

Household Preferences for School Bus Transportation: Survey Evidence from Wake County, North Carolina*

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Abstract

Despite widespread recognition and availability, school bus use across the United States is declining. As of 2022, the majority of public schoolchildren do not travel to and from school by bus, but rather by private vehicle. This transition generates private and social costs, including increased traffic congestion and additional travel time for parents and guardians. Together, this suggests a disconnect between current school bus service and potential users. To investigate preferences for school transportation, I designed and fielded a survey investigating household preferences for school bus transportation in the Wake County Public School System, the largest school district in North Carolina. By collecting both revealed and stated preference data, I identify trade-offs respondents are willing to make between travel time and delays or cancellations of school bus service. On average, respondents would trade more than one hour of weekly student travel time to avoid a delay or cancellation of service. Leveraging dichotomous choice information, I find survey respondents value their students' travel time at a rate of roughly \$23 per hour per week. Additionally, respondents would be willing to pay \$20 to avoid a delay or cancellation of school bus service. To my knowledge, these are the first willingness to pay estimates related to school transportation.

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1 Introduction

According to the Federal Highway Administration’s 2022 National Household Travel Survey, the majority of the roughly 49 million public schoolchildren in the United States now travel to and from school in a private vehicle, rather than via the school bus, walking, or riding a bicycle (Van Dam, 2024; National Center for Education Statistics, nd.). This marks the first year on record that private vehicles are more popular than all other modes of transport combined. Yet, this fact is not so hard to believe. Both local and national news outlets have chronicled the growth of the car rider line and its frustrations: increased traffic around schools, hours spent waiting to pick up children, and, as a byproduct, increased vehicle idling (Clark, 2023; Hurley, 2024; Kurzyna, 2021; Rosenberg, 2023; Schmitt, 2023, for example). Increasing private vehicle use generates significant private costs to the individual student’s household: more time spent waiting in car lines, interruptions of workdays, more vehicle miles traveled, more gasoline used, and more automotive wear and tear. But, the costs of car lines are not limited to the households of students; other individuals in the surrounding community face greater traffic congestion, longer commute times, and higher emissions from both increased vehicle miles traveled and increased idling.¹ Indeed, some estimates find that 10 to 14% of car trips during morning rush hour are for school travel alone (O’Rourke, 2023). Thus, the costs of school transportation are not limited to public schoolchildren and their families, but are rather borne by schoolchildren, their families, and the wider community.

However, there is a way to negate some of these social and private costs: the school bus. An almost universal component of public school systems in the United States, the school bus is free to use, generally safer than a private vehicle, and can provide an easy and efficient way to transport children to and from school (National Highway Traffic Safety Administration, n.d.).² When students use the school bus, parents and guardians avoid trips for drop-off and pickup, saving time, gasoline, and, indirectly, money. Other individuals, who share the same roads as household vehicles and school buses, benefit from fewer vehicles on the roads, less traffic and idling, and ultimately lower emissions (Environmental Protection Agency, 2023; Barth & Boriboonsomsin, 2010).³ As with the costs of school transportation, the benefits accrue to students, their families, and the communities where they live. However, these benefits are dependent upon students using the bus both frequently and consistently. As the private vehicle rises in popularity, school bus service

¹As noted by the St. Louis Federal Reserve, as vehicle miles traveled increases, emissions increase proportionally. See <https://fredblog.stlouisfed.org/2024/01/vehicle-miles-traveled-and-transportation-carbon-emissions/> for further information.

²School buses are designed to be safer than passenger vehicles in preventing crashes and injuries. See <https://www.nhtsa.gov/road-safety/school-bus-safety> for more detail.

³By reducing the number of vehicle miles driven and the amount of idling-related emissions, local communities would see improvements in air quality.

across the United States faces increasing skepticism and scrutiny.

Local news reports from across the United States document long commute times, unreliable service, and even double routes that result in children getting to school well after class begins.⁴ In Kentucky, a new bus routing system and network failed dramatically on the first day of school, resulting in students arriving home hours late, while in Illinois, Rockford Public School District modified school start times to accommodate double routes in the mornings needed to provide all students bus service (Clark, 2023; Hagerty, 2023). At the start of the 2023-2024 school year, the Wake County Public School System in North Carolina announced that there would be over 3,000 students arriving late to school every day due to bus driver shortages, even if the busing system ran without other issues on any given day (Hui, 2023b). Because issues of travel time, reliability, and other concerns such as bullying, make the school bus an unattractive option, parents and guardians switch to driving their children in a private vehicle, generating negative externalities.

