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A comment on “Extraction, Assimilation, and Accommodation: The Historical Foundations of Indigenous–State Relations in Latin America”

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Abstract

Carter (2024) examines the historical conditions that shape protection versus assimilation for indigenous communities, arguing that state-led conscription programs are one such factor. In a natural experiment leveraging conscription for a 1920s Peruvian highway designed to replicate a pre-colonial road system (Qhapaq Ñan), Carter finds through a geographic regression discontinuity design that eligibility for state conscription increased the likelihood of a municipality having an indigenous movement by about 30 percentage points (approximately .75 standard deviations) and scores on an omnibus accommodation measure by about .3 items (approximately .4 standard deviations). The omnibus measure includes the number of institutions that an indigenous community reports preserving (increased by .3 items on a 7 point scale, or .25 standard deviations), likelihood of having a communal land title (increased by 12 percentage points, or .3 standard deviations), and likelihood of registration with the government (increased by 9 percentage points, or .3 standard deviations). All point estimates are significant at the .1% level.

We successfully computationally reproduce all main claims of the paper but find inconsistencies between the map of the road presented by Carter and that used by Franco et al. (2021) that affect its passage through a small number of municipalities. In order to investigate whether these municipalities drive the main findings without the ability to identify municipalities in the data, we drop municipalities iteratively and re-run the analysis, finding only minor changes in coefficient estimates across subsets. In addition, we explore a number of sensitivity analyses for the regression discontinuity design that vary the functional form, vary the bandwidth window, and use the Rosenbaum method for window selection. While the results remain consistent under all analyses, we recommend for further research to recode treated municipalities on the basis of the alternative road map and explore the as-if random assumption in light of evidence linking proximity to the precolonial road to various economic and political outcomes.

[1] The authors would like to acknowledge Christopher Carter, the author of the original paper, who provided valuable support and comments throughout this replication.

1. Introduction

Carter (2024) investigates the effect of state conscription on the degree of assimilation of Indigenous communities into state institutions. He does so in the context of 1920s Peru, in which indigenous communities were conscripted by the Peruvian government into a project to build a highway along the path of a pre-colonial road, called the Qhapaq Ñan.

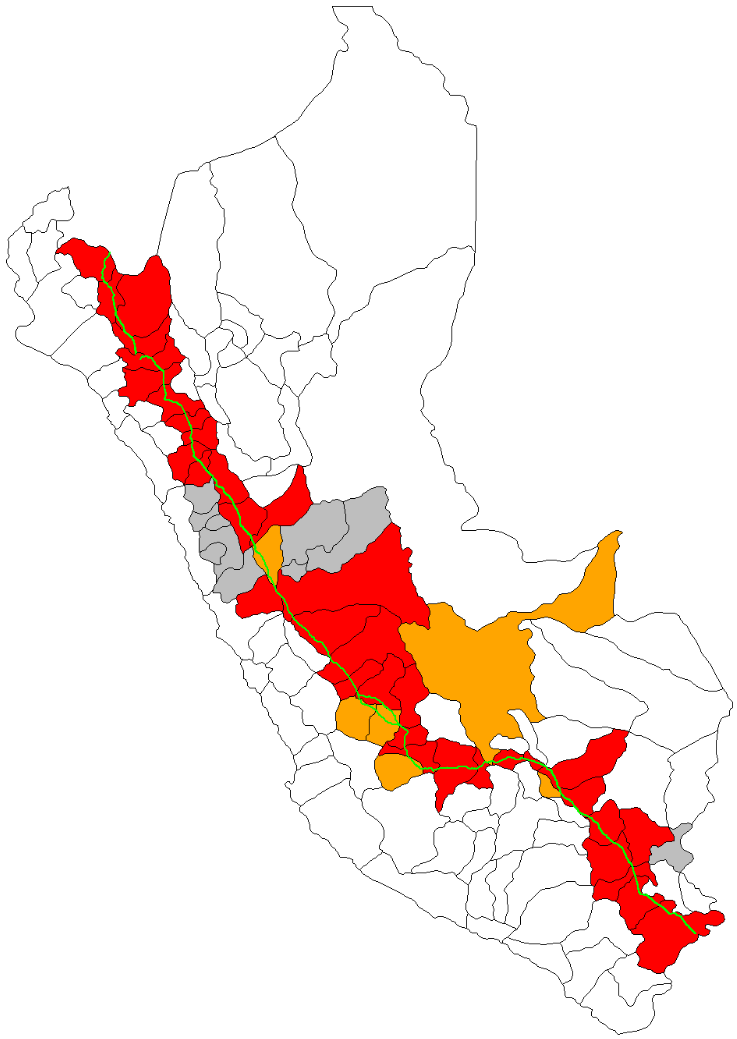
Developed over several centuries by the Incas based on pre-Inca infrastructure, the Qhapaq Ñan was an extensive trade, defense, and communication network that sustained the empire. Carter draws on field and archival work to argue that municipalities through which the pre-colonial road passed were eligible for conscription into the 1920s recreation project. According to Carter, this eligibility was as-if randomly assigned, thus offering an opportunity to test the effect of state conscription on modern political outcomes for Indigenous communities.

In this report for the Institute for Replication (Brodeur et al. 2024), we begin by exploring the map of the Qhapaq Ñan used to code the running variable in Carter's analysis as well as the plausibility of the assumptions necessary for a causal claim. Specifically, we consider whether the pre-colonial road might be a source of endogeneity driving differences in modern political outcomes across Indigenous communities. We then offer a series of robustness tests and sensitivity analyses to determine whether Carter's results remain consistent under alternate specifications and potential sources of confounding. The final section concludes.

2. Alternative Road Map and Causal Assumptions

In this section, we first discuss the road map presented in Carter's analysis, which we believe is a potential threat to inference that we identify. We also discuss potential concerns as to its accuracy. In an analysis of the long-term effects of the Inca road on economic development, Franco et al. (2021) also include a map of the Qhapaq Ñan, which they obtained from the Peruvian Ministry of Culture. The map is then validated through geolocations of *tambos*, or small warehouses set up next to the road that are still visible today. The Franco et. al. (2021) map differs from that provided by Carter, presenting a different shape and passing through different provinces. One province, in particular, is categorized as untreated in Carter's analysis but surrounds "treated" provinces, with the corresponding road map forked around it. No such fork exists in the Franco et. al. (2021) road map. The maps in question can be found in Figure S13 in Carter's supplementary appendix and Figure 1 in the main text of Franco et al. The specific provinces (treated and untreated) included in Carter's analysis are given in Figure 3 and use provincial borders from 1940. We map both the different paths followed by Carter's and Franco et al's maps below with Carter's path in blue and Franco et al's path in red.

Although we cannot verify the true path of the pre-colonial Qhapaq Ñan, evidence suggests that the map used by Franco et al. is more plausible. It runs through valleys from city to city and coherently tracks along the Incan ruins as well as contemporary roads. It is also in close proximity to *tambos* built by the Incan empire that still exist today. In contrast, Carter's road covers mountains, has questionable altitude changes, and passes over Lake Chinchayacocha (see below in red), while the Franco et al. map passes plausibly along the lake's shore (in orange). The Franco et al. map also covers several different provinces, including the Aija province, which Carter excludes as a treated province. We map the provincial differences, with provinces covered by both authors' road paths in red, provinces only covered by Franco et al's path in orange and provinces covered by only Carter's map in gray. These inconsistencies, combined with the fork, render us hesitant to trust the primary source data and coding of treatment provinces on which the regression discontinuity rests.



