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TRANSPORT FINDINGS

When is Perceived Accessibility Over- or Underestimated by Accessibility Indicators?

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Findings

This study delves into mismatches between accessibility indicators and perceived accessibility across transport modes for the case of grocery shopping. Conducted in Gothenburg, Sweden, the study combines a web panel survey with 1,423 participants and detailed location-based accessibility indicators. Findings reveal mismatches, with analyst's overestimation (when the accessibility indicator is high, despite low perceived access) and analyst's underestimation (low indicator, high perceived accessibility) varying across transportation modes. Notably, underestimation is prominent for car accessibility. Multinomial logistic regressions identify key variables influencing these mismatches, such as parenting status, education level and habitual car use.

1. Questions

For nearly a century, transport analysts have strived to develop accessibility indicators mirroring the real-world capacity of transport and land-use systems to provide accessibility to essential activities. In recent years, however, perceived accessibility has gained increasing attention, allowing individuals to self-report the ease of reaching daily activities (Aoustin and Levinson 2021; Lättman, Olsson, and Friman 2018; van der Vlugt, Curl, and Wittowsky 2019; De Vos et al. 2022). While some studies find correlations between perceived and modeled accessibility using various indicators (Baier et al. 2020; Fone, Christie, and Lester 2006), others report weak or no correlations at all (Lättman, Olsson, and Friman 2018; van der Vlugt, Curl, and Wittowsky 2019). Yet, systematic attempts to investigate why mismatches occur between the analyst's view on accessibility (using indicators) and perceived accessibility have been limited (Ryan and Pereira 2021). The main research questions addressed in this article are which types of mismatches are most common across transport modes and for whom accessibility indicators tend to overestimate or underestimate perceived accessibility.

2. Methods

The study was conducted in Sweden's second-largest metropolitan region, Gothenburg. To capture perceived accessibility, data were gathered from a web panel designed to represent a cross-section of the adult population. The survey took place between November 10-23, 2021, a period without COVID-19 restrictions in Sweden, with 1,423 respondents participating.

The survey measured perceived accessibility for several activities. We focus on grocery shopping since it is an activity regularly undertaken by most adults. Participants provided self-reported assessments on a 5-point Likert scale, responding to the statement "It was easy for me to do grocery shopping using [transport mode] during the last month." Perceived accessibility was assessed solely for respondents who reported recent grocery shopping. Accessibility for car and bicycle was evaluated among those reporting access to each mode, whereas walking and public transportation accessibility was measured for all participants. The questionnaire also included items on sociodemographics as well as transportation-related attitudes and habits.

Accessibility indicators were computed from the respondents' residential location[1]. Initial evaluation included several accessibility indicators. The article uses a cumulative opportunity indicator, indicating how many grocery stores reached within 15 minutes for each mode of transportation, as it exhibited the strongest overall correlation with perceived accessibility.

Aligned with the framework proposed by Ryan and Pereira (2021), the dependent variable aims to capture mismatches between accessibility indicators and perceived accessibility, drawing from the analyst's perspective on accessibility through indicators. Unlike Ryan and Pereira (2021), who used the median of the accessibility indicator to define mismatches, we chose bottom/top quintiles, considering them more effective in emphasizing substantial disparities between the analyst's view and respondents' perceptions. The categories for a given transport mode are as follows (see also Figure 1):

- Mismatch 1, "analyst's underestimation," the indicator value is in the lowest quintile, yet the respondent fully agrees/agrees that grocery shopping is easy.
- Mismatch 2, "analyst's overestimation," the indicator value is in the highest quintile, but the respondent fully disagrees/disagrees that grocery shopping is easy.
- Neither

We employ multinomial logistic regressions to measure the probability of overestimation and underestimation, with neither as the reference category. We include independent variables related to sociodemographics, transportation attitudes, and travel habits. Multicollinearity tests show values well below problematic thresholds. Definitions and descriptive statistics are available in the supplementary material.

3. Findings

Table 1 reveals instances of both analyst's overestimation and underestimation, varying by transport mode. Few cases of overestimation and underestimation are observed for walking, which is expected, as it is a mode people generally

1 See the supplementary material for a detailed description of how travel times were calculated for each mode of transportation.