Given the wide-reaching impacts of school transportation, understanding preferences in greater detail will allow for better designed transportation policy to effectively address the wants and needs of households and students. I investigate household preferences for school bus transportation in the Wake County Public School System, the largest school district in North Carolina via a web-based survey of parents and guardians. I collect revealed preference data, including mode of transportation, travel times on the school bus and in the private vehicle, and how often there is a delay or cancellation of bus service in a typical week. By collecting information on both the school bus and private vehicle, I am able to recover marginal rates of substitution, or trade-offs, between student travel time and delays/cancellations of service. On average, respondents trade approximately 48 minutes of additional weekly student travel time to avoid one delayed or canceled school bus trip.

Because the revealed preference variation in travel time and school bus service disruptions has limited range and may be correlated with unobserved factors, I then use stated preference data collected through a series of choice experiments to estimate these same parameters. Using the choice experiment data, I find respondents would trade roughly 82 minutes of weekly student travel time to avoid one delayed or canceled school bus trip.

Lastly, I conduct a third analysis that uses stated preference, contingent valuation data on a hypothetical driver service program where a private vendor would charge households a fee to transport their student to and from school. This question provides random variation of travel time and service disruption

⁴A double route refers to a routing scheme wherein a driver will perform one pick up or drop off route and upon completion will perform another route. For morning pick up, the first route of students typically leaves earlier in the morning than compared to a single route scheme and for afternoon drop off, the second route of students typically arrive home later in the afternoon.

levels and through this I identify marginal willingness to pay estimates for reductions in student travel time, reductions in the number of delayed or canceled trips, and the value of respondent time savings from avoiding school-related travel. Overall, the average respondent would pay \$23 to reduce their student’s travel time by one hour and would pay around \$20 to avoid one service disruption.⁵

The remainder of this paper is organized as follows: Section 2 discusses relevant literature, Section 3 details the background of the Wake County Public School System and recruitment of survey participants. Section 4 details key survey elements. Section 5 examines the data obtained from the survey instrument, including cleaning procedures and summary statistics. Section 6 presents the empirical model used for the analyses in Sections 7, 8, and 9. The paper concludes with a brief discussion in Section 10.

2 Prior Literature

There is little work regarding school transportation in economics, with existing literature focusing on the relationship between school transportation and economic outcomes or public transit strikes. Angrist and co-authors examine school-related travel for non-neighborhood enrollments and subsequent effects on school integration, college enrollment, and academic achievement in Boston and New York City (2022). Cordes and co-authors focus on the impacts of school bus ride length on academic performance and attendance for New York City students (2022). Leveraging variation in timing across school districts in Georgia, Austin, Heutel, and Kreisman identify causal effects of school bus retrofits on student health and academic performance. Other work in economics focuses on roadway congestion and public transit. Anderson finds commuters who use public transit are “likely to be individuals who commute along routes with severe roadway delays,” (2014). Similarly, Adler and van Ommeren examine transit strikes in Rotterdam and find the effects of transit strikes are most pronounced during rush hours (2016). Thus, to my knowledge, the economics literature says next to nothing about school bus transportation in and of itself.

Outside of economics, there is literature focuses on equity in transit and determinants of travel. Weinstein et al. examine equity of school bus service in New York City using student-level data in New York City. They find students of color are likely to live further from school and face longer bus rides, aligning with the findings of Cordes, Rick, and Schwartz (2022). When analyzing the 2017 National Household Travel Survey, Libde and coauthors find school bus use is declining, down to 32.8% in 2017 from 33.4% in 2009. At the same time, children from low income households have a longer average bus ride, and Black

⁵As will be discussed shortly, a service disruption is a delay of 5 or more minutes or a cancellation of school bus service

children are more likely to ride the bus (2020). Together, this work suggests potential distributional effects of poor school bus service, and possibly varying preferences by demographic characteristics. Regarding school transportation, Rafiq and Mitra (2020) examine the determinants of carpooling in California using data from the 2012 California Household Travel Survey. They find carpooling behavior is strongly associated with distance to school, parental education, and household income. However, there is a significant limitation: children in California appear to travel in ways that are systematically different than the rest of the US, given children in California walk or bike to school at twice the rate of children nationwide (Rafiq & Mitra, 2020).⁶

In their *Habitat International* article, Bhatnagar and co-authors, motivated by equity issues, environmental concerns, and a desire for more information to improve route efficiency, investigate preferences for school bus transportation in Delhi, India (2022). They survey parents about their priorities when considering having their child use the bus and split their sample into bus users and non-bus users. As distance from school increases, students are more likely to use the school bus (Bhatnagar et al., 2022). Parents of both bus users and non-bus users state travel time is a significant concern, and non-bus users are especially concerned with, as the authors put it, punctuality of service.