We are also uncertain that the assumptions necessary for causal inference in the context of a natural experiment hold. Although Carter claims that eligibility for labor conscription was as-if randomly assigned, evidence suggests that this may not be the case and that it could drive the results that he obtains. Franco et al. (2021) find that the Inca Road does indeed have significant effects on myriad facets of modern economic development, including higher wages, higher educational attainment, and reduced child malnutrition. This is in line with the literature on long-run economic development that finds that historic projects, particularly infrastructure, continue to benefit those who live in proximity today (Dell 2010).

While Franco et al. (2021)'s findings suggest that those who live near the pre-colonial road differ economically, there is reason to believe that this means that they differ politically as well. Income and educational attainment are key predictors of political attitudes and behavior. Thus, provinces near the Qhapaq Ñan may differ in their potential outcomes from the broader Peruvian population and respond differently to eligibility for state conscription as a result. This result may then extend the provincial borders, which are the main dividing line for the causal analysis carried out by Carter. The precolonial road itself thus remains a significant confounding factor.

Carter claims that his road map is not representative of the documentation used to generate his list of provinces where conscription into road construction took place, which are based contemporaneous accounts from the 1920s of where the road was perceived to have been. Nevertheless, it is unclear why Carter's coded road perceptions would differ from *tambos* that had been evident in Peruvian geography for the preceding four centuries.

We are impeded from further analysis down this path by limitations within Carter's replication data that prevent recoding. Carter cannot provide point shapefiles of Peruvian municipalities from 1940 and states that he manually coded distances from municipalities to 1940 provincial borders. Such geolocations are important for recoding distances to provincial borders that include the Franco et al road, rather than the Carter road. The geolocations of municipalities can be coded based on contemporary data, but such coding is time consuming and beyond the scope of I4R's replication reports. As such, we leave analysis of the Franco et al provinces based on Carter's RDD design to future research.

3. Computational Reproducibility

We used the replication package here: https://doi.org/10.7910/DVN/GS838F. The cleaning codes were provided in the replication package, along with the raw data. We successfully computationally reproduced all the main results (Figures 4 and 5) from the raw data.

	Fully	**Partial**	**No**
Raw data provided	x		
Cleaning code provided	x		
Analysis data provided	x		
Analysis code provided	x		
Reproducible from raw data	x		
Reproducible from analysis data	x		

While we do not uncover coding errors and are able to reproduce figures 4 and 5, we are unable to verify that point estimates replicate exactly given that they are not reported numerically. Visual comparison seems to indicate that the figures replicate identically, but the format in which results are delivered prevents perfect verification.

4. Robustness Reproduction and Replication with New Data

We now turn our attention to our robustness reproduction and replication. We conduct a replication by considering subsamples of municipalities that might better approximate the alternative road map and a robustness reproduction by varying the functional form of the regression, varying the bandwidth window, and using the Rosenbaum method for window selection. We cluster the standard errors at the region level instead of at the region/year level to account for non-independence between years within each region.

For our analysis, we rely on the same specifications and local regression discontinuity analysis leveraging proximity to the pre-colonial road as the running variable. The decision to conduct these replication exercises and robustness checks was taken after reading the paper and observing the code.

4.1 Iterative municipality drop

The alternative map of the Qhapaq Ñan presented in Franco et al. (2021) suggests that certain municipalities considered by Carter to be eligible for conscription may have been included erroneously. As outlined in section 2, there is evidence to suggest that the latter map is more plausible and so we explore whether provinces through which the road may not have passed drive the main findings.

An ideal test would be simply to drop the relevant municipalities and re-run Carter's specifications for the subset of municipalities through which Franco's road passes. However, the data provided in the replication package do not allow us to identify specific municipalities. Working around this limitation, we drop municipalities from the sample iteratively, re-running the specifications for all subsets of the data and graphing the coefficient distributions. We present the results in figures 3 through 10.

The results suggest that no single municipality drives the findings. While there is some variance across subsets, coefficients remain largely consistent and are normally distributed, suggesting that differences are largely stochastic. Importantly, all coefficients remain significant at the same level reported in the paper (p = .01). While we cannot conclude that the inclusion of all municipalities in question does not alter the results, it seems unlikely.

However, it is important to note that while we do explore the effect of dropping municipalities, we do not examine that of adding ones in. There are municipalities through which Franco's road passes but Carter's does not. Future research should confirm that results are robust to the inclusion of these municipalities.

4.2 Varying the functional form

In addition to the iterative municipality drop, we explore the robustness of the findings to particular modeling choices. Specifically, we vary the functional form to polynomials of the second and third degree and rerun the main analyses. Figures 11-14 present the results.

We find that the effect of labor conscription on the omnibus measure of accommodation is robust to alternative functional forms, but that the effect on the probability of indigenous movements is not. While the paper reports significant findings at the p = .01 level for the effect on indigenous movements, the significance level drops to p = .05 for the second order polynomial using the CER bandwidth. The results are insignificant using a third order polynomial for both CER and MSE bandwidths. Corresponding p values in comparison to those in the original study are presented in Table 1.

4.3 Varying the bandwidth window

We vary the bandwidth window as well in order to verify robustness. Figures 15 and 16 present the local average treatment effect (LATE) for varying bandwidth values and polynomials for the movement and accommodation measures, respectively. We find that coefficient estimates are robust to alternative bandwidths.

4.4 Rosenbaum bounds

Although we have assessed the extent to which modeling choices such as functional form and bandwidth window impact the findings presented in Carer (2024), unobserved confounding remains a potential source of unexplored bias. Rosenbaum bounds offer a powerful means of characterizing the sensitivity of findings to varying levels of unobserved confounding, providing an estimate for lower and upper bounds of the p-value at each level.

We calculate Rosenbaum bounds for Carter’s main outcomes (movements and accommodation) using the ‘rdlocrand’ package in order to assess the sensitivity of his causal claims to possible such confounding (Cattaneo et al. 2018). We find that the coefficient estimate for the effect of conscription on movements is insensitive to high levels of unobserved confounding, with lower and upper Rosenbaum bounds of 0 under log gamma levels of 1.5, 2, 2.5, and 3. However, moderate levels of unobserved confounding could alter the estimated effect on the omnibus measure of accommodation. While all lower bounds are 0, we derive upper bounds of 0, .1, .97, and 1 for the same log gamma levels of confounding. While we cannot determine the true degree of unobserved confounding affecting selection into treatment, our results provide some confidence in the claims of the original paper, at least in regard to the effect of labor conscription on Indigenous movements.

5. Conclusion

Carter offers an interesting and novel theory to account for variance in the degree to which Indigenous communities experience protection versus assimilation - labor conscription. Leveraging an infrastructure project in which the Peruvian government forcibly conscripted Indigenous communities living in municipalities located along the path of a pre-colonial road, he offers evidence that the historical experience of conscription does indeed shape Indigenous political behavior.

We have successfully reproduced these findings computationally and presented an original sensitivity analysis that finds that they are somewhat robust to potential confounding. However, the inconsistencies that we uncover in the road map provided by Carter and other published sources cast doubt on its accuracy and how treatment was encoded. Additionally, despite Carter's qualitative work, research on the Inca Road implies that the as-if random assumption cannot be accepted as straightforwardly as he suggests. Given the relationship between the pre-colonial road and modern economic outcomes, selection into treatment remains a salient concern for any causal interpretation of this research design.