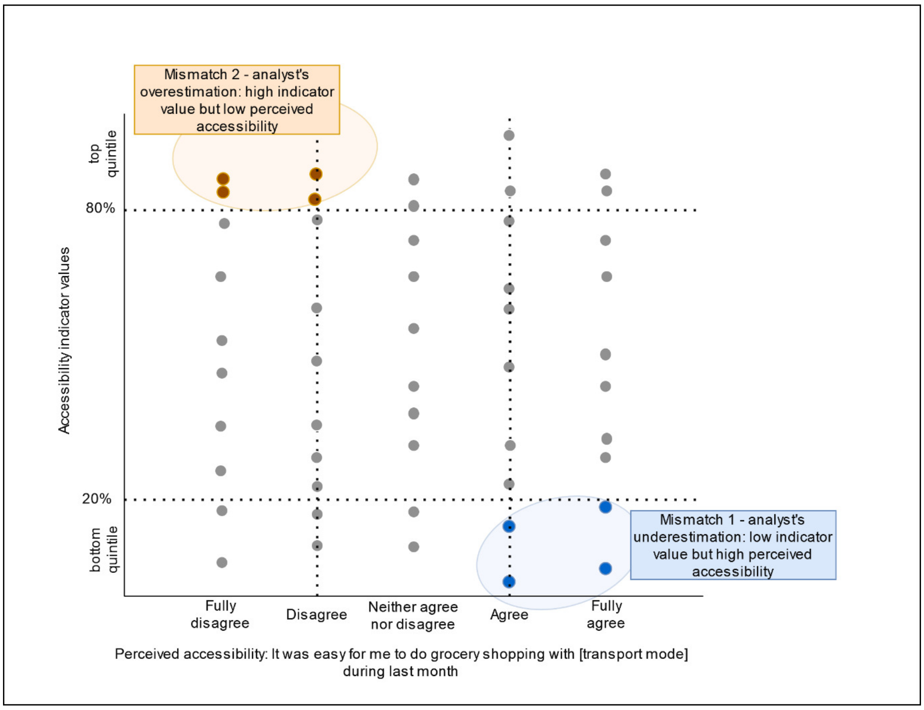

Figure 1. Illustration of how mismatches were measured.

Table 1. Frequencies of the dependent variable.

	Walk		Bicycle		Public transport		Car	
	N	%	N	%	N	%	N	%
Mismatch 1: analyst's underestimation (low indicator value but high perceived accessibility)	81	5.8	40	3.7	57	3.7	308	27.4
Mismatch 2: analyst's overestimation (high indicator value but low perceived accessibility)	50	3.6	73	6.8	104	7.5	29	2.6
Neither overestimation nor underestimation (used as reference category in regressions)	1236	90.6	964	89.5	1225	88.4	788	70.0
	1367	100.0	1077	100.0	1386	100.0	1125	100.0

have good knowledge about. Overestimation is more common than underestimation for cycling and public transport. Conversely, for cars, underestimation is more prevalent, which is expected as cars might be the only viable option for grocery shopping in non-urban areas, highlighting substantial differences between cars and other modes.

Table 2 presents the results from the regression models, one for each transport mode. Initially, more independent variables were included. However, we choose to present models where only the variables that have a significant effect in at least one of the four models are included. For example, gender was not significant in any of the models. An odds ratio (OR) above one indicates higher likelihood of over/underestimation, and below one indicates lower likelihood.

Table 2. Multinomial regression models.

	Walking		Bicycle		Public transport		Car	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Mismatch 1: analyst's underestimation (low indicator value but high perceived accessibility)								
Age	0.991	0.331	0.993	0.637	0.967**	0.007	1.010	0.089
Residing with children	1.777*	0.021	1.505	0.248	2.062*	0.015	1.805**	<.001
Higher education	0.574*	0.020	0.807	0.529	0.398**	0.002	0.610**	<.001
High income earner	1.405	0.321	2.235*	0.042	0.828	0.731	0.843	0.402
Transport planning preference: priority for cars	0.592	0.127	0.482	0.141	0.329*	0.038	1.144	0.407
Uses a car for grocery shopping	0.915	0.724	1.617	0.201	0.599	0.087	5.302**	<.001
Mismatch 2: analyst's overestimation (high indicator value but low perceived accessibility)								
Age	0.991	0.447	0.989	0.303	1.009	0.279	0.628	0.992
Residing with children	0.329**	<.001	0.617	0.064	1.117	0.611	0.426	0.719
Higher education	1.509	0.183	1.487	0.140	1.081	0.723	0.237	1.686
High income earner	0.657	0.399	0.994	0.988	0.679	0.299	0.196	0.258
Transport planning preference: priority for cars	1.243	0.523	1.118	0.748	1.110	0.721	0.875	0.904
Uses a car for grocery shopping	2.505**	0.008	0.497*	0.012	0.397**	<.001	-	-
R^2 (Nagelkerke)	0.051		0.051		0.072		0.223	
N	1346		1044		1341		1089	

* p < 0.05; ** p < 0.01

For walking, public transport, and car, there is a higher likelihood that the indicator underestimates accessibility for individuals residing with children. Several factors, including spatiotemporal constraints related to childcare, may influence the unique perception of accessibility in families with children. Higher education is associated with lower likelihood of underestimation for all modes of transportation. Income, age, and preferences in transport planning are only significant in the analyst's underestimation of public transport accessibility.

The strongest effects, as expected, are found in the variable that captures whether one usually drives to shop for groceries. There is a higher likelihood for the car indicator to underestimate perceived accessibility for those who shop for groceries by car. At the same time, it is more likely that the indicator overestimates perceived accessibility by walking for people who use a car for grocery shopping. This means that even though the accessibility indicator is relatively low, those who shop for groceries by car are more likely to perceive grocery shopping by walking as easy.

Conclusion

The findings highlight complexities in translating accessibility indicators into individuals' perceived accessibility. Mismatches are more common for car travel, particularly in the form of analyst's underestimation when the indicator is low, but perceived accessibility is high. Additionally, we have identified individual traits that contribute to explaining these mismatches. Finally, it is essential to note that accessibility indicators and perceived accessibility are distinct measures, and neither should be considered as a ground truth (Pot, van Wee, and Tillema 2021). While some mismatch is anticipated, significant disparities, as observed in our study, pose challenges, especially considering the pivotal role of various accessibility indicators in policy and planning. Addressing these challenges requires careful consideration in future studies, which should comprehensively evaluate different methodologies for understanding these mismatches, with a particular focus on diverse definitions of overestimation and underestimation.

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SUPPLEMENTARY MATERIALS

Detailed variable description

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