The school bus is a unique form of public transportation, with the potential to reduce congestion and travel time. The dedication of household time and resources suggests there is a disconnect between current school bus service and potential users. Simultaneously, there are important equity, academic, health, and environmental considerations in improving school bus service and gaining investment in a vital component of the American public education system. In order to invest in the futures of both students and the communities in which they reside, it is essential to understand the value of the school bus system and the needs of its users. My work helps fill this substantial gap in the literature by providing novel insight into household preferences for school bus transportation in an American school district, incorporating the role service disruptions have in decision making, and examining the value of student travel time.

3 District Background and Recruitment of Participants

3.1 District and County Background

The survey was designed for parents and guardians of public schoolchildren in the Wake County Public School System (WCPSS), located in the heart of North Carolina’s Research Triangle. The district

⁶Children in California take the school bus about one-third as frequently as children nationwide.

served just under 160,000 students through 198 public schools during the 2023-24 academic year, making WCPSS the largest school district in the state (Wake County Public School System, n.d.).⁷ More broadly, Wake County is home to both the state capital, Raleigh, and is one of the anchors of the Research Triangle. As a result, Wake County attracts a highly educated and skilled workforce with significantly higher incomes than the rest of the state and country (Rice, 2024). The median household income in the county, in 2023 dollars, was \$101,763, compared to the North Carolina median income of \$69,904 and \$78,538 nationally (Census Bureau QuickFacts). Wake County is also one of the fastest growing counties in the United States as of 2023, with a population growth of 5.4% from April 1, 2020 to July 1, 2023 (Census & Demographics, n.d.).

Busing in WCPSS has faced struggles and increased scrutiny in recent years, with the district having eliminated 52 bus routes at the start of the 2022-23 school year and making remaining bus routes longer (Hui, 2022). Chronic bus driver shortages in the district, and indeed nationwide, have made it difficult for districts to retain and recruit enough drivers to maintain school bus routes and service reliability (Hui, 2022). Local news coverage chronicled parents frustrations and concerns with unreliable service, including workday disruptions, financial concerns after having to pay for a service to transport their children or reducing working hours to be available for school drop off and pick up (Hui, 2023b).

School bus service continued to face limitations in the 2023-24 school year. With an estimated 90,000 students, over half of the student body, registered to ride the bus, and a reduction of 56 full-time drivers from the year before, WCPSS was short 17 permanent drivers going in to the 2023-24 year. In an effort to address this shortfall, district administrators announced an “A/B schedule” for school bus service, which would have students on the affected 17 routes receive bus service every other week (Hui, 2023a). After concerns from parents and school board members, a new plan that ensured all students had an assigned driver was announced. However, this new initiative implied that 3,157 would arrive late to school every day.⁸ This plan, while replacing the rejected A/B plan, may affect academic outcomes, a concern raised by at least one school board member. Additionally, this plan was a “best case scenario” situation, and if any driver absences or other delays in travel occurred more students would subsequently arrive late to school. A 10% absence rate among bus drivers would mean 6,000 students “will have late or no bus service,” as noted by local news (Hui, 2023c). It was in this context that the survey was developed and later fielded.

During development, two dimensions of reliability were identified: service delays and service cancellations. Service delays mean the bus is late, but does run the assigned route. A cancellation means the

⁷Charter schools are not included in WCPSS, or in this work in any way.

⁸Specifically, the students would arrive after instructional time had begun, rather than just missing homeroom.

bus, for whatever reason, is unable to run that particular route at the time and no service is provided. Both are currently issues in WCPSS (Hui, 2023a; Hui 2023b). Delays range in time, and can result in students being late to school, subsequently causing them to miss instructional time. Cancellations run the risk of students being late or being unable to attend school at all.⁹ For the purposes of simplicity, I aggregate both delays and cancellations into one category: service disruptions. This has simplifying benefits: the choice experiments discussed later do not have to deal with varying time, delays, and cancellations, but rather only time and disruptions. This also reduces the cognitive burden on respondents.

