Author Response to Reviews of

If you build it who will come? Equity analysis of park system changes during COVID-19 using passive origin-destination data

Authors
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RC: Reviewer Comment, AR: *Author Response*, ☐ Manuscript text

We are grateful to the two anonymous reviewers for their review and consideration of the manuscript. In this document we have highlighted additions to the text of the manuscript with blue letters and ~~text removed from the manuscript with red letters.~~

As a general change from the first manuscript, we have updated the library used to generate our maps, resulting in minor changes to the presentation but not the content. We also pulled new data from OpenStreetMap for the park amenities. This resulted in small changes to the estimated model coefficients but none are substantial enough to affect the findings. A few minor typographical errors have also been corrected.

1. Reviewer B

RC: This study aims to evaluate how converting roadway facilities into open pedestrian spaces affects park accessibility and the socio-spatial distribution benefits of those changes. The authors use StreetLight data from Alameda County, California to estimate a park activity location choice model, from which they construct their park accessibility measure. They find that Alameda County's street conversions have disproportionately benefited Black, Hispanic, and low-income households. Overall, this is a good paper with a path to publication.

AR: *We are grateful that the reviewer found our paper worthwhile.*

1.1. Literature

RC: The intro paragraph to the Literature section only mentions two literatures when in fact there are three subsections of literature discussed. It would be useful to include a synthesis of the literature on sociodemographic variation in park utility at the end of section 2.1. Good review of the literature on measuring accessibility.

AR: *Originally, the "two literatures" referred to the parks preference literature and the accessibility literature. We agree that the paragraph is unnecessarily confusing. It now reads:*

> Understanding the equity benefit distribution of park access requires us to consider ~~two integrated but rather distinct~~ multiple literatures. First, we discuss theories of justice as they have been applied to transportation policy to introduce our conceptualization of equity. Next, we consider the disparity in park utility perception among different populations. We subsequently consider quantitative techniques to evaluate the access that individuals have to park facilities. Finally, we consider recent research documenting and analyzing street conversions instigated by the COVID-19 pandemic.

1.2. Methodology

RC: Utility-based accessibility is a good framework for analyzing the distributional benefits of street conversions, and the authors generally do a good job of explaining and supporting that methodological choice. However, the paper would benefit from additional explanation on at least three issues.

RC: First, it is unclear to me whether the same 10 additional parks are used for each synthetic choice maker's choice set, or whether a new random selection of 10 additional parks is done for each choice maker.

AR: *It is a different set of 10 parks for each synthetic choice maker. We have clarified this in the manuscript as*

> For this reason we randomly sample 10 additional parks to serve as the non-chosen alternatives~~for our~~ , with a different set of 10 parks for each synthetic choice maker.

RC: Second, the authors should discuss how reasonable their selection of choice sets is. I understand that it's impractical to estimate a choice model with 500 alternatives. But how realistic are the choice sets of 10 randomly selected parks? Is there a way to generate more realistic choice sets without biasing the model results?

AR: *The estimates of a choice model with random sampling of alternatives are known to be unbiased but inefficient relative to either a complete choice set or a more carefully constructed sampling scheme (Train, 2009). In this case, we observe that it would be difficult to create a realistically weighted alternative set (the ten nearest parks? The three nearest parks, two major regional parks, and five at random? Something else?) that is itself unbiased. We also observe that the problem of efficiency is not a challenge in this analysis; virtually all estimated parameters would not change their level of significance or interpretation with marginally more precise estimates. We have added the following to the methodology discussion:*

> Such random sampling of alternatives reduces the efficiency of the estimated coefficients but the coefficients remain unbiased (Train, 2009); a more elegant sampling approach might have resulted in smaller estimated standard errors, but the estimation results (presented below) suggest this is not a concern in this application.

RC: Third, the authors should provide more justification for their choice of cost coefficient since there are no cost variables in their model. Why is the chosen cost coefficient reasonable and not arbitrary? Did the authors explore other options?