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Tables

Table 1 – P Values Across Functional Forms

Point Estimate	Original Study	2nd Order	3rd Order
Mobilization (Bias-corrected, CER)	.008***	.015**	.158
Mobilization (Conventional, CER)	.006***	.014**	.126
Mobilization (Bias-corrected, MSE)	.004***	.007***	.176
Mobilization (Conventional, MSE)	.003***	.006***	.104
Accommodation (Bias-corrected, CER)	2.67e-09***	2.36e-09***	4.64e-10***
Accommodation (Conventional, CER)	9.63e-11***	5.58e-10***	1.48e-10***
Accommodation (Bias-corrected, MSE)	3.26e-10***	8.25e-09***	2.40e-09***
Accommodation (Conventional, MSE)	3.17e-12***	3.23e-09***	4.57e-10***

Note: Values reported to three digits. Associated coefficients significant at the ***[1%] **[5%] *[10%] level for lower and upper bounds.

Table 2 – Rosenbaum Bounds

Level of Unmeasured Confounding	Movements	Accommodation
Gamma = 1	(0,0)***	(0,0)***
Gamma = 2	(0,0)***	(0,.1)*
Gamma = 2.5	(0,0)***	(0,.97)
Gamma = 3	(0,0)***	(0,1)

Note: Reported values of gamma are exponentiated. Windows were selected via the mean squared error (MSE). Bounds were calculated from 100 replications for computational efficiency, but results are consistent under 200, 300, and 400 replications as well.
Associated coefficients significant at the ***[1%] **[5%] *[10%] level for lower and upper bounds.