3.2 Recruitment of Participants and Response

Participants were recruited via WCPSS’s weekly parent/guardian newsletter. The following announcement was sent out via email on January 4, 2024:

We want your help! WCPSS is partnering with researchers at NC State University to learn more about families’ preferences for transportation services. Complete this short, anonymous survey. We want to hear from you whether your child currently receives district transportation services or not. Results of this survey will be analyzed by researchers and shared with district leaders to support future policy and planning.

An NC State affiliated link was used to direct respondents to the survey, placed via hyperlink in both the title of the survey and the phrase “short, anonymous survey.” All parents and guardians in the district were encouraged to take the survey on a personal device. To preserve the anonymity of respondents, one general link was provided and the district handled all communication with potential respondents.

On January 5, 2024, one day after the survey was launched, local Raleigh news station ABC 11 Eyewitness News reported on the survey. Coverage included a handful of parent interviews that had positive and negative reactions to the survey content (Athans, 2024). The local Raleigh paper then began covering the survey, emphasizing that the survey was not paid for by the district. The reporting also clarified that despite concerns raised on social media, the district was not looking to use a driver or van service as a substitute or supplement for school bus service (Hui, 2024). The local media coverage is of note for two reasons: first, and most practically, it may have affected how respondents viewed and answered the survey and may therefore affect subsequent regression results.¹⁰ Second, the local coverage and social media discussion highlights

⁹See Van Dam, 2024 for a discussion on absenteeism.

¹⁰As will be noted later, 69.92% of observations in the final dataset were collected prior to the news coverage.

that school transportation is a salient issue in Wake County and efforts around school transportation are considered newsworthy.

The survey was closed on February 2, 2024, following a significant decline in the number of new responses.¹¹ I received 5,205 complete responses, and an additional 3,430 incomplete responses, leading to a response rate of 5.31%.¹² When examining the dates of collection, 69.92% of responses, or 3,812 observations, were collected prior to the publication of the ABC 11 Eyewitness News article.¹³

4 Survey Elements

The survey instrument is a web-based survey powered by Qualtrics. The following section discusses essential elements in detail.

4.1 Household Structure

In the household structure section, respondents are asked how many currently enrolled WCPSS students reside in the household during the school year ranging from one to four or more.¹⁴ Respondents are asked the grade of each student, the name of the student's school, the approximate one-way driving distance in miles from their residence to the school, whether or not the student attends a magnet school, and what modes of transportation the student typically uses. Possible modes of transportation include the school bus, the private vehicle, walking/biking, public transit, a private fee-for-service vendor (e.g., Uber or Lyft), vendor transportation, or other.¹⁵ If the school bus option is selected, respondents are asked to report how often the student rides the bus during a typical school week, from one trip to ten trips.¹⁶ If the "other" option is selected, a follow-up question is presented asking the respondent to briefly describe this other way in a text box on the page.¹⁷ Respondents with multiple students answer these questions for each student reported in the household. Once a respondent has completed the questions for all students in the household, the instrument randomly selects one student to be the focus of more detailed questions, with

¹¹52 complete responses were recorded after January 18, 2024, two weeks after the survey launched.

¹²Communications with WCPSS indicate there are 102,675 households in the district

¹³When calculating the response rate using the number of individuals opening the survey, the rate increases to 8.41%. Counting only the original complete responses, the response rate is 5.1%

¹⁴The decision to cap the possible number of students at four was made to limit survey length and complexity.

¹⁵Vendor transportation refers to transportation arranged by the district for students who have special transportation needs and cannot take a typical school bus.

¹⁶In a typical week, there are ten school-related trips: five in the morning and five in the afternoon.

¹⁷The most common "other" option was a student outside of the household driving the respondent's student to school.

equal probability of selection across all students.¹⁸ For the remainder of this work I will refer to the student randomly chosen by the instrument as the “selected student,” or “student.”

The primary focus of this survey is the school bus and understanding household preferences for school bus transportation, with the data collection focusing on school bus and private vehicle use. Therefore, if a student does not have an assigned school bus, only walks or bikes to school, uses vendor transportation, or otherwise does not use at least one of the main modes of transportation under study (the school bus and the private vehicle), then the respondent is sent to the end of the survey.

