four types of areas

2,000 responses



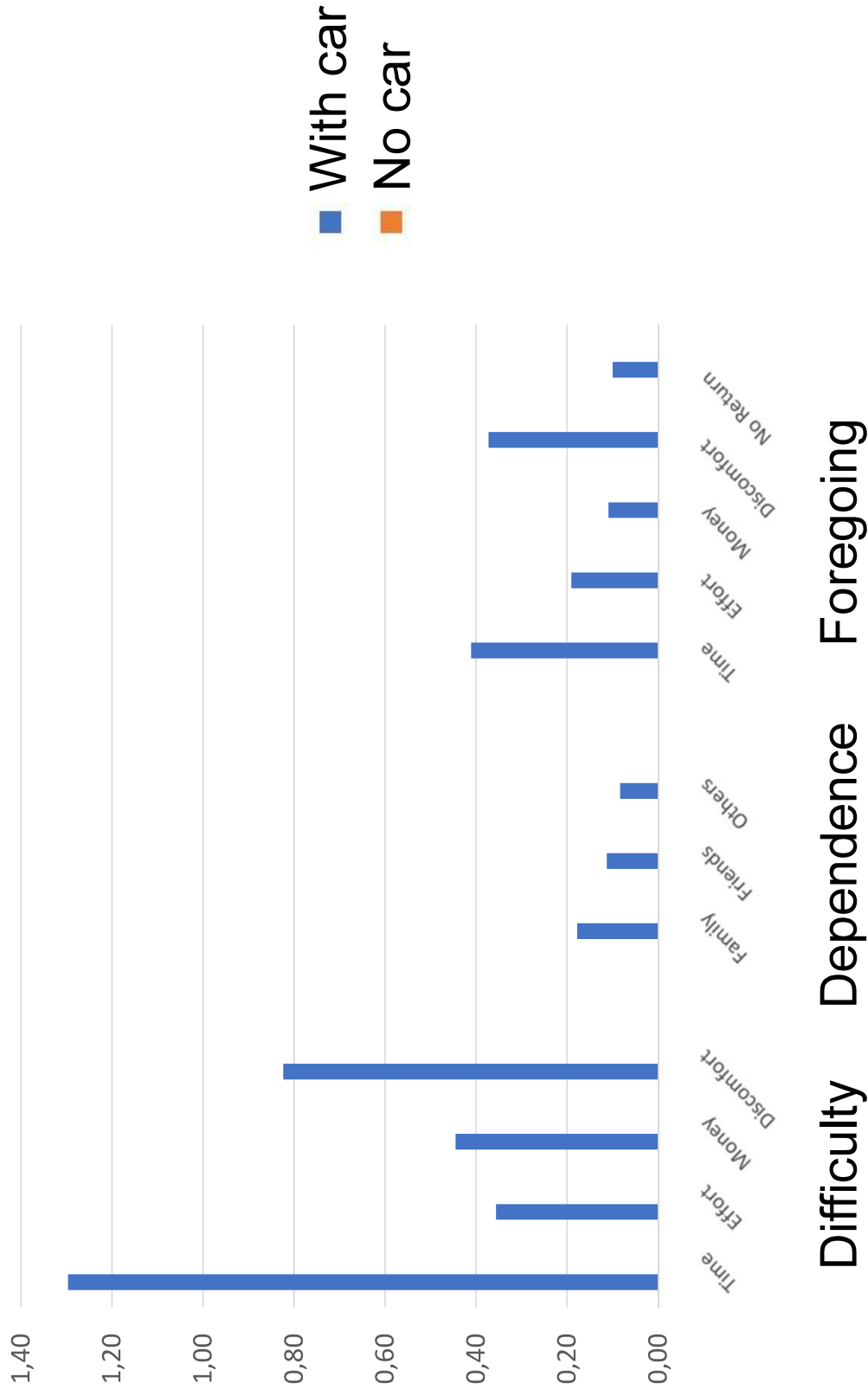
Level of
difficulty



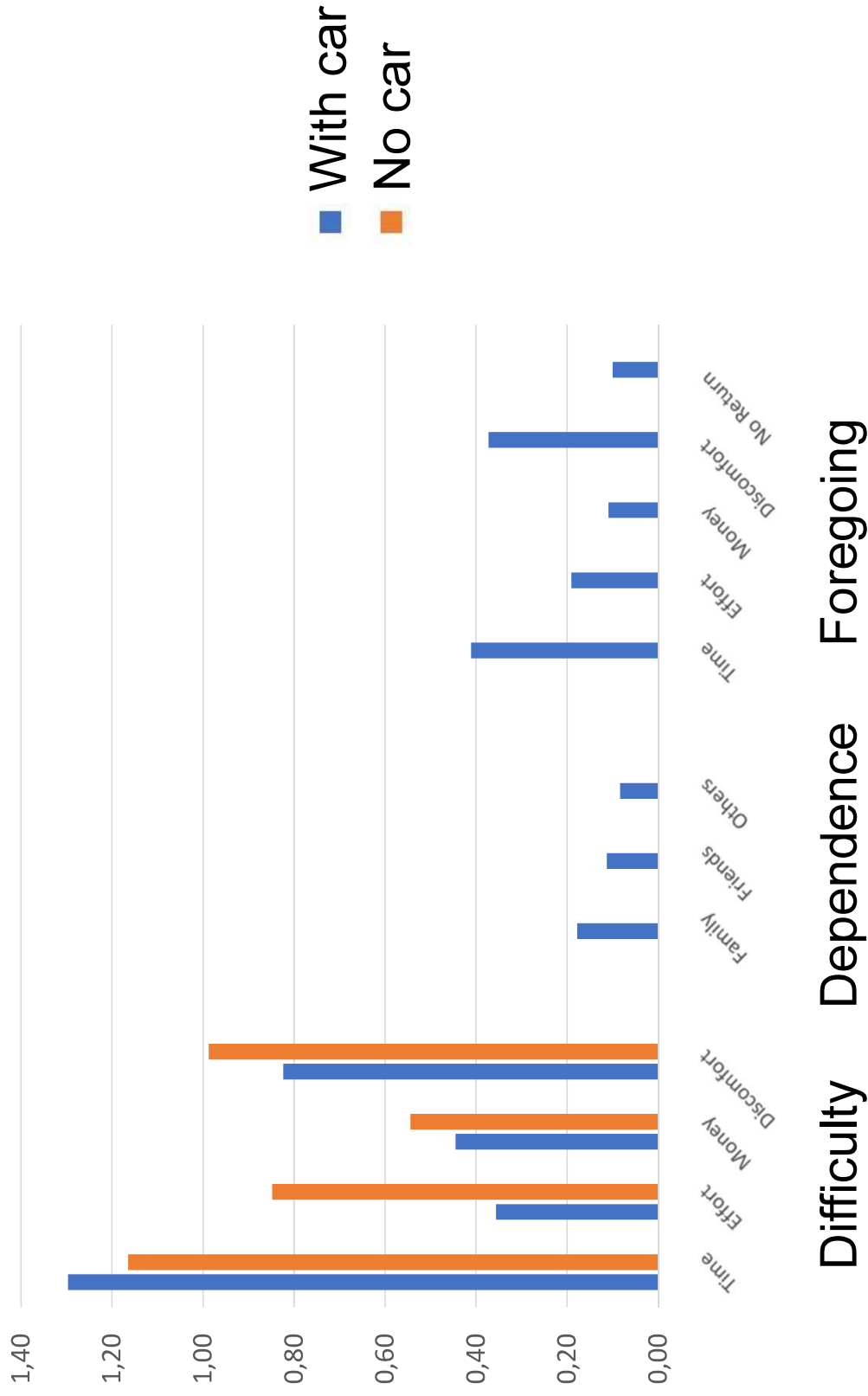
With car
No car

Trips Dependence Foregoing