Figures

Figure 1 - Reproduction of Figure 4 from original study

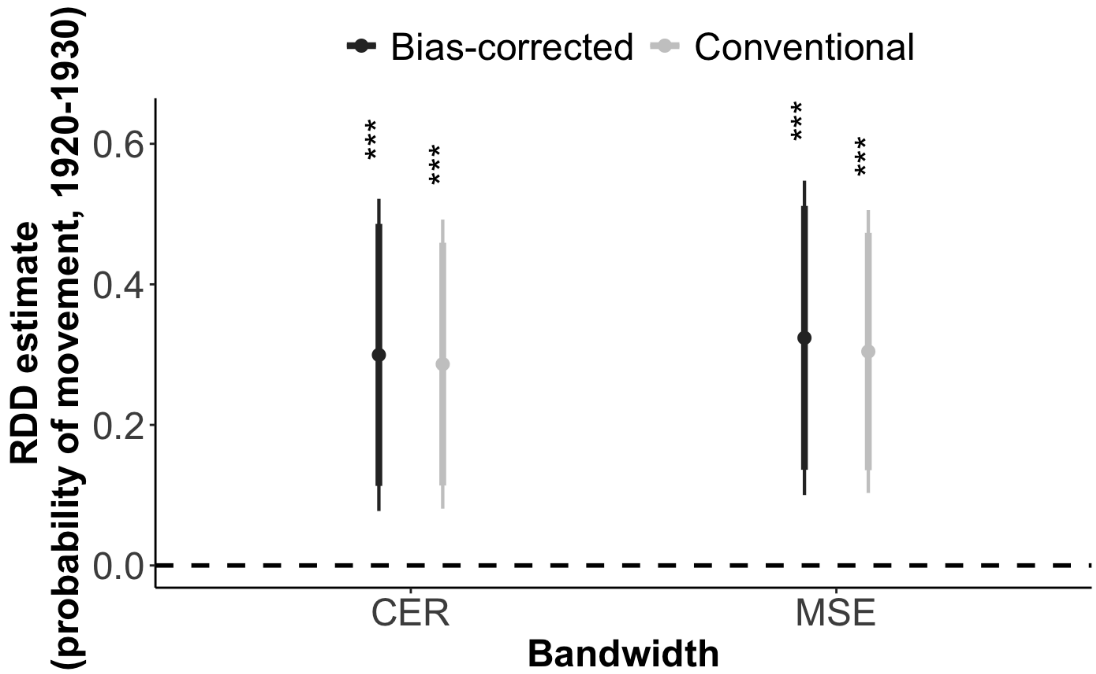

Figure 2 - Reproduction of Figure 5 from original study

