Travel Model Diversity and Potential Transportation Scoring Strategies

An Arc White Paper

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An Arc Research White Paper

Travel Model Diversity and Potential Transportation Scoring Strategies

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Background

Our analysis of location-based metrics presented in the companion paper revealed a connection between high Walk Score data results and lower single-occupant vehicle use. After this connection was identified, we wanted to explore how transit mode variability relates to Walk Score data. Our initial hypothesis was that, where better transit infrastructure exists and is measured by Walk Score, there is more usage of existing pedestrian, public transit, and biking networks, and thus, more occupants engaging with multiple transit modes. Given that every measure besides single occupant vehicle travel is preferable and emits less greenhouse gas emissions, we still believe variability will capture higher performance on Arc transportation and more sustainable forms of transportation.

Methodology

In order to capture diversity of transit modes, we used Simspon's Diversity Index, a method commonly used in ecology to describe the diversity of a set of species using the "evenness" of the dataset across multiple species. In this instance, the "species" are possible transit modes, and the "evenness" is determined by the frequency of use of different transit modes (in percent) reported by occupants. The output of this method is a single value ranging from 0-1 representing diversity transit transit data (1 = Very diverse, 0= no diversity).

Arc provides 9 different commute mode options: bus, car: solo, car: 2-3 carpool, motorcycle or scooter, walk, bike, telecommute, subway/metro, and tram or streetcar. Using the distribution of transit mode popularity, we calculated a Simpson's value for around 300 projects.

The higher the Simpson's value, the more diversity of modes were used to access a project's location. We then took the Simpson value and calculated the correlation between the Arc Walk Score, Bike Score, and Public Transit results.

Results

Table 1. Correlations between transportation metrics and travel mode variability as assessed with the Simpson Diversity Index. Partial correlations indicate the degree to which the diversity of travel modes predict other metrics.

Transportation Metric	Correlation to Simpson's Div Index
Arc Transportation Score	0.41
Walk Score	0.42
Transit Score	0.50
Bike Score	0.30

The transit Simpson value ranged from as low as 0.04 to as high as 0.85. When compared with the Arc Transportation-Walk Score correlations, the relationships were slightly stronger between the Simpson's score for transit mode diversity and the Walk score metrics. The transit mode diversity correlated least with Bike Score (r^2 = 0.3), weakly with Walk Score (r^2 = 0.4), and most with the Public Transit Score, with an r^2 value of 0.5. The stronger relationship between transit diversity and Public Transit Score may be attributed to the Public Transit score covering more aspects of transportation than the other two location-based metrics.

In order to model what an application of diversity of modes as an indicator could look like within arc, we also created a density plot to indicate the distribution of Simpson diversity scores. We approximated the potential Arc Score based on the Simpson score relationship to show what potential Arc Transportation scores would result from a given Simpson score. As noted in the first comparison paper (link here), we once again see that projects generally have high Arc Transportation Scores and as a result, the bulk of diversity scores were above 0.25.

Figure 1. Frequency distribution of travel modes. Higher Simpson values (right side) indicate higher mode diversity. Lower Simpson values (left side) indicate low mode diversity (e.g., predominance of single passenger vehicle travel)