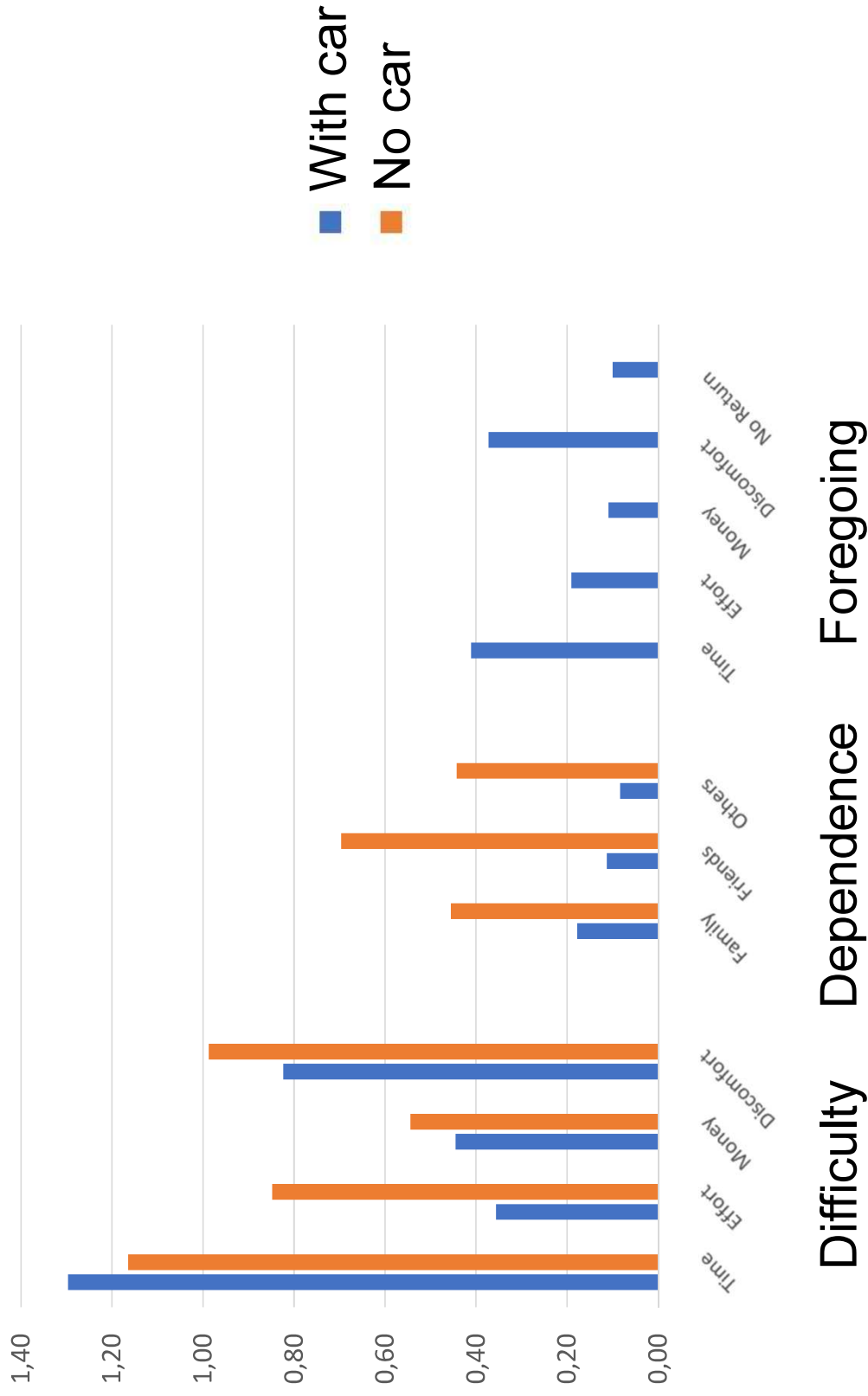
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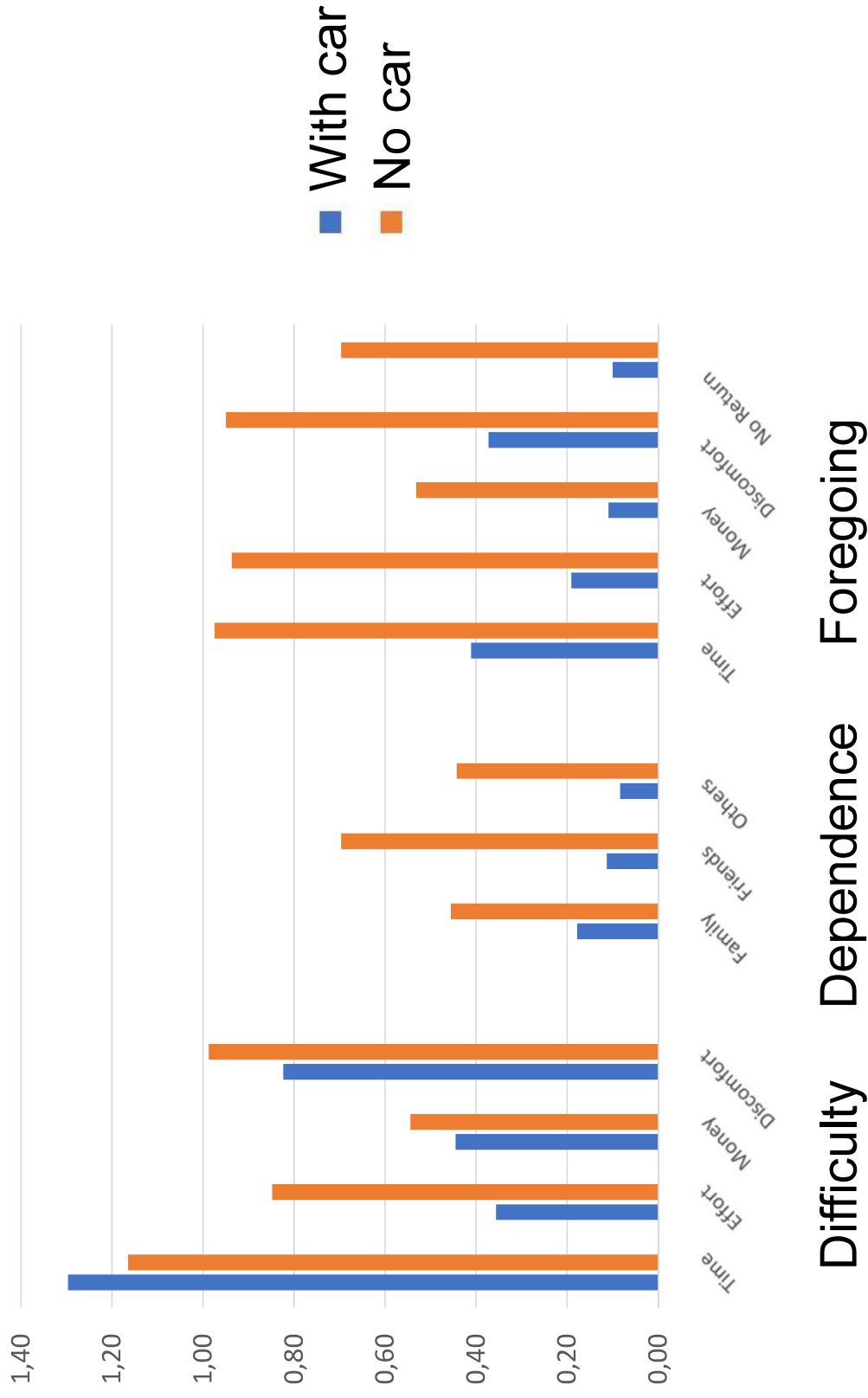
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Level of difficulty