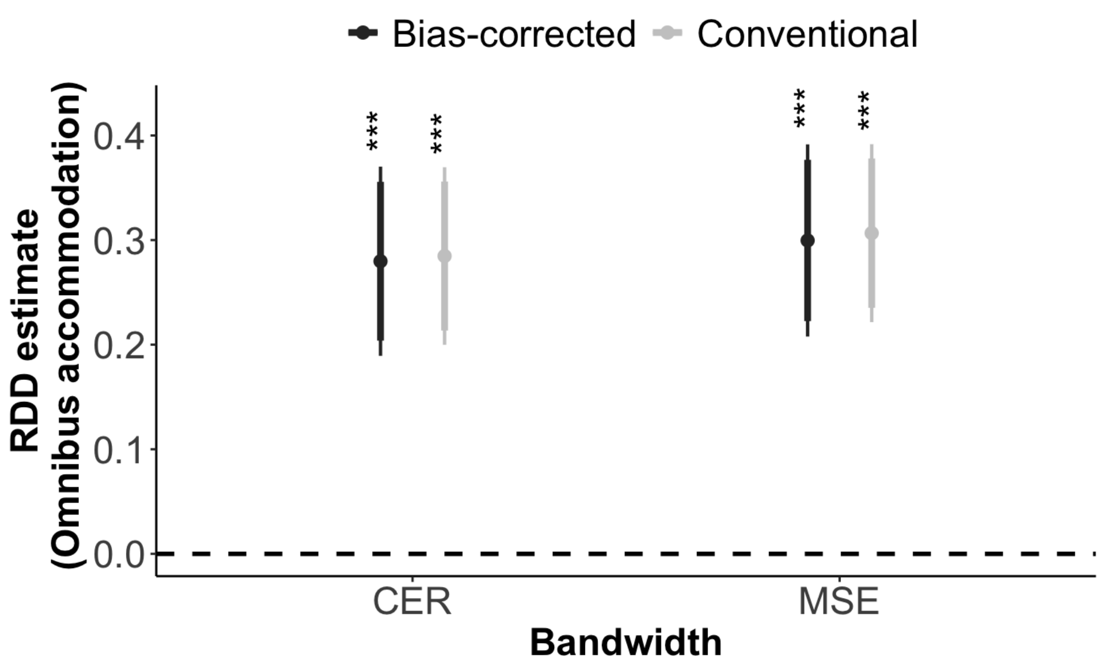

Figure 3

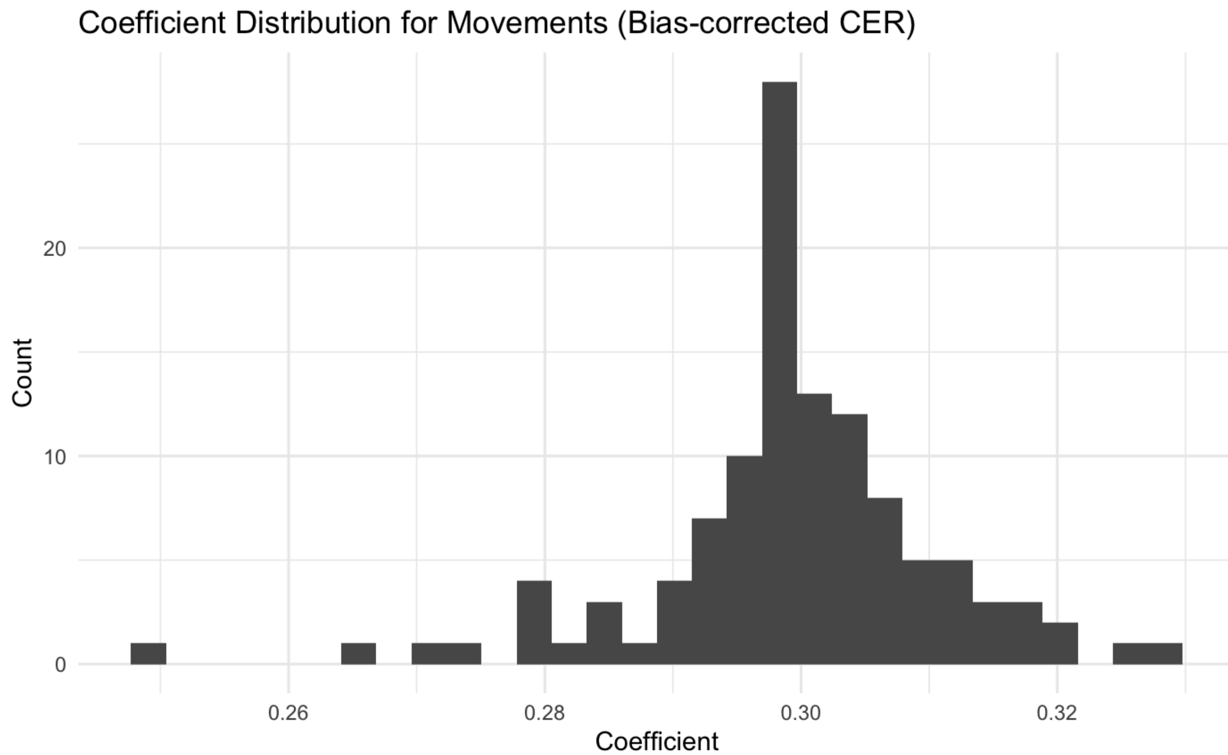

Figure 4

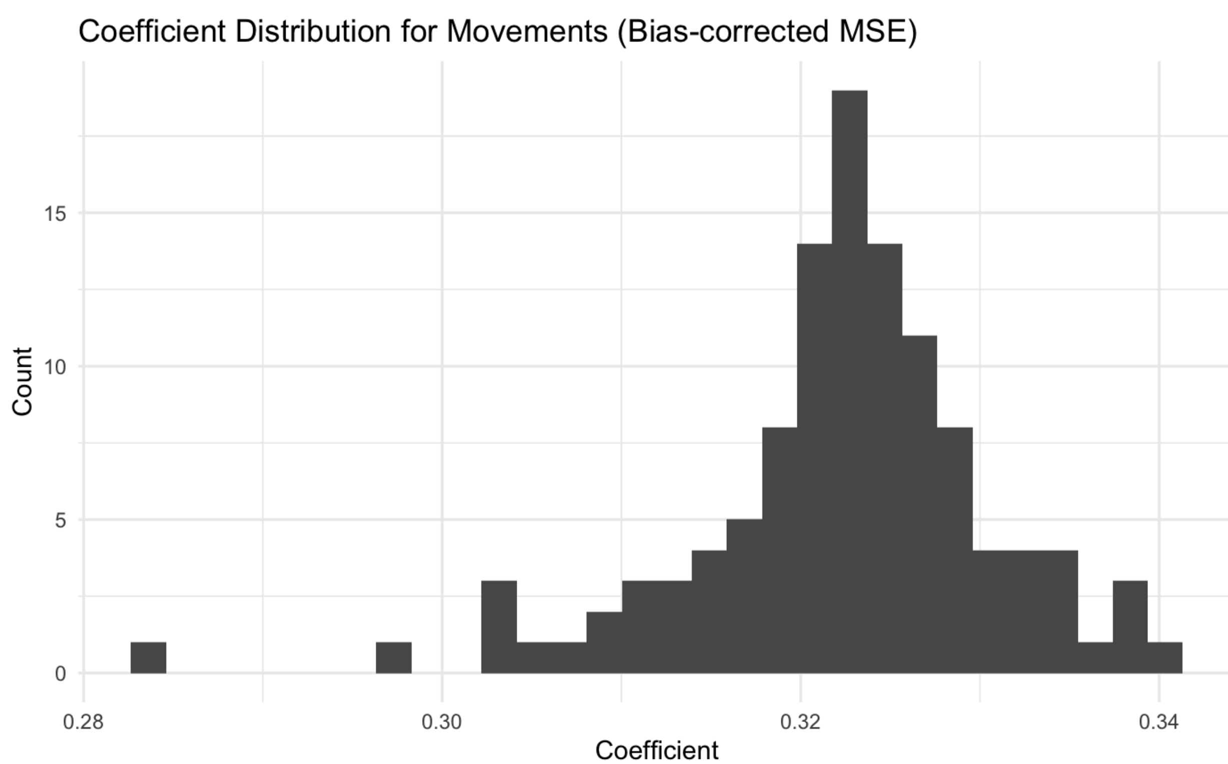

Figure 5

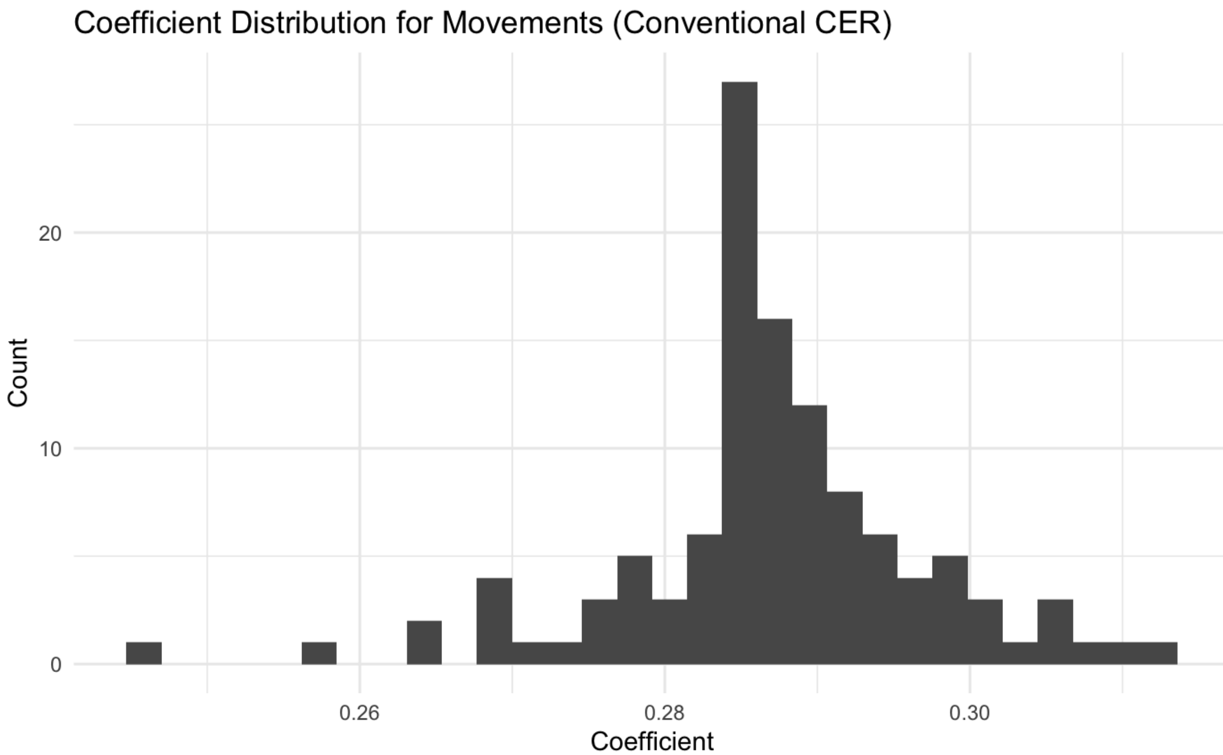