AR: *Because we are only using the cost coefficient to scale the logsum utility benefits and not to do rigorous cost-benefit analysis, any reasonable scalar would be sufficient. That said, we suggest that using the cost coefficient present in the region's activity-based travel model for relevant trips could hardly be characterized as arbitrary. Nevertheless, we have re-written the relevant paragraph to be more clear. In doing so, we have adopted the MTC model documentation directly, which differs modestly from the ActivitySim open-source model derived from it. This results in a new parameter value, and consequently scaled changes to the user benefits estimates. Though the numerical benefits have changed, our central finding related to benefit distribution has not been affected.*

As a substitution, we use an estimate of the cost coefficient obtained from the ~~open-source activity-based travel demand model ActivitySim (?), which is itself based on the regional travel model employed by the~~ Metropolitan Transportation Commission (MTC~~), the~~ , San Francisco Bay regional MPO~~. ActivitySim uses a cost coefficient of -0.6 divided by the each simulated agent's value of time to determine destination choices for non-work trips .[a] In ActivitySim, as in most~~) "Travel Model One" activity-based ~~travel models, the value of time is considered to vary with an~~ travel demand model (Metropolitan Transportation Commission, 2012). In this model, the utility of destination choice for social and recreational trips uses the mode choice model logsum as an impedance measure. The mode choice model cost coefficient varies with each individual's ~~income, but in this aggregate destination choice model, an aggregate~~ value of time~~will suffice~~. The average value of time in the synthetic population for the ~~Bay Area~~ calibration scenario is $7.75 per hour~~, resulting in a cost coefficient on the destination choice utility of -0.215. Dividing the difference in accessibility logsums by the negative of this value gives an initial estimate of the monetary value of the policy to each park user~~. Dividing that value of time by the in-vehicle travel time parameter of -0.018 results in an implied mode choice cost coefficient of $(-0.018/min * 60min/hr)/(7.75\$/hr) = -0.139/\$$.

[a] ~~To be precise, this is the cost coefficient on the mode choice model for social, recreational, and other trip purposes, which influences destination choice through a logsum-based impedance term.~~

1.3. Results

RC: Should the ratio of coefficients be reversed (p. 16)? Shouldn't the coefficient for the desired amenity (in this case increased park acreage) be the numerator, divided by the coefficient for the cost (in this case distance)? Using the ratios reported in the manuscript would imply that park visitors living in block groups with a high proportion of Black and low-income residents would be willing to travel farther for bigger parks than others, contrary to the authors' conclusion that they are "considerably more sensitive to the distance to a park" (p. 20).

AR: *The reviewer is correct that we had the ratio backwards, though not the direct interpretation. Because the distance coefficient is larger for block groups with high proportions of Black individuals, this implies that residencts of these block groups are indeed more sensitive to distance. We have changed this sentence in the results section to read as follows:*

That is, individuals will travel further distances to reach larger parks. The ratio of the estimated coefficients implies that on average, people will travel ~~3.41 times further~~ twice as far to reach a park ~~twice~~ 3.47 times as large.

RC: In the equity analysis, the authors should explain how they calculated the benefit "for simply having more options" (p. 20). They should also provide a citation for the proposition that "[o]ne property of logsum-based accessibility terms is that there is some benefit for simply having more options" (p. 20).

AR: *We are unaware of a specific citation for this claim, but the assertion is trivially derived from the logsum equation. If one new alternative q is added to the choice set, then the logsum becomes $\ln\left(\sum_{j\in J} e^{u_j} + e^{u_q}\right)$; because $e^x > 0$ everywhere, and because $\ln(x)$ is monotonically increasing, then it is always true that $\ln\sum_{j\in J} e^{u_j} < \ln\left(\sum_{j\in J} e^{u_j} + e^{u_q}\right)$. We have added the following sentence to the mathematical description,*

> Note also that the logsum increases with the size of the choice set: if a new alternative q is added to J, then $\ln \sum_{j \in J} \exp(V_j) < \ln(\sum_{j \in J} \exp(V_j) + \exp(V_q))$ for any value of V_q.

RC: I suggest caveating the presentation of monetary benefits. Many readers might find these numbers difficult to understand and/or arbitrary (despite the preceding explanation of calculating consumer surplus in the methods section). How real are these dollar values? Do they suggest that the total value of the street closures is just $664,628? From my perspective, the strength of the consumer surplus analysis is not in presenting dollar values. The strength is that it allows an estimation of the distribution of benefits, which could be done regardless of the value of the cost coefficient.

AR: *This is a very good point. One advantage of converting a consumer surplus into monetary terms is that it transforms what is a fairly esoteric quantity — the utility benefits derived via a choice model logsum — into a value that policy maker and the public can understand. Of course, our own edits to the manuscript show how heavily this value depends on assumed or estimated cost coefficients which have some uncertainty distribution associated with them. We have added the following caveat to the limitations section:*

> The monetary benefits we present in this analysis are heavily dependent on two separate assumptions. First, reasonable researchers might have selected different values of time or cost coefficients. Second, the decision to assign one benefit to each household could also have been made differently. A change in either assumption would lead to a highly different total benefits estimate, but it would not change the distribution of the benefits, which is the objective of this study. At some level, converting the esoteric measure of choice model logsums into a unit that can be conveniently compared against other policies is desirable to help the public and policy makers evaluate such decisions. Further research should establish guidelines and practices for applying accessibility logsums in monetary cost-benefit analyses.