Level of
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Population segments by problem intensity

Cluster centres (Z-scores)

Variables	Cluster 1 – well off	Cluster 2 - moderate	Cluster 3 – severe problems
n			
Forgoing trips			
Reliance on others			
Q1.1. (convenience)			
Q2.1. (time)			
Q2.2. (effort)			
Q2.3. (money)			
Q2.4. (discomfort)			
Q4.5. (24-hours)			

Trip difficulty questions

¹ Higher values indicate more severe problems

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Average of population = 0
Better-off people = negative z-scores
Worse-off people = positive z-scores

Population segments by problem intensity

Cluster centres (Z-scores)

Variables	Cluster 1 – well off	Cluster 2 - moderate	Cluster 3 – severe problems
n	936(65%)		
Forgoing trips	-0.4		
Reliance on others	-0.19		
Q1.1. (convenience)	-0.38		
Q2.1. (time)	-0.46		
Q2.2. (effort)	-0.39		
Q2.3. (money)	-0.37		
Q2.4. (discomfort)	-0.54		
Q4.5. (24-hours)	-0.24		

¹ Higher values indicate more severe problems

Population segments by problem intensity

Cluster centres (Z-scores)

Variables	Cluster 1 – well off	Cluster 2 - moderate	Cluster 3 – severe problems
n	936(65%)	404 (28%)	
Forgoing trips	-0.4	0.56	
Reliance on others	-0.19	0.19	
Q1.1. (convenience)	-0.38	0.77	
Q2.1. (time)	-0.46	0.95	
Q2.2. (effort)	-0.39	0.61	
Q2.3. (money)	-0.37	0.66	
Q2.4. (discomfort)	-0.54	1.03	
Q4.5. (24-hours)	-0.24	-0.18	

¹ Higher values indicate more severe problems

Population segments by problem intensity

Cluster centres (Z-scores)

Variables	Cluster 1 – well off	Cluster 2 - moderate	Cluster 3 – severe problems
n	936(65%)	404 (28%)	90 (6%)
Forgoing trips	-0.4	0.56	1.69
Reliance on others	-0.19	0.19	1.19
Q1.1. (convenience)	-0.38	0.77	0.49
Q2.1. (time)	-0.46	0.95	0.53
Q2.2. (effort)	-0.39	0.61	1.28
Q2.3. (money)	-0.37	0.66	0.94
Q2.4. (discomfort)	-0.54	1.03	0.99
Q4.5. (24-hours)	-0.24	-0.18	3.36

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Cluster analysis resulted in three clusters of respondents

- 65% of respondents: “all well”
- 28% of respondents: “modest problems” (mostly relate to time)
- 6% of respondents: “serious travel problems”

Impact of COVID-19 on travel problems

	All Respondents COVID vs. Pre-COVID
	Statistic
Difficulties: Time	-12.11***
Difficulties: Effort	-3.05***
Difficulties: Cost	-3.91***
Difficulties: Discomfort	-8.28***
Reliance	0.22
Trips Forgone	-1.92*
Composite Index	-5.29***

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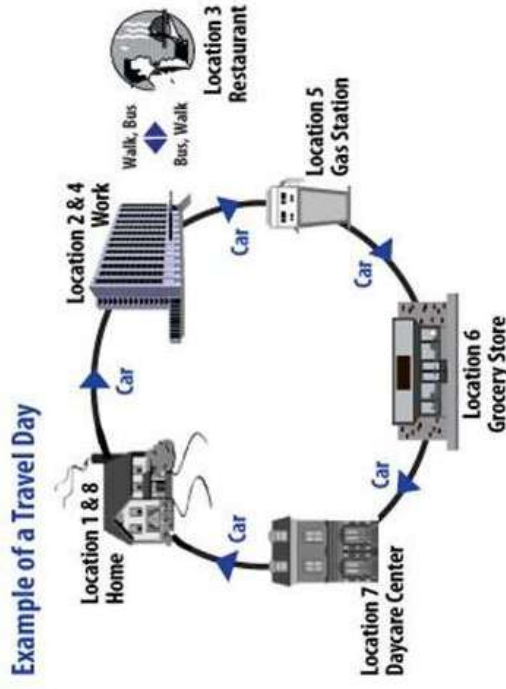
Have Vehicle Access					
Pre-COVID		COVID		COVID vs. Pre-COVID Statistic	
Average	SD	Average	SD		
2.23	1.11	1.61	0.92	-13.13***	
1.44	0.86	1.25	0.66	-4.87***	
1.52	0.94	1.32	0.76	-5.03***	
1.80	1.04	1.37	0.76	-9.71***	
6.62	14.84	6.23	15.05	-0.56	
9.78	17.13	7.12	14.96	-3.50***	
14.01	14.88	8.84	13.60	-7.73***	

)) Method 2: Analyze observed mobility

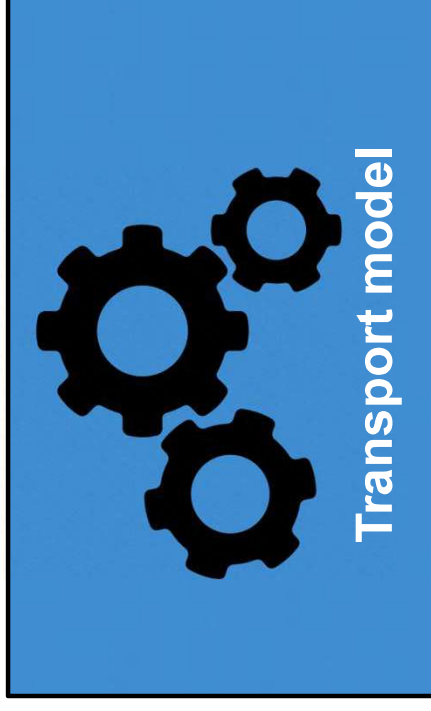
From trip patterns to transport problems ...