Figure 6

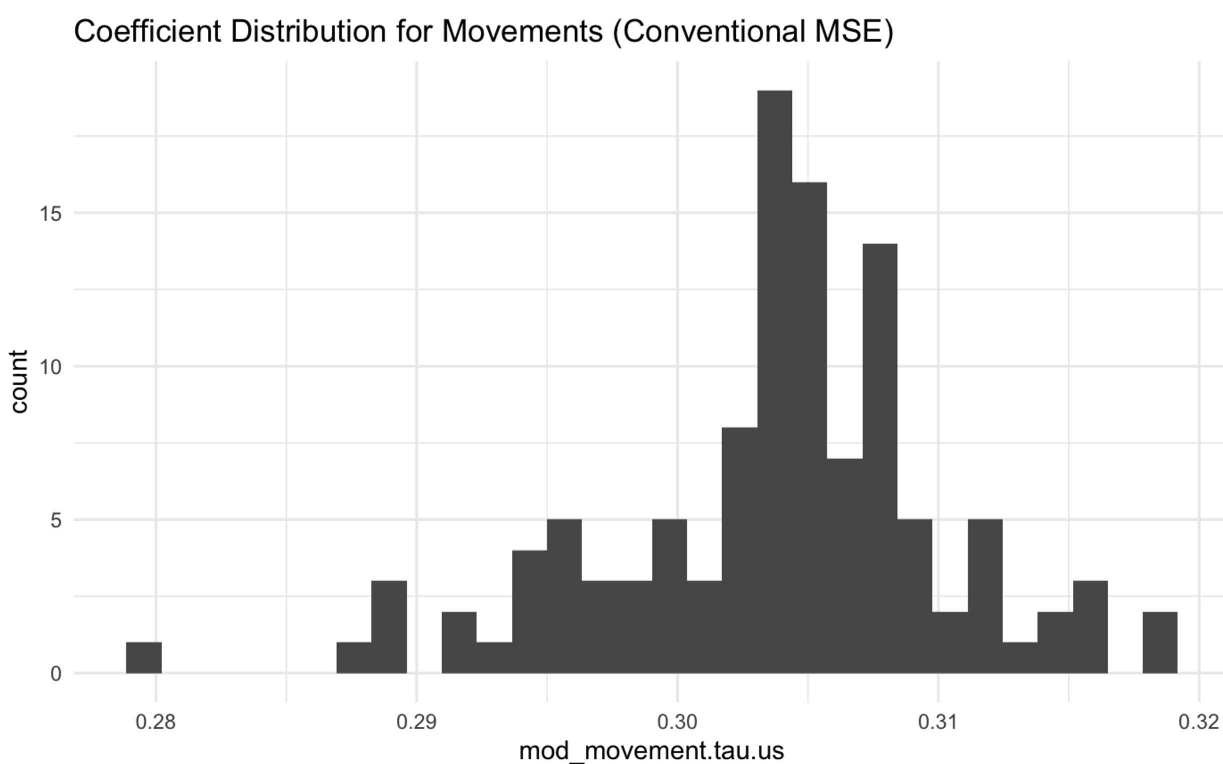

Figure 7

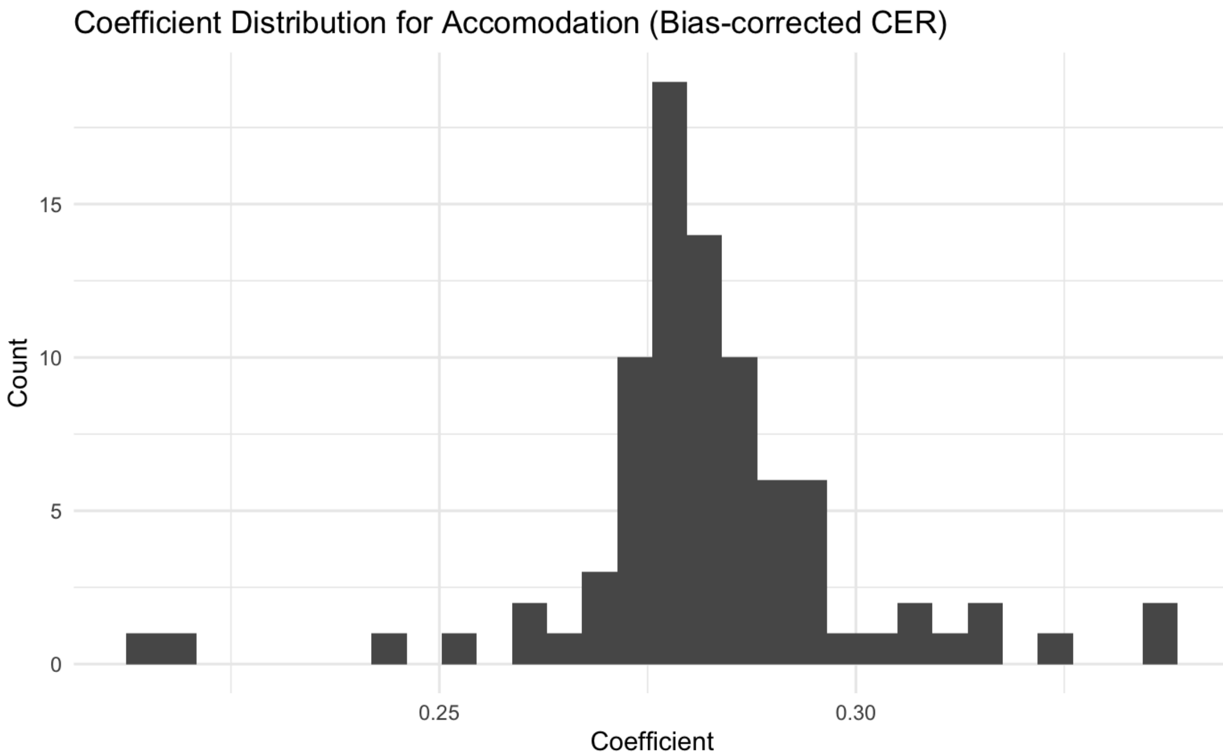

Figure 8

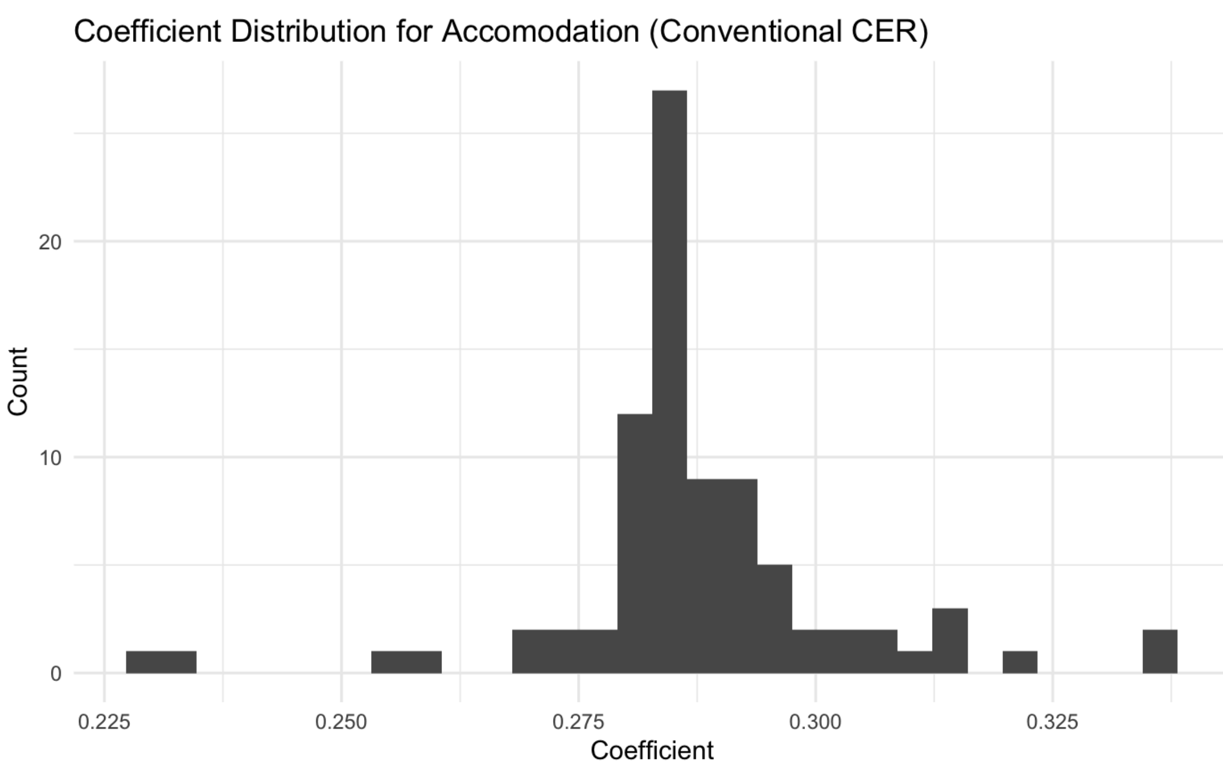

Figure 9