RC: The block group segmentations indicate that the utility equations could be different for different groups. That also affects the equity analysis. It is likely that not all residents of each block group will benefit similarly from the COVID-19 street closures. This would affect the distributional equities. I suggest mentioning this caveat.

AR: *We feel the previous addition has also addressed this caveat, which we agree is important to mention.*

2. Reviewer E

RC: Thank you for the opportunity to review this manuscript. The authors assess the policy of converting roads into pedestrian open spaces streets in Alameda County, California, from an equity perspective. One of the main contributions from the manuscript is the clever use of travel behaviour data collected through mobile phone sensors to answer questions about equity at the intersection of mobility and land use planning. Another interesting contribution stems from their use of utility-based accessibility measures to address a timely theme that cuts across transport policy and questions of distributive justice. Despite having access to a wealth of data and proposing to answer an interesting research question with potential contributions to policymaking, the paper still needs substantial work to be considered for publication in the Journal of Transport and Land Use. I expect the comments I provide below help improve the manuscript.

AR: *We appreciate that the reviewer found our methodology "clever" and our contribution "interesting." We are similarly grateful for the constructive criticism the reviewer provided.*

2.1. Surrounding Land Uses

RC: I am not persuaded by either the methodological choices made by the authors or their engagement with the academic literature on accessibility. Perhaps the most critical potential threat to internal validity consists of the author's assumption that residents in Alameda County will visit the recently pedestrianized spaces motivated by the same factors that encourage them to visit parks: recreation, exercise, and social interaction. One possible avenue to overcome this limitation could be to account for land uses, for instance, restaurants or retail spaces, around the destinations included in the analysis as a proxy for unobserved differences in trip purposes (e.g., shopping, exercising, and leisure) unavailable in passively collected mobile phones data. These factors, which can be paired with amenities found in parks, were not accounted for in the models presented, neither the potential consequences for their omissions in the conclusions inferred from the model results.

AR: *It is not immediately clear to us what the reviewer is suggesting we change in our analysis. It seems strange to consider including retail and restaurant opportunities surrounding a park in the destination choice model — if that is the suggestion — given that these facilities would have been shuttered during the COVID lockdowns when the street conversions were active. It is true that the converted streets are not like parks in several key ways, and this is one key benefit of our proposed utility-based methodology. We can describe the converted streets as lacking several amenities of other parks, which could not be done with a cumulative opportunities or gravity based method. As we describe in the modestly revised conclusions,*

> In estimating these benefits, we applied an emerging technique to estimate park choice preferences and utility from passive mobile device data. This technique allowed a more nuanced measure of access that allowed us to consider the converted streets as providing quantitatively different ~~access~~ amenities than other city parks.

2.2. Travel Mode of Access

RC: Another strong assumption that also poses a tread to the research's internal validity is that residents who visit open spaces, including the ones the authors focus on, is that they will travel to these places by foot, and therefore penalizing all individuals by distance instead of travel time. Of course, accounting for travel times requires access to mode choice, which some travel behaviour and physical activity mobile applications can detect. One alternative to mitigate this problem, assuming that there is no information about mode choice, is to subset from the dataset those who had a higher likelihood of had conducted their trip by foot. If this was neither an alternative, it is imperative to include a paragraph discussing how the assumption that all walked to their destinations may compromise the analysis and conclusions.

AR: *It is not true that we assumed that all people travelled to their destination on foot. We required a measure of distance between home block group and park, and we chose to use the distance of the walk path. This might be modestly longer or shorter than the drive or transit path distance. We could have used the Euclidean distance instead, but in other research Macfarlane et al. (2021) saw no meaningful difference between the two measures. To do as the reviewer suggests by incorporating the observed mode of travel would require not just information on how the person accessed the park that they chose, but* ***also how they would have reached their alternative park destinations****, which is not available other than as a probability. We include a paragraph in the limitations discussing the limits of this assumption, and call for future research (now*

underway) to use the mode choice model logsum instead of travel time by any single mode.

> The distance to a park was represented in this study using a walk network retrieved from the OpenStreetMap project. Though perhaps superior to a Euclidean distance, this measure still has many limitations. First, we were unable to verify the integrity of the underlying network information; based on our prior experience, it is likely that some broken or improperly connected links artificially inflated the measured distance for an unknown number of park / block group pairs. A more serious limitation, however, is that experienced travel distances are a function of the transport mode employed by the traveler. Using bare distances does not provide any detail on how access to parks might be increased with improved transit service, for example. Using a mode-choice model logsum as a multi-modal impedance term in the activity location choice model would enable this kind of analysis.