- Transport versus other reasons
- Choices versus constraints
- When are lower trip rates a transport problem?

Travel behavior survey



Travel demand model

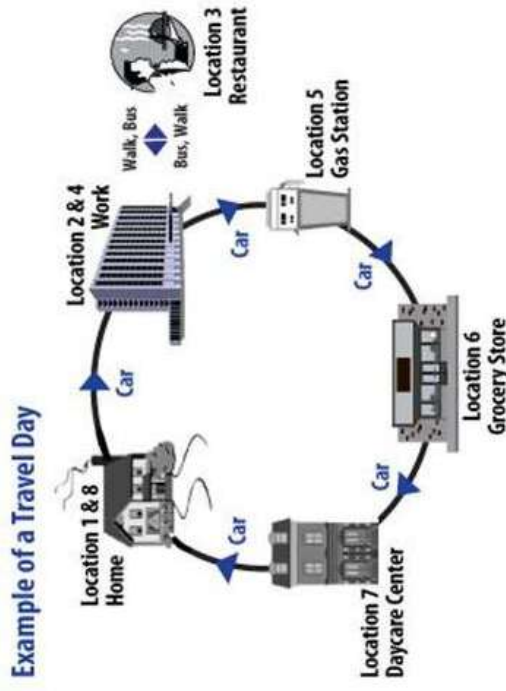


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Travel behavior survey



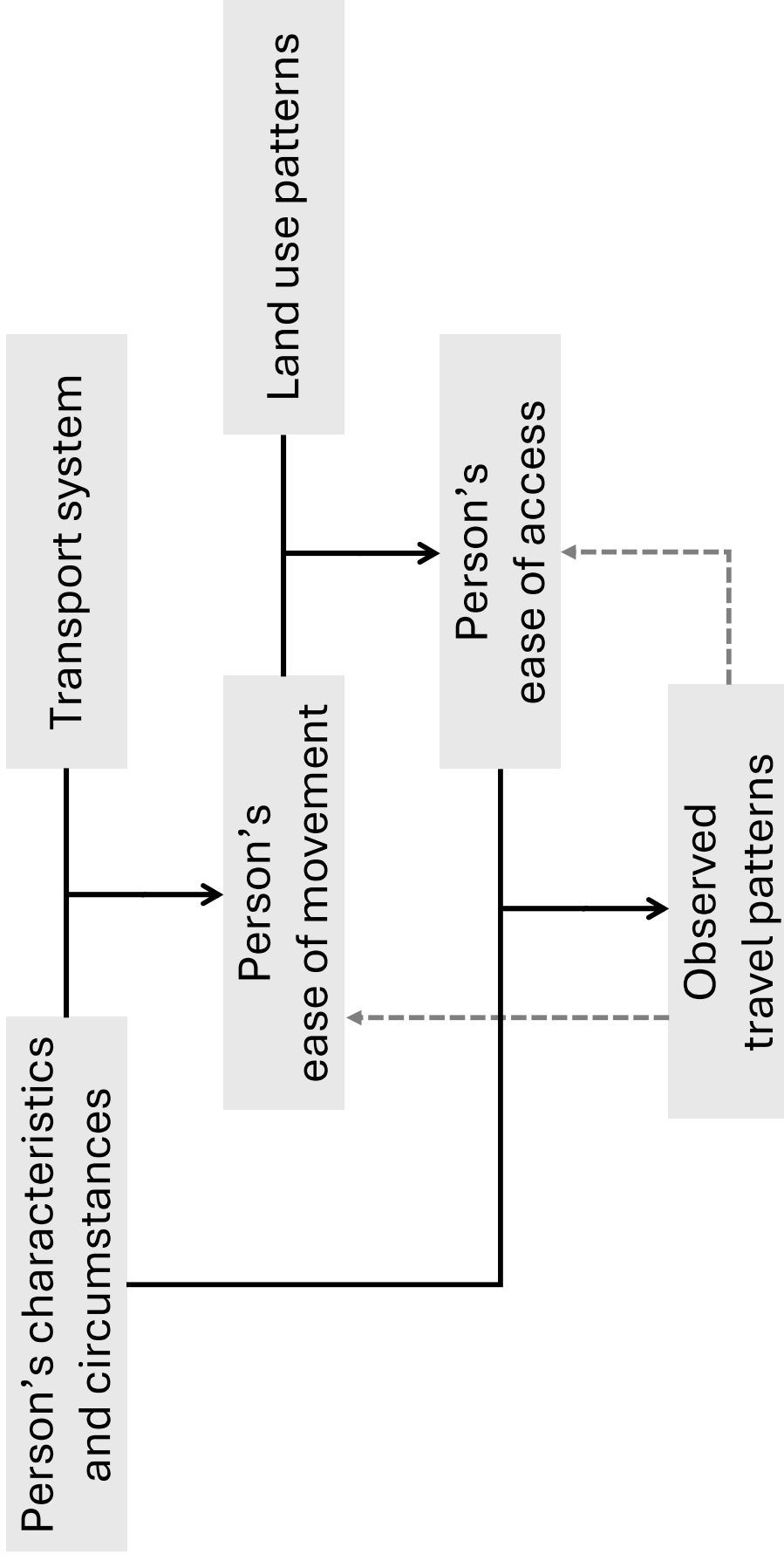
Analysis of travel patterns



Estimate of ease of movement

Low ease of movement
indicates transport problems

Conceptual model underpinning the analysis



Available GPS-based travel behavior surveys

Metropolitan area	Data collection period	Number of respondents	Number of trips
Jerusalem	2010-2011	11,139	98,337
	2014-2017	11,087	96,748
Tel Aviv	2014	11,287	97,859
	2016-2017	10,247	98,398
Haifa	2016-2017	12,186	113,976
Be'er Sheva	2014-2015	12,478	115,655
Total		68,424	620,973
Total after cleaning		62,981	571,576

Trip frequency

- Trips per day
- Trips in evening hours
- Trips in night hours
- Activities per day
- Number of distinct activities conducted