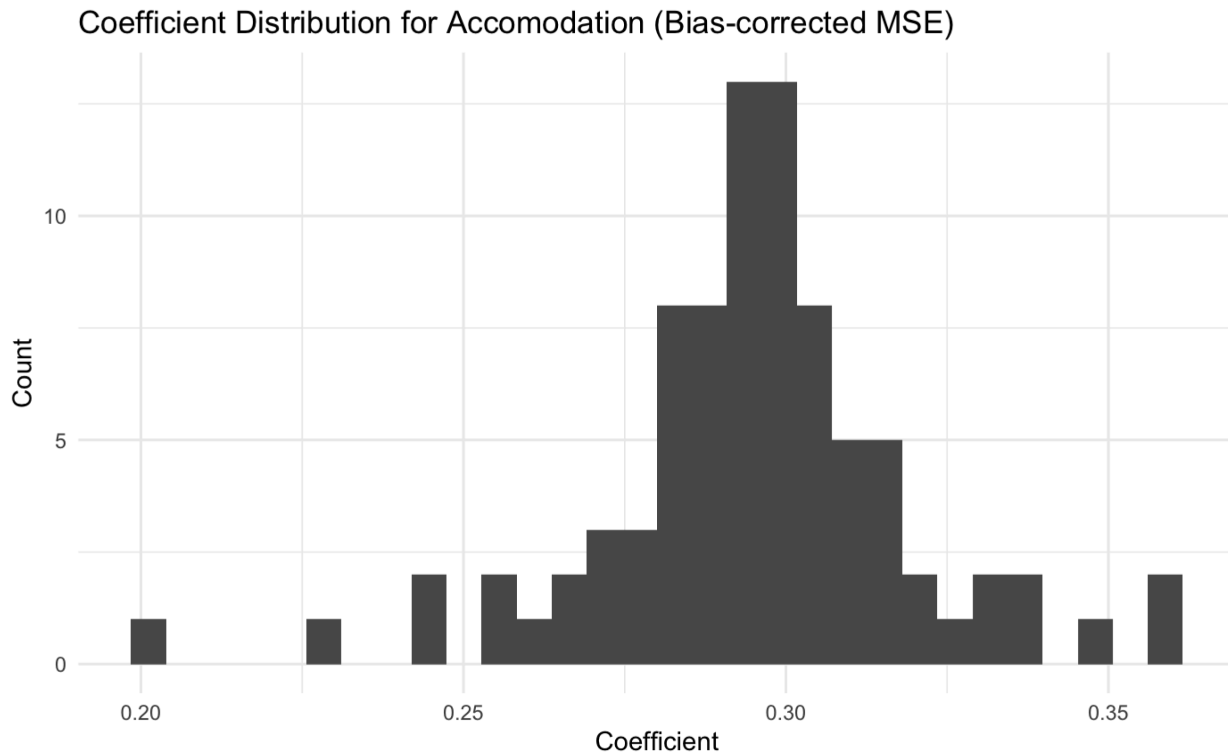

Figure 10

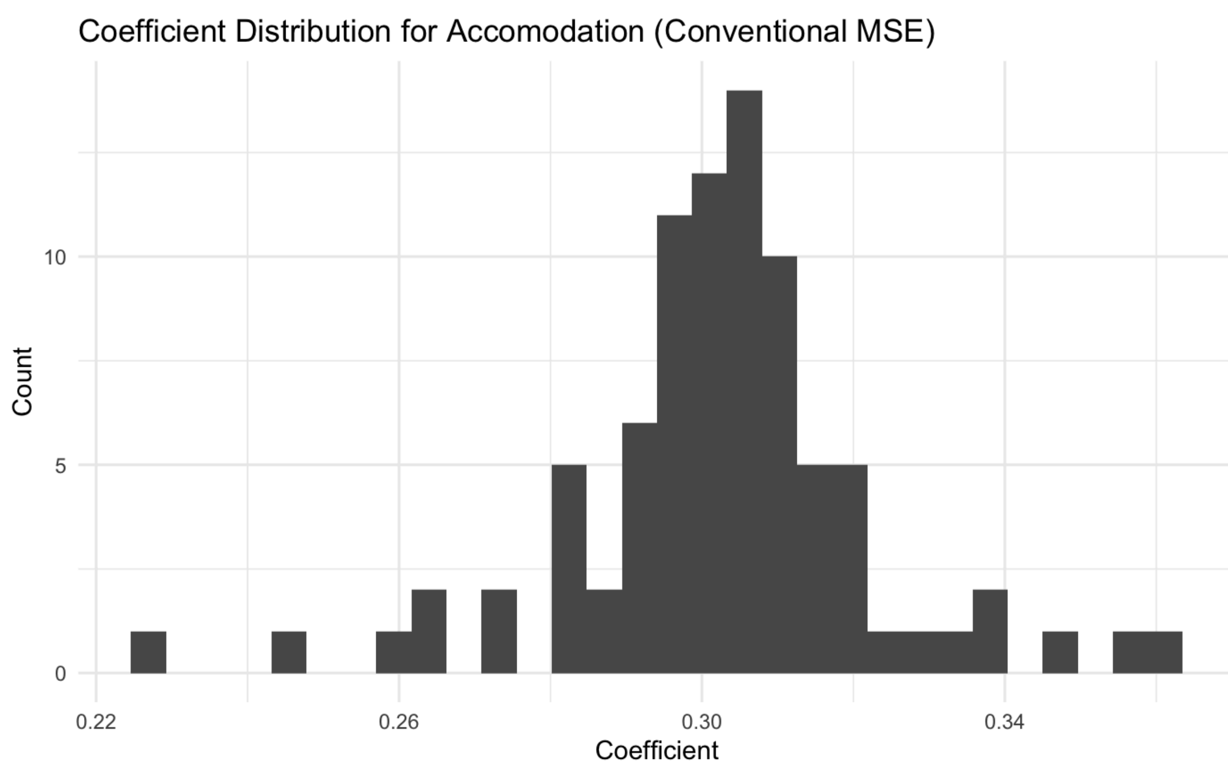

Figure 11

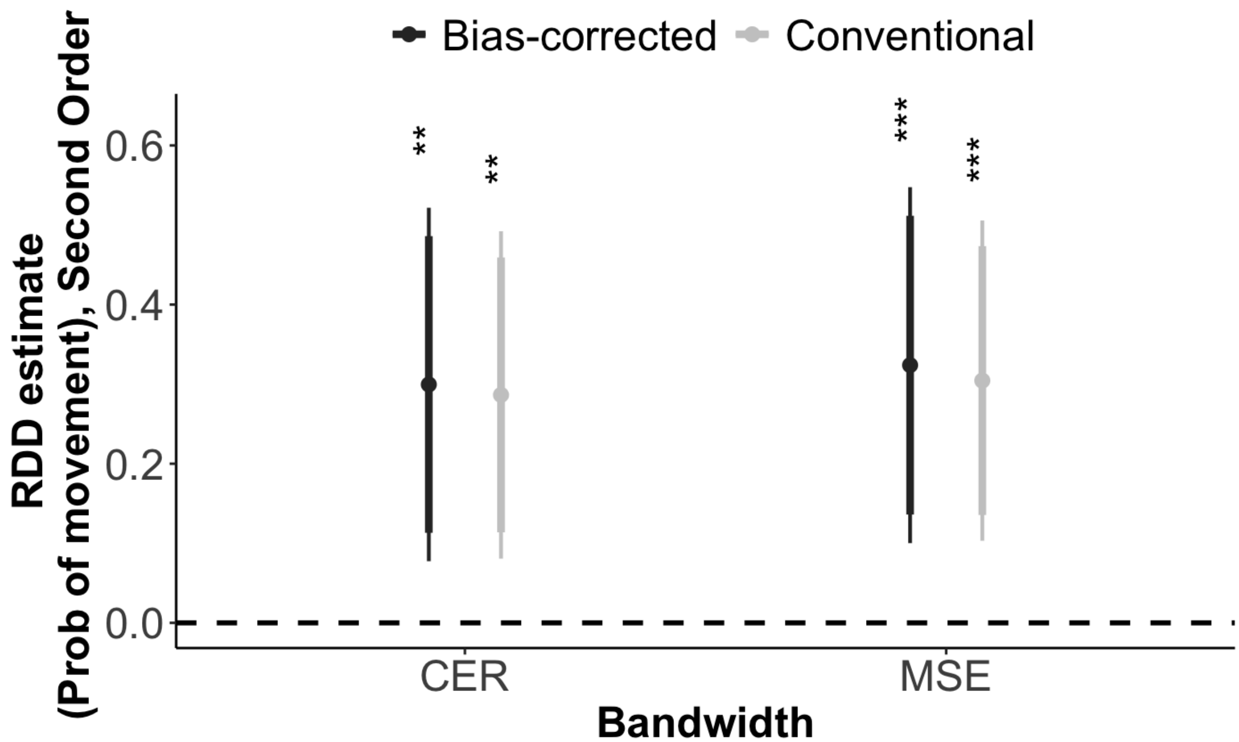

Figure 12

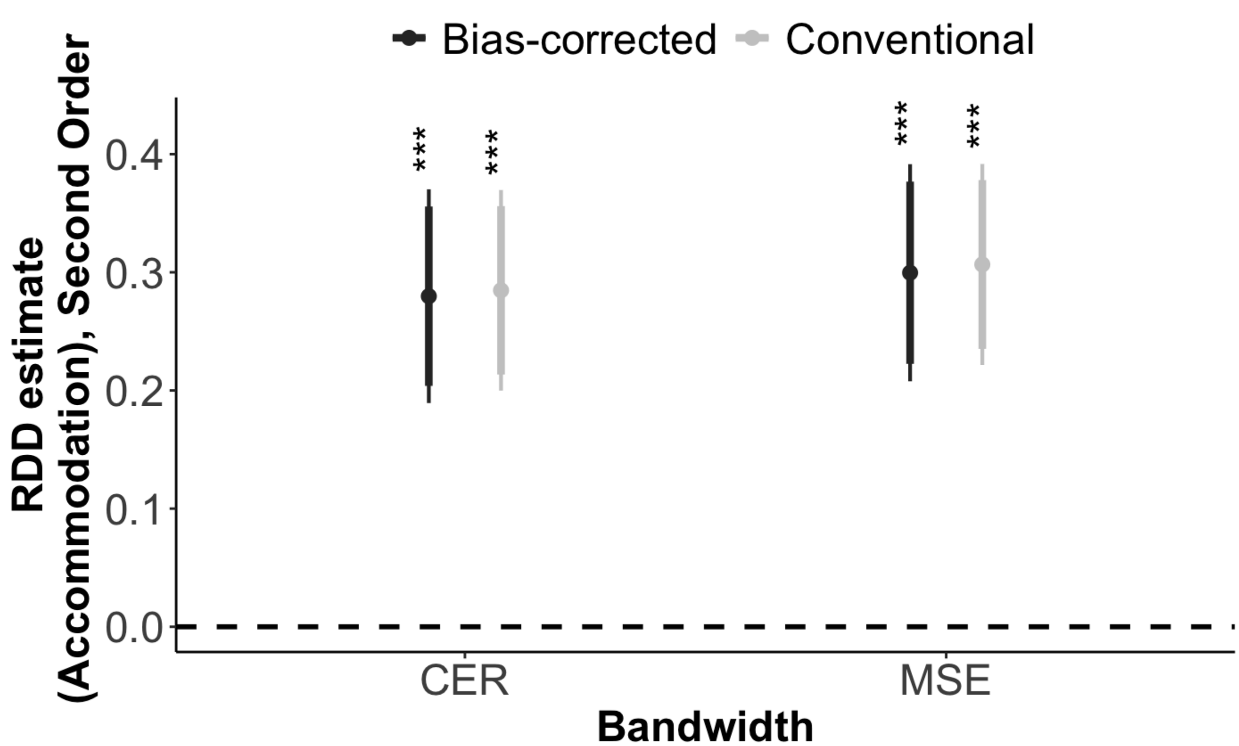