4.2 Detailed Transportation

Once a student is randomly selected, respondents are asked detailed transportation questions regarding how the selected student gets to and from school during a typical week. There are two groups of questions: one designed for selected students who travel on the bus and another for selected students who travel in a private vehicle. If earlier responses indicate the selected student uses both the bus and a vehicle, then both groups of questions are presented (see Figure 1).

In the group of questions focused on school bus use, respondents are asked if the selected student typically rides the bus in the morning, in the afternoon, and if the student has any after school activities. I then solicit travel time on the school bus, ranging from “10 minutes or less” to “90 minutes or more” for a typical trip.¹⁹ Service disruptions solicited on a scale from zero, meaning no service disruptions, to ten, meaning two disruptions a day, one in the morning and one in the afternoon. Travel time is measured at the trip level, while service disruptions are measured at the weekly level.

To build a richer picture of a respondent’s transportation options, respondents who report their student uses the school bus are asked about commute time in a private vehicle. The private vehicle commute is split into two questions: the first soliciting the time it would take to drive from the residence to the selected student’s school, wait in the drop-off line, and drop the student off; the second solicits how long it would take to return home after drop-off. This allows for differentiation between a student’s travel time and a respondent’s travel time. If a respondent reports they are unsure, follow up questions are presented to obtain bounds on the commute time. Private vehicle travel time options range from “10 minutes or less,” to “60 minutes or more,” with 5 minute intervals between each option.

¹⁸If a household only has one student, then that student is automatically selected.

¹⁹Morning and afternoon times are solicited separately and it is reasonable to think households using the bus would be aware of travel time differences.

The questions focused on private vehicle use first solicit more information about who drives a student, such as a sibling, a parent, a neighbor, or a paid childcare worker. If the respondent has indicated the selected student is driven by a member of the household and someone outside the household, then respondents are asked if they participate in a carpool, and if so, how frequently.

Every respondent viewing the driving questions is asked about the typical travel time to and from school when using a private vehicle. The first question asks how long the trip to school would take from leaving the residence to when the student is dropped off, including time spent waiting in a drop-off line. Then, the respondent is asked how long it would take to return home, arrive at work, or reach whatever destination they normally go to after drop-off. This allows for differentiation between student and respondent travel time, given that the respondent's trip continues after the student is dropped off at school. Similar questions are asked regarding the afternoon commute.

Respondents who receive the driving-focused questions are still asked about the selected student's school bus. Both school bus travel time and service disruptions are solicited in a similar manner as in the bus-focused questions, with the same ranges of travel time and service disruptions. In this instance, if respondents are unsure of the school bus travel time or service disruptions, a followup question is presented to gauge a rough estimate of travel time and or the number of service disruptions.²⁰

4.3 Stated Preference Sections

The survey has two stated preference sections. The first presents choice experiments, referred to as hypothetical "Action Plans," that alter the selected student's school bus route by changing the number of school bus service disruptions and the travel time on the bus. The second is the driver service section, which presents information about a hypothetical third-party service that would drive the selected student to and from school for weekly fee. Both of these sections are discussed in detail below.

4.3.1 Choice Experiments

Each action plan (choice experiment question) has two attributes: weekly school bus travel time and service disruptions. There are two framings of the action plans: school bus service improvements and school bus service deteriorations. The improvements reduce travel time and the number of service disruptions, while

²⁰If the selected student does not have an assigned school bus, there is a corresponding option that respondents may select. In this version of the school bus travel time question, respondents are not asked about the morning and afternoon commutes individually, as respondents are less likely to be aware of any differences between the two.

the deteriorations increase travel time and the number of service disruptions.²¹ Respondents who report only using the private vehicle see the series of plans that improve bus service by reducing school bus travel time and the number of service disruptions. Those who report using only the school bus see a series of plans that degrade bus services through longer travel times and increasing the frequency of service disruptions. For respondents who report using both the school bus and a private vehicle, both sets of plans are presented.