Mode use

- Number of independent motorized trip legs
- Number of trip legs by private motorized vehicle as a driver
- Number of motorized trip legs as a chauffeur
- Number of motorized trip legs as a passenger

Speed

- Average aerial speed across all motorized trips
- Average aerial speed across all trips by private motorized vehicle as a driver
- Average aerial speed for all public transport trips (door-to-door)
- Average aerial speed for public transport trip legs

Distance

- Total aerial distance traveled
- Directness of travel

Ease of movement parameters

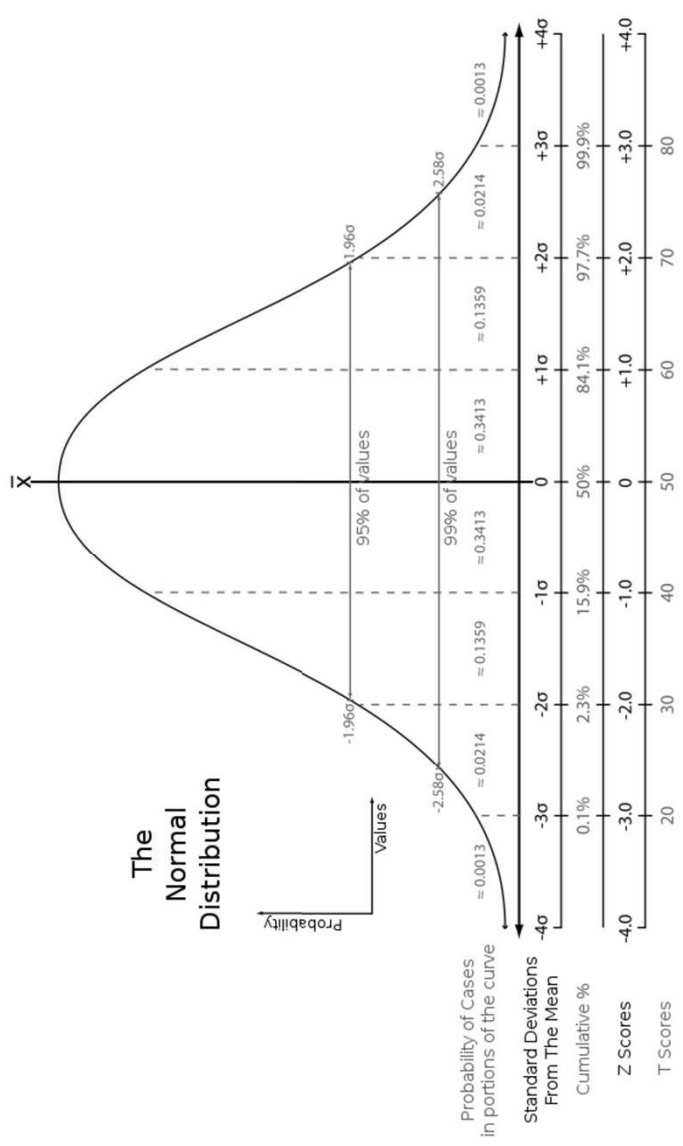
Effort

- Long walking trips
- Trip leg ratio

Normalization of ease of movement parameters: z-scores

The number of standard deviations by which the value of an observed data point is above or below the mean value for the entire sample.

$$Z_i = \frac{x_i - \bar{x}}{s}$$



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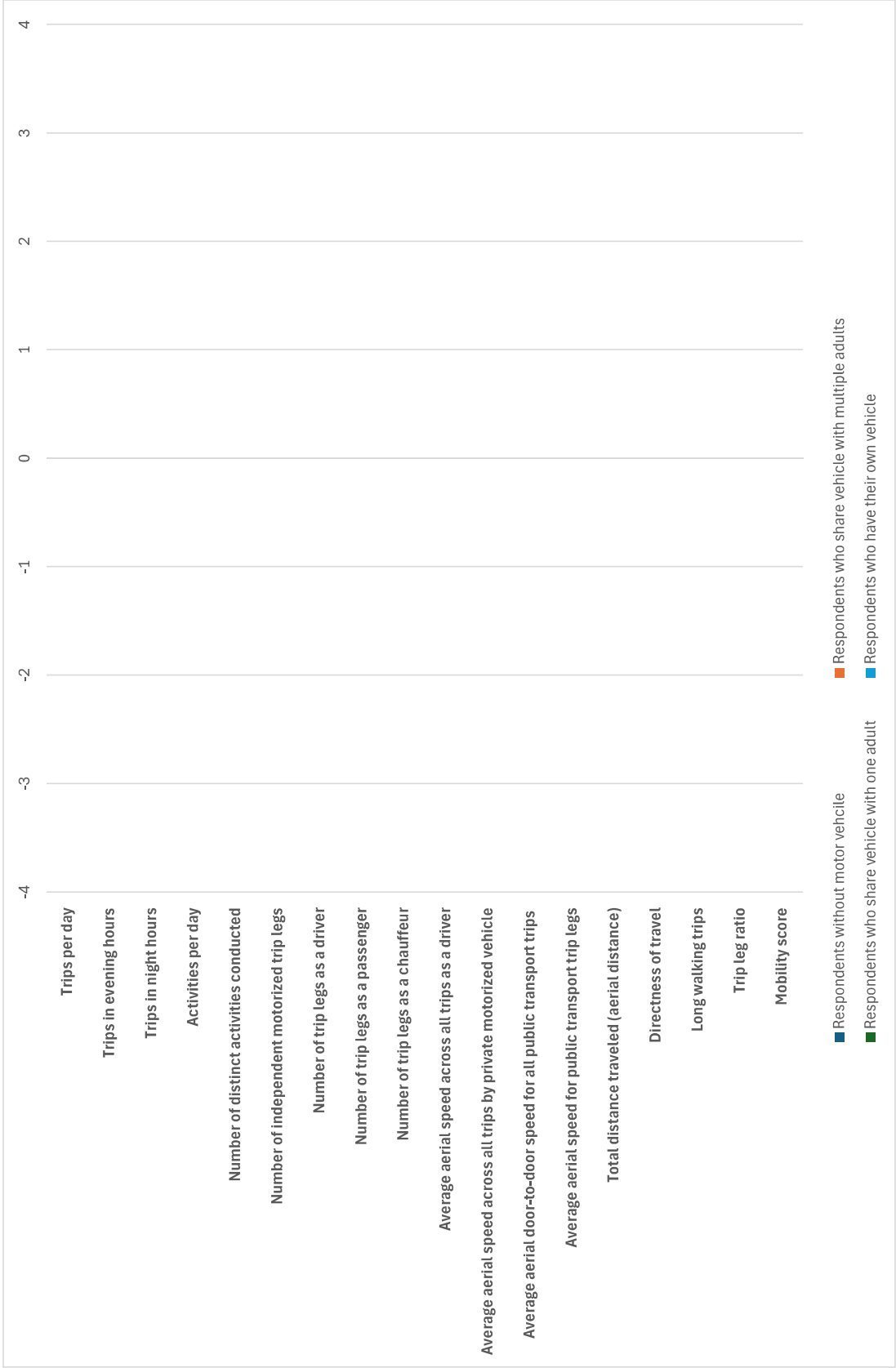
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Composite Mobility Score