2.3. Causal Effects

RC: Although the motivation is a particular policy and the word 'change' is in the title, it caught my attention that the authors' research design overlooks the time dimension. While cross-sectional analyses like the one presented can contribute to the academic literature, the paper does not account for time. For instance, classifying trips by whether they occurred before and after streets were banned to cars and open to only pedestrians and cyclists will provide results more attuned to the paper's motivation. Since the research design employed prevents authors from linking the policy in question with particular behaviours and preferences, any language suggesting cause-and-effect must be edited to reflect the nature of the research design employed.

AR: *It is possible that the reviewer has misunderstood our methodology. We estimated destination choice models using location-based services data, and then applied this same model to two different park availability conditions. We do not estimate a new model for the COVID-19 condition because we do not have that data, though we agree that that would be a valuable analysis. As we state in the limitations,*

> Similarly, there is no information on what kind of trip the device-holder actually accomplished at each park. These limitations combined mean that it would likely be infeasible to directly observe devices that traveled to the converted streets during the COVID-19 lockdowns. The ideal dataset for estimating individual park activity location choices generally and in special situations remains a high-quality, large-sample household survey of real individuals.

2.4. Literature

RC: Regarding the concept of accessibility and the particular ways scholars have attempted to operationalize it, the authors need to explain better why cumulative opportunities measures are inferior in the context of the research question the manuscript attempts to answer. It is not enough to say: "However, they [cumulative opportunity measures] may be too simple, especially concerning trip costs near the threshold." For example, a person living in front of the park may have the same accessibility level that another living 9 minutes away from the same park if the objective of the analysis is to measure how many parks can be accessed within a predefined (or normative) travel time threshold. I recommend expanding this section of the literature review to other works that move from pure methodological discussions to more theoretical ones. One start point could be the paper titled "Measuring accessibility: positive and normative implementations of various accessibility indicators" by Páez et al. (2012). The work of transportation scholars Rafael Pereira or Ahmed El-Geneidy on accessibility may be of help as well.

RC: Another significant omission is the definition of equity that guides the analysis. Please refer to the paper titled "Distributive justice and equity in transportation" by Pereira et al. (2017a) for a thorough discussion on the issue. Other two relevant sources are the Taylor and Tassiello Norton (2009a) article "Paying for Transportation: What's a Fair Price?" and "Environmental Injustice and Transportation: The Claims and the Evidence" by Schweitzer and Valenzuela Jr (2004).

AR: *We agree that our positioning of the equity analysis and its relationship to accessibility would benefit from a firmer grounding in the literature. We are grateful for the references the reviewer provided, which have allowed us to strengthen these discussions in the literature review.*

2.5. Equity and theories of justice

The pursuit of equity, as it pertains to distributions of costs and benefits, is necessary, though insufficient, to the pursuit of justice, which Fainstein (2010) argues should be a central pursuit of urban policy and planning. Fainstein (2010) draws on theories of justice to propose that a just city is one that is equitable, diverse, and democratic. Schweitzer and Valenzuela (2004) discuss the literature on environmental justice and transportation in terms of cost- and benefits-based claims of injustice (both of which relate to equity under Fainstein's framework of the just city) and process-based claims (which relate to democracy under Fainstein's framework).

Taylor and Tassiello Norton (2009b) apply theories of justice to categorize equity-based arguments in support of various transportation finance mechanisms. Pereira et al. (2017b) similarly survey the moral philosophy literature and apply it to transportation policy evaluation. Both papers emphasize that claims of distributional (in)justice must specify *what* is being distributed in addition to what that distribution should be be. Taylor and Norton (2009) argue that the distributions of revenue collection, expenditures, and benefits from use of transportation infrastructure must be considered together. Pereira et al. (2017b) apply Rawlsian egalitariansim (Rawls, 2001) and capabilities approaches (Sen, 2014; Nussbaum, 2001) to argue that the transportation policy should focus on the distribution of accessibility, broadly defined as the ability to both access the transportation system and use it to access destinations. They join Martens (2012) in calling for further research to arrive at a operational definition of accessibility that best aligns with a justice-theoretic approach.

In this study, we follow Pereira et al. (2017b) in focusing on accessibility and adopt a utility-based accessibility measure, as we discuss in the following sections. While our analysis does not rely on a strict definition of an ideal distribution of accessibility, we start from a proposition rooted in both Marxian ethics (Heller, 1976) and liberation theology (John Paul II, 1991) that an equitable distribution is one that favors vulnerable and marginalized populations.