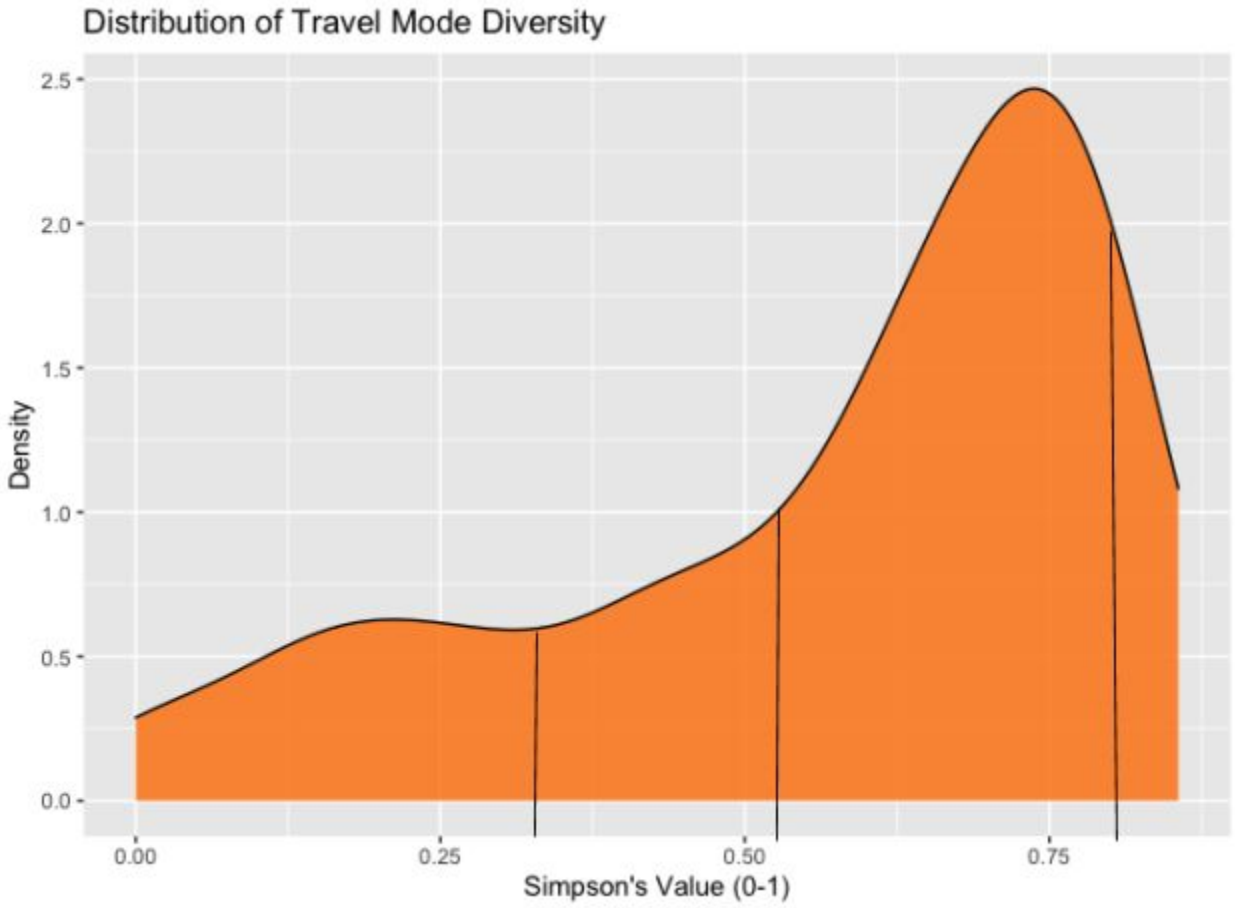

Table 2. Illustrative scoring for travel mode based on the sample of Arc participants. Values between these points would be linearly extrapolated.

Diversity Metric	**Arc Transportation Performance Score**
0.00	0
0.35	40
0.6	80
>0.9	100

Discussion

While Simpson's value is used to address diversity within transportation choice, there are several limitations and inaccuracies pertaining to the application of this metric to transportation choices. For example, Simpson's value would normally be calculated using whole numbers, and it may round off the percentages we used to model the distribution of transit mode quantities. Since Simpson's does not take into account which transportation mode is most frequently used, just how many are used. This means, for example, that a project could have low Simpson's value if every occupant bikes to work, but a higher Simpson's value if 75% of occupants commute in a single-occupant vehicle and 25% commute by bike. This example demonstrates that low CO2 emissions from commuting does not necessarily mean a high Simpson's value. Additionally, some occupant data had not been available or updated, and we could anticipate higher correlations should a project collect updated data on occupant commuting.

We also correlated Arc Transportation scores with the Simpson's diversity score, which resulted in a correlation of 0.41. This finding is interesting, as it may reveal that varying transit modes does not currently connect to a large change in Arc Transportation score, given the weak relationship. That being said, we wanted to explore what Travel Mode Diversity *could* look like if it played a role in Arc Transportation Score, and analysed the density of simpson's values in order to develop a scoring breakdown for Arc.

Conclusion

The findings from our previous paper included analyzing the impacts of Covid-19 on current Arc Transportation Scoring, which are less sensitive to occupancy and self-reported travel information. Options include a focus on mode choice and diversity and tracking apps. Our work outlined above demonstrates a correlation in transit mode diversity and location-based metrics, which indicates that transit mode diversity may be a valuable indicator to consider when refining arc transportation scoring practices.

Connecting performance to practice is the key function of Arc. While mode diversity in this analysis is not necessarily directly correlated with Walk Score metrics, they both measure the availability and density of transit, revealing greater details about transportation opportunities of the project. Walk Score metrics can identify and inform LEED project locations, and transit mode diversity in particular can help existing projects compare the utilization of transit options to availability. Comparing existing patterns and preferences to transit infrastructure will guide policy and incentives to support alternative commuting models aligned with occupant behavior and the project region.

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About Arc

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