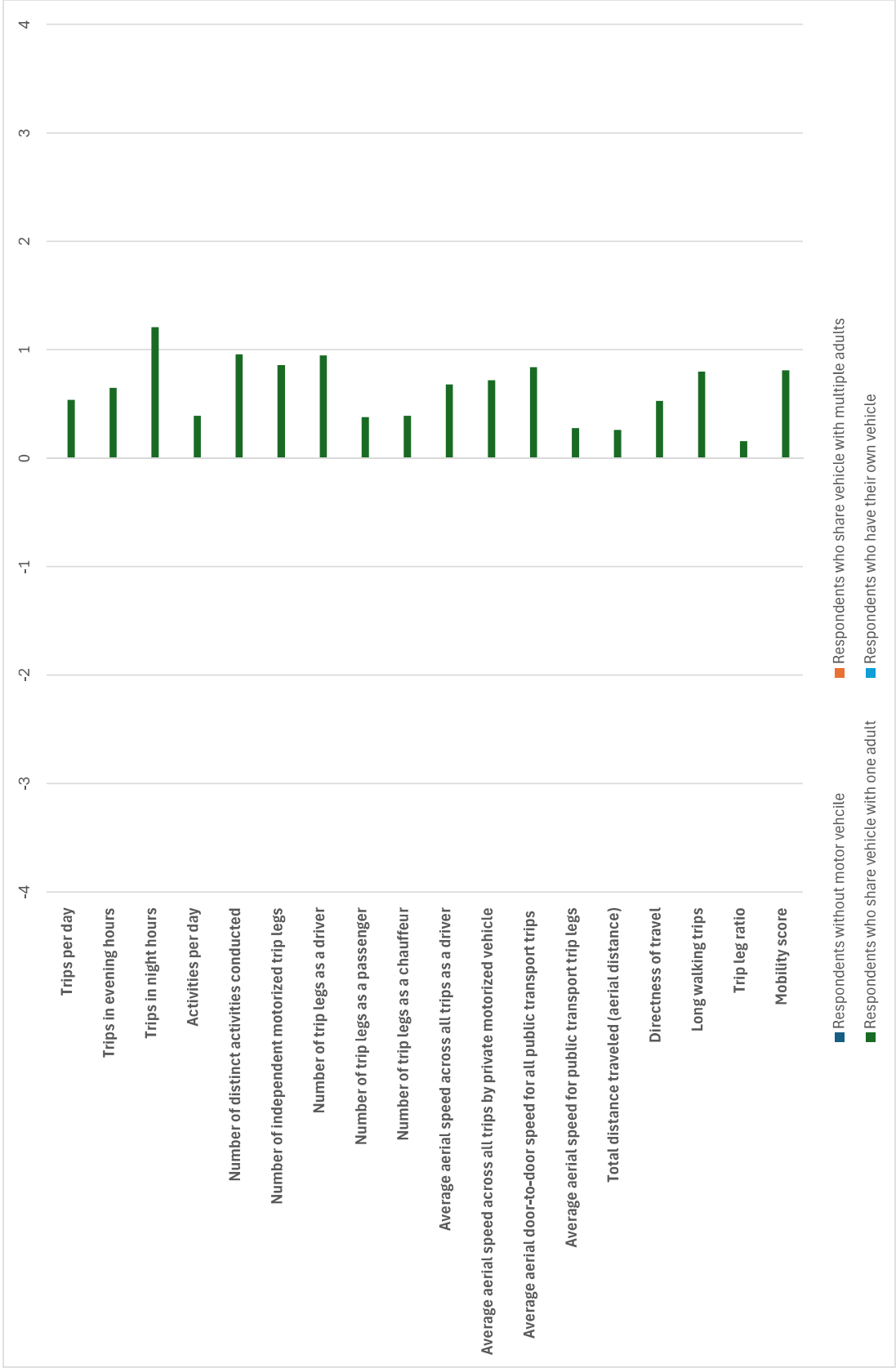
Results by respondents' access to motor vehicle

- Respondents without motor vehicle
- Respondents who share motor vehicle with two or more adults
- Respondents who share motor vehicle with one other adult
- Respondents who are sole user of motor vehicle

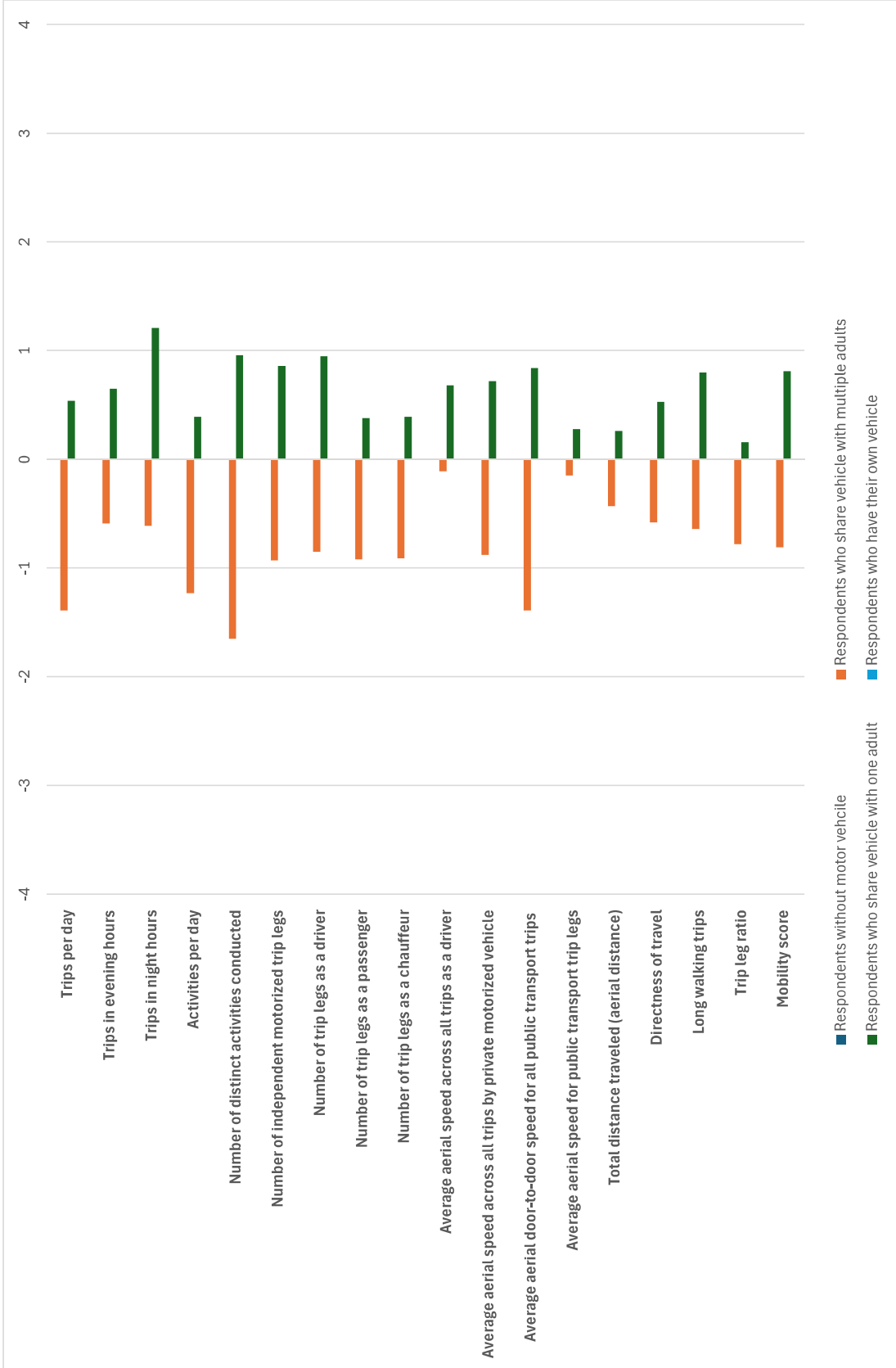
Average z-scores by access to motor vehicle