AR: *We have also rephrased our abstract and concluding paragraph in response to this criticism as follows:*

We then apply this model to examine the accessibility benefits resulting from COVID-19 street conversions to create a set of small park-like open spaces; we find that this ~~has been a pro-social policy in that~~ policy has improved equity in that maginalized communities including Black, Hispanic, and low-income households receive a disproportionate share of the policy benefits, relative to the population distribution.

The research we present here suggests that this policy had measurable and meaningful benefits to neighborhoods in Alameda County, California, and that these benefits were distributed in an equitable ~~or even a pro-social manner~~ manner in the sense that the distributin favored marginalized populations.

References

S. S. Fainstein. *The Just City*. Cornell University Press, Ithaca, 1st edition edition, July 2010. ISBN 978-0-8014-7690-7.

A. Heller. *The Theory of Need in Marx*. Allison & Busby, London, 1st edition edition, Jan. 1976. ISBN 978-0-85031-174-7.

John Paul II. *Centesimus Annus*. Encyclical Letter. Vatican, Vatican, May 1991. URL https://www.vatican.va/content/john-paul-ii/en/encyclicals/documents/hf_jp-ii_enc_01051991_centesimus-annus.html.

G. S. Macfarlane, N. Boyd, J. E. Taylor, and K. Watkins. Modeling the impacts of park access on health outcomes: A utility-based accessibility approach. *Environment and Planning B: Urban Analytics and City Science*, 48(8):2289–2306, 2021. ISSN 2399-8083. doi: 10.1177/2399808320974027. URL https://doi.org/10.1177/2399808320974027.

K. Martens. A justice-theoretic exploration of accessibility measures. In K. T. Geurs, K. J. Krizek, and A. Reggiani, editors, *Accessibility Analysis and Transport Planning*. Edward Elgar Publishing Inc, Northampton, Massachusetts, Oct. 2012. URL https://www.elgaronline.com/view/edcoll/9781781000106/9781781000106.00020.xml. ISBN: 9781781000113 Publisher: Edward Elgar Publishing Section: Accessibility Analysis and Transport Planning.

Metropolitan Transportation Commission. Travel model development: Calibration and validation, 2012. https://mtcdrive.app.box.com/s/7crr7bwhromi2au42jnpp11fqe5l24xq.

M. C. Nussbaum. *Women and human development: The capabilities approach*. Number 3. Cambridge University Press, 2001.

A. Páez, D. M. Scott, and C. Morency. Measuring accessibility: positive and normative implementations of various accessibility indicators. *Journal of Transport Geography*, 25:141–153, 2012.

R. H. Pereira, T. Schwanen, and D. Banister. Distributive justice and equity in transportation. *Transport reviews*, 37(2):170–191, 2017a.

R. H. M. Pereira, T. Schwanen, and D. Banister. Distributive justice and equity in transportation. *Transport Reviews*, 37(2), Mar. 2017b. ISSN 0144-1647. doi: 10.1080/01441647.2016.1257660. URL https://doi.org/10.1080/01441647.2016.1257660. Publisher: Routledge _eprint: https://doi.org/10.1080/01441647.2016.1257660.

J. Rawls. *Justice as fairness: A restatement*. Harvard University Press, 2001.

L. Schweitzer and A. Valenzuela. Environmental Injustice and Transportation: The Claims and the Evidence. *Journal of Planning Literature*, 18(4):383–398, May 2004. ISSN 0885-4122. doi: 10.1177/0885412204262958. URL https://doi.org/10.1177/0885412204262958. Publisher: SAGE Publications Inc.

L. Schweitzer and A. Valenzuela Jr. Environmental injustice and transportation: the claims and the evidence. *Journal of planning literature*, 18(4):383–398, 2004.

A. Sen. Development as freedom (1999). *The globalization and development reader: Perspectives on development and global change*, 525, 2014.

B. D. Taylor and A. Tassiello Norton. Paying for transportation: What's a fair price? *Journal of Planning Literature*, 24(1):22–36, 2009a.

B. D. Taylor and A. Tassiello Norton. Paying for Transportation: What's a Fair Price? *Journal of Planning Literature*, 24(1):22–36, Aug. 2009b. ISSN 0885-4122. doi: 10.1177/0885412209347156. URL https://doi.org/10.1177/0885412209347156. Publisher: SAGE Publications Inc.

K. E. Train. *Discrete Choice Methods with Simulation, 2nd Edition*. Cambridge University Press, Cambridge, mar 2009. doi: 10.1016/S0898-1221(04)90100-9. URL http://linkinghub.elsevier.com/retrieve/pii/S0898122104901009.