In order to present meaningful changes, travel time is presented at the weekly level, rather than at the trip or daily level. For additional simplicity, the assumption of ten trips per week is made in the travel time calculations. Baseline school bus travel times range from 10 minutes or less to 90 minutes or more. Therefore, when travel time is scaled to the weekly level, the minimum possible baseline school bus travel time is 100 minutes per week and the maximum is 900 minutes per week. This assumption was repeatedly communicated to respondents in the experimental section using both in-text explanations and a table, as shown in Figure NUMBER. The service disruption measure ranges from zero, meaning no delays or cancellations of service, to ten, meaning a delay or cancellation every trip during a standard five day school week.²²

The introduction to the choice experiments is shown in Figure NUMBER.²³ Respondents are shown a preamble explaining the travel time calculations and a table summarizing their current travel situation, shown in Figure 1.5. After respondents have reviewed their current weekly travel times and level of service disruptions, the first action plan is shown. The preamble and table presented remain the same across all action plans, regardless of if a respondent sees an improvement or deterioration of service. An example of an action plan is shown in Figure 1.6. Respondents have three potential responses: use the bus every day, drive every day, or use the bus some of the time and drive some of the time. If respondents select the last option, a follow up question asks how often the respondent would have their student use the school bus in a typical week. After respondents have completed the choice experiments, they move to the second of the experimental sections: the driver service.

4.3.2 Driver Service

The driver service section holds school bus service fixed at its current baseline level and presents respondents with a hypothetical third-party service that would transport their selected student to and from

²¹That is, for an improvement in service, the design applies a negative change to the baseline conditions and a deterioration applies a positive change. There are no cross-changes where one attribute improves while another deteriorates.

²²By construction, service disruptions are already measured at the weekly level.

²³While this figure uses the term “oldest,” respondents would have seen a descriptive that matches their selected student (such as “second,” if the second student in the household was selected).

school for a fixed fee. The attributes of the driver service are monetary price, student travel time, and service reliability, with each attribute randomly varied.²⁴ Figure 1.7 shows the preamble and one version of the driver service question. Respondents have three possible answers: enroll in the service, not enroll, or report they are not sure.

A student’s driver service travel time is calculated by taking the student’s private vehicle travel time and adding either 25 or 50 minutes (the two possible changes). The levels of reliability and price are chosen at random, without regard to baseline school bus reliability or household income. When the respondent’s potential time savings are known, based on prior answers, the potential time savings are also presented in the driver service question, as seen in Figure 1.7. This information is not known for some respondents, given that a respondent’s time savings is only collected in the driver focused questions. If the selected student only uses the school bus, then the respondent does not see a reminder of potential time savings in this section. All other components and information in the driver service question remain the same.

4.4 Demographics

Demographic questions are the final component of the survey. Questions regarding age, income, Hispanic status, and race are presented in a similar fashion as the US Census.²⁵ Additionally, respondents are asked about the number of adults and children in the household. Following the literature, questions about the number of licensed drivers in the household and the number of vehicles the household has access to are included (Rafiq & Mitra, 2020 for example).

5 Data

Of the 8,635 individuals opened the survey, 5,205 provided complete responses. Of the 3,430 incomplete responses, there are 100 observations where the respondent reached the final comments page of the survey and 188 observations where respondents reached the demographics section of the survey, meaning these observations completed all, or nearly all, of the instrument. Additionally, 60 observations did not meet the criteria for the experimental sections and were skipped forward to the end of the survey. These observations were recorded as incomplete, but the respondents answered all available questions. Together, these 348

²⁴While there are 16 possible versions of the driver service question, respondents only view one.

²⁵Age and income are asked in ranges, while race is categorized as American Indian or Alaska Native, Black or African American, White, Asian, and Native Hawaiian or Pacific Islander. Hispanic status is asked separately

observations can be considered “effective completes,” and are kept for analysis. Remaining incomplete observations are dropped from the sample, leaving 5,553 observations. After screening for non-responsiveness and speeding, defined as completing the survey in three minutes or less, the resulting dataset includes 5,452 observations.

5.1 Descriptive Statistics

Figure 5 presents the percent of survey respondents living in each Wake County ZIP code in the left map and the percent of WCPSS households living in each ZIP code on the right.²⁶ When contrasting the two maps, it becomes apparent that areas of western and northern Wake County were over-sampled, while areas of eastern and central Wake County were under-sampled. Using the information on how many WCPSS households live in each ZIP code, ZIP code level weights are applied to the data and subsequent analyses to correct for this geographic over- and under-sampling.²⁷

Table 3 presents summary statistics, where Column 1 includes weights for the number of children in the household and Column 2 includes weights for the number of children and the share of WCPSS households living in the respondent’s ZIP code. After applying the ZIP code weights, both the average time spent on the school bus (*Student Weekly Travel Time on School Bus*) and the number of service