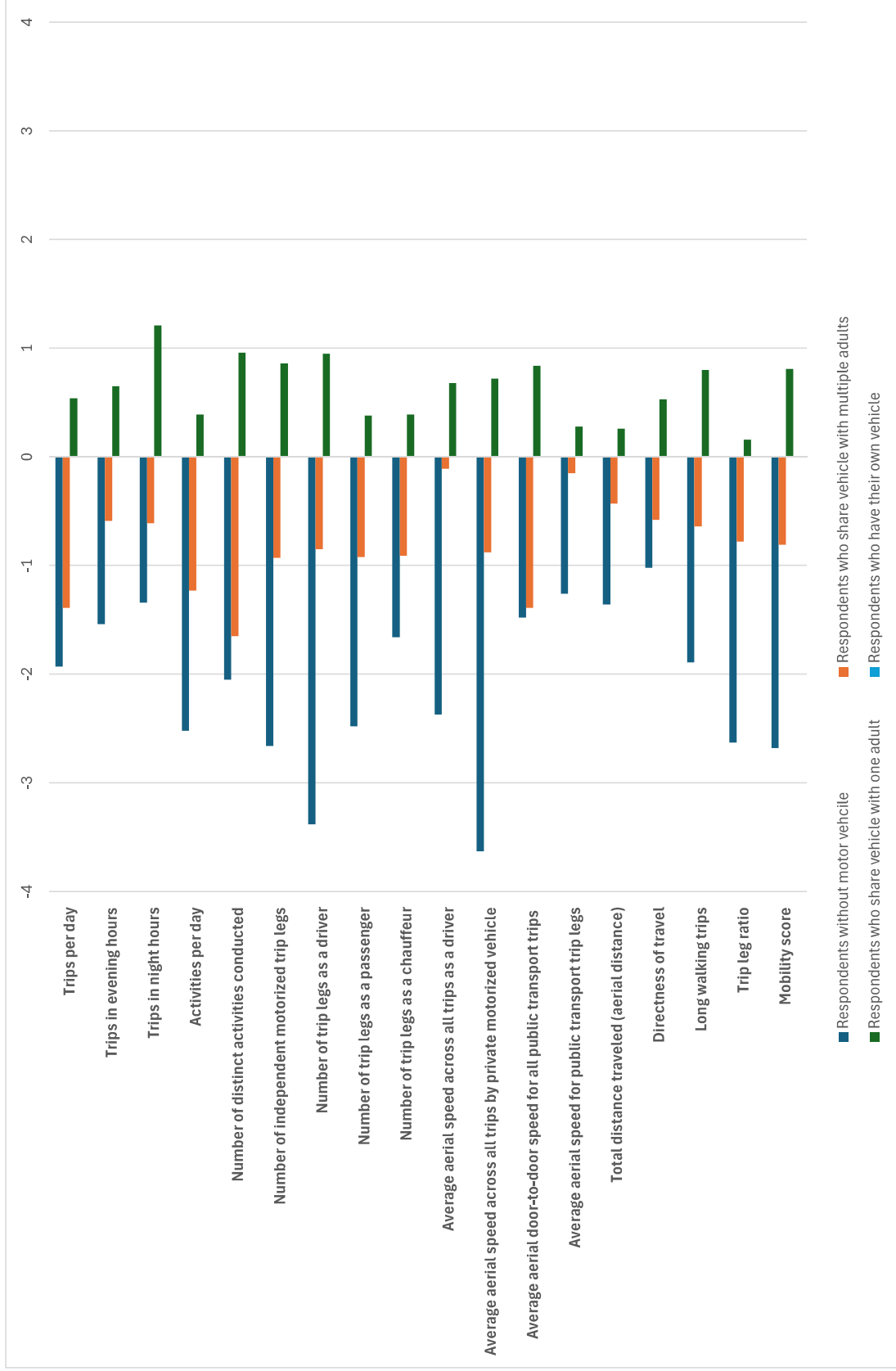
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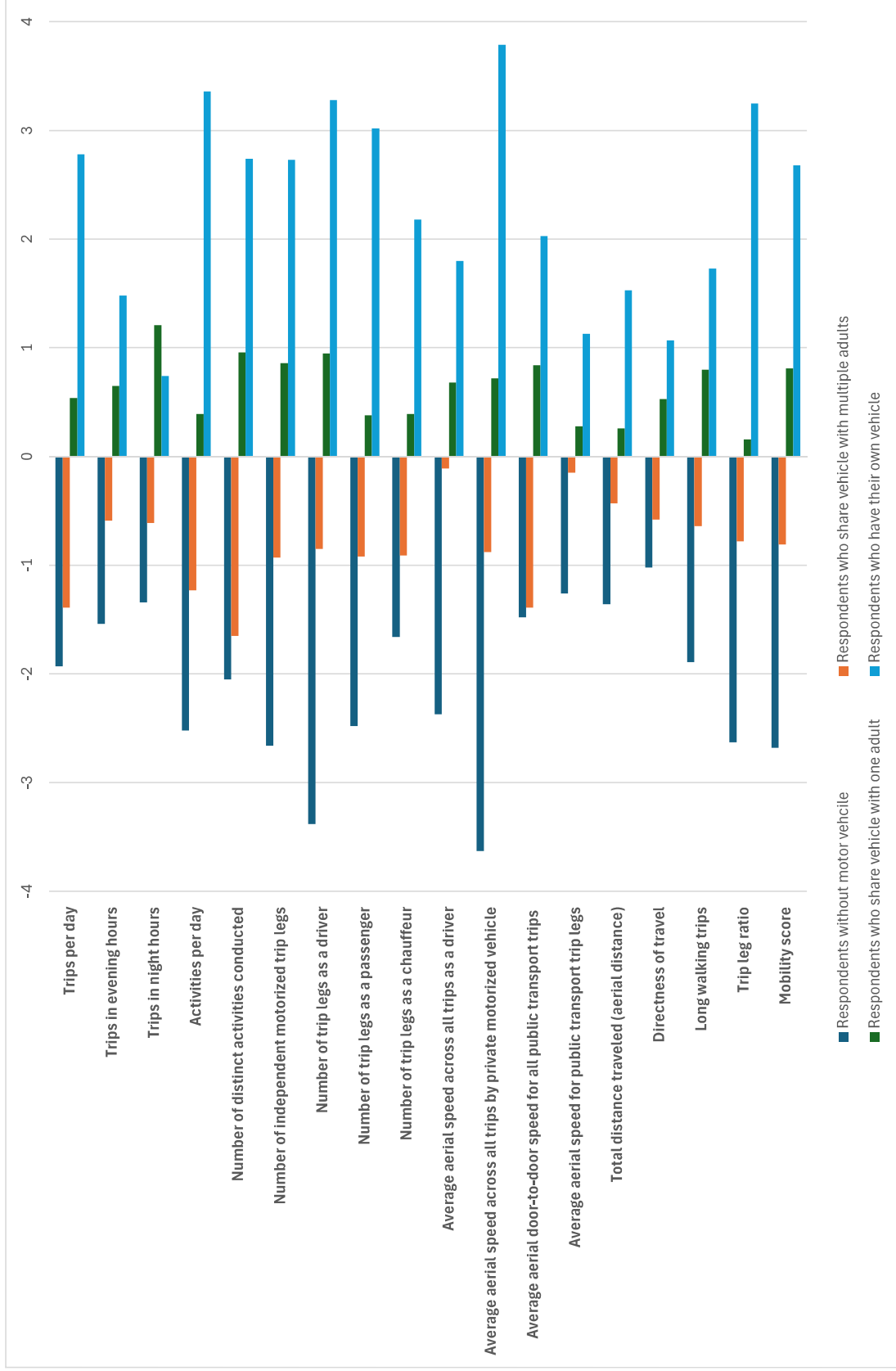
Average z-scores by access to motor vehicle