Figure 13

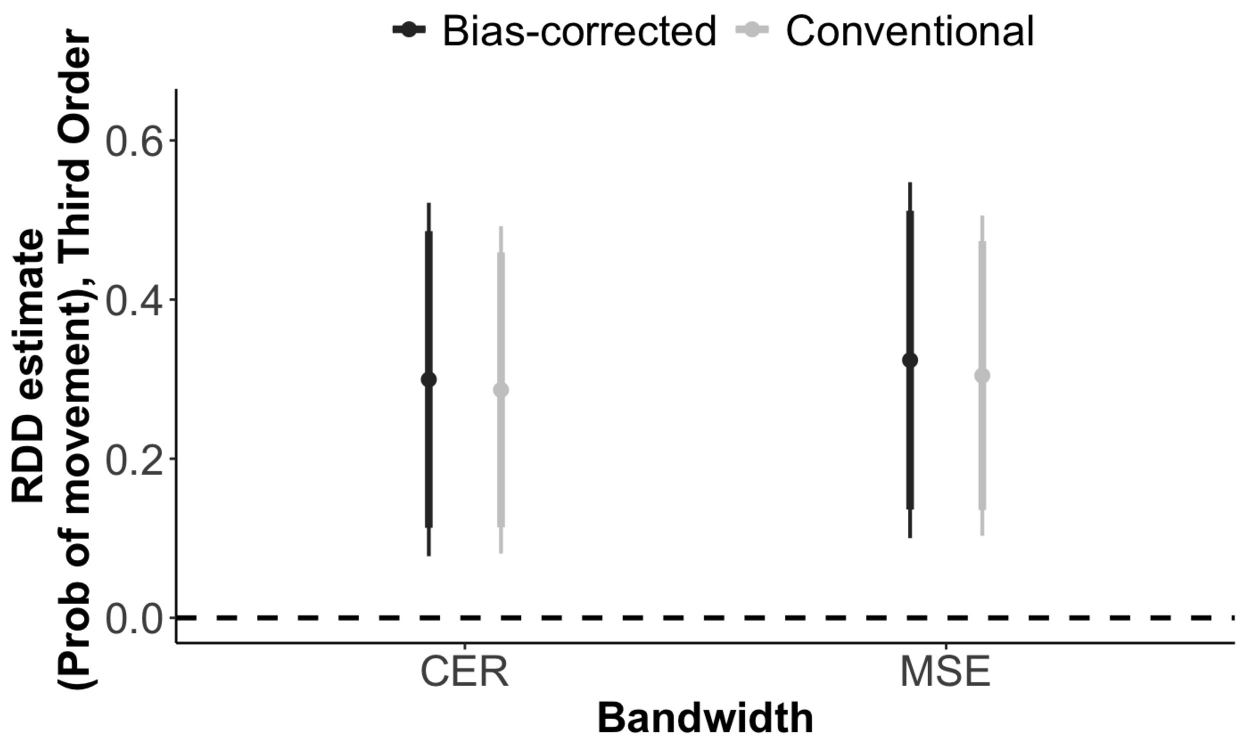

Figure 14

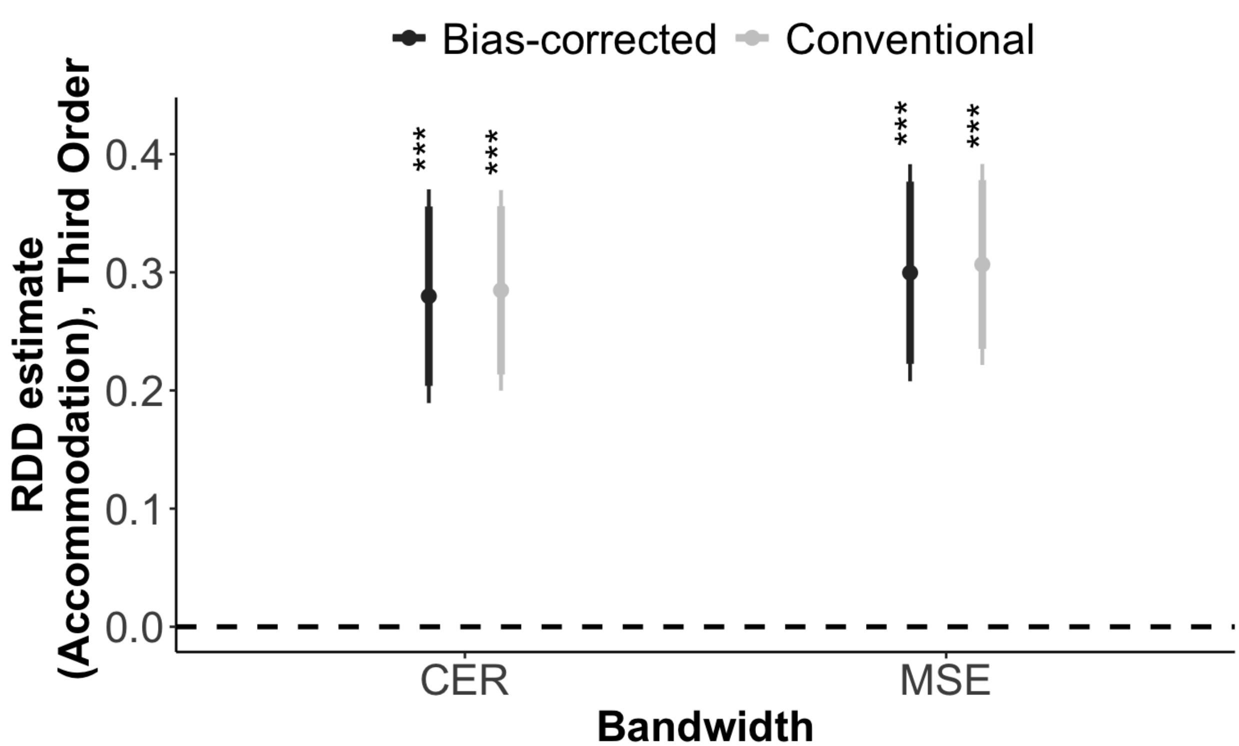

Figure 15

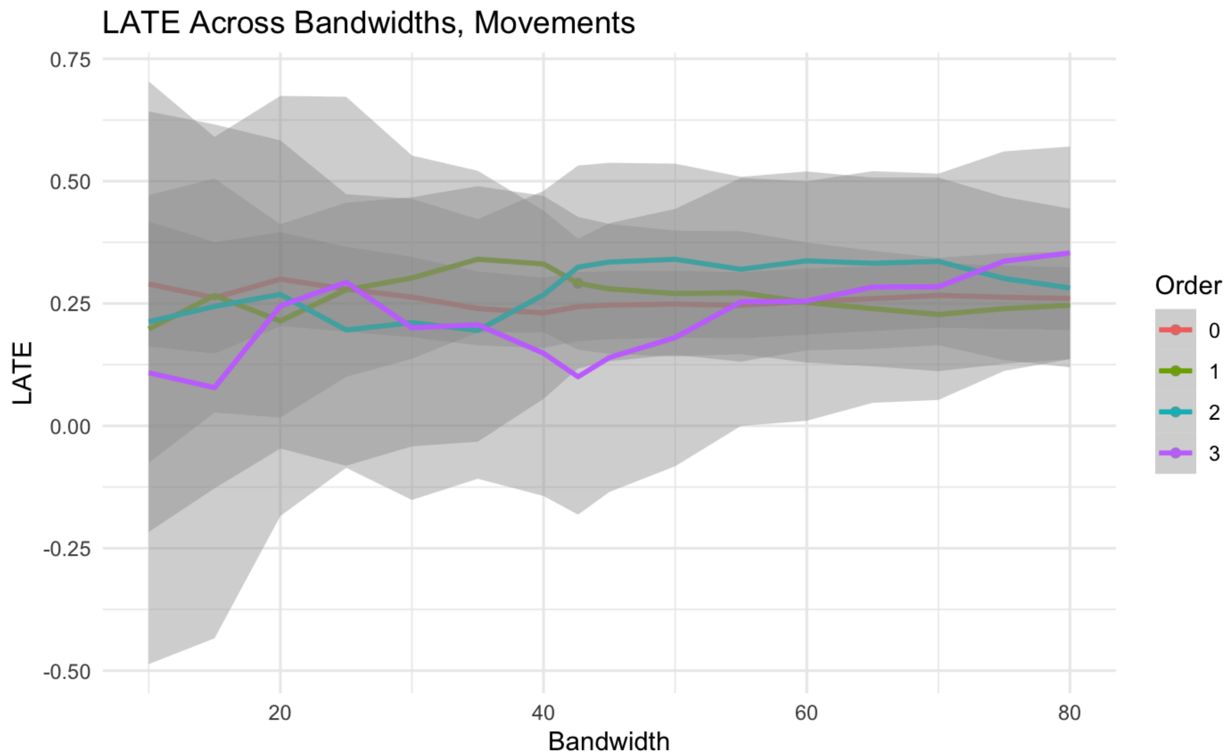

Figure 16