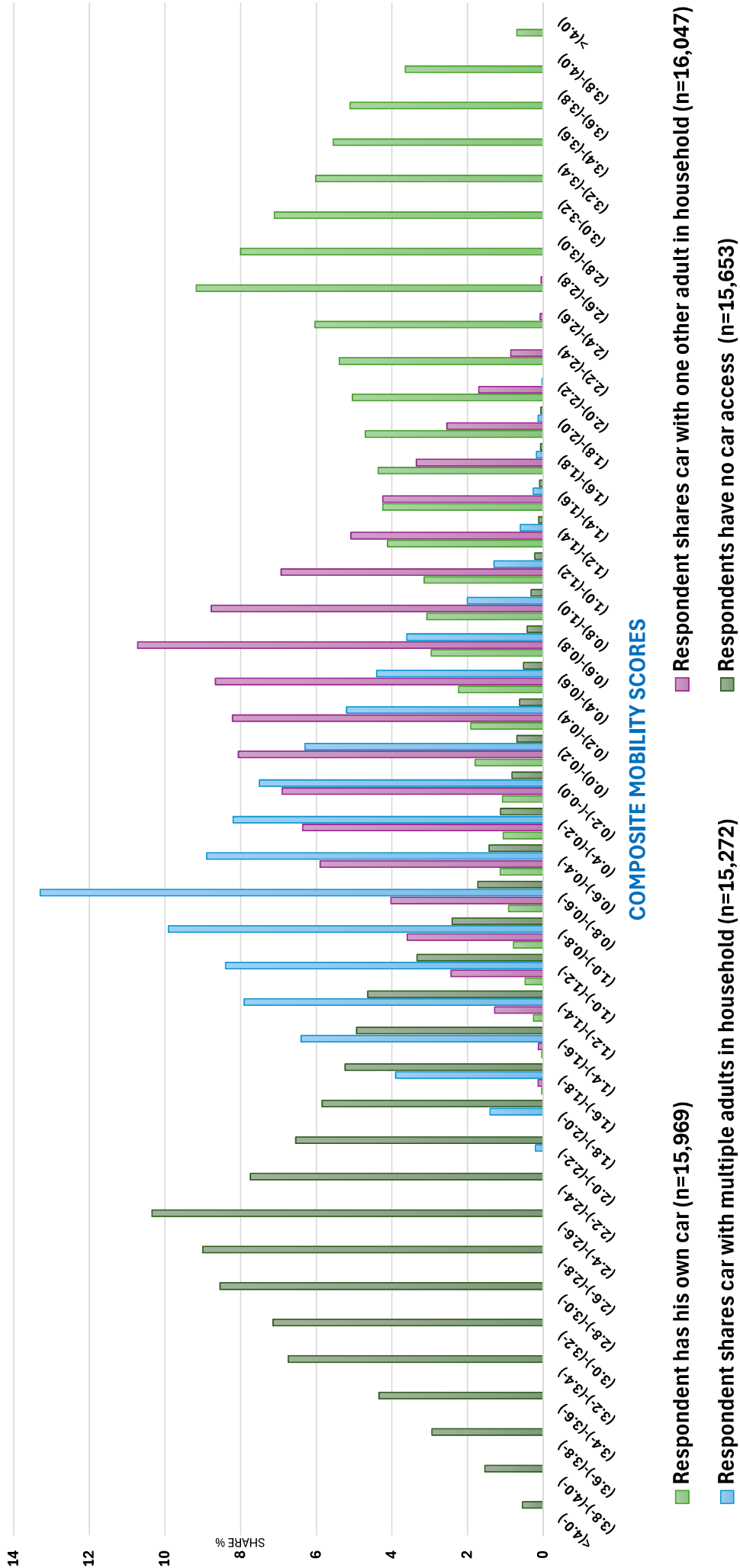
Average z-scores by access to motor vehicle



Average z-scores by access to motor vehicle



Composite mobility score by access to motor vehicle



)) Conclusion

Transport planning should

- ❖ Focus on people, not on transport system performance
- ❖ Assess who is served well and who is served poorly
- ❖ Analyze travel behavior survey data in novel ways
- ❖ Employ new survey tools to directly identify transport problems



Transport Justice

Designing Fair Transportation Systems

Karel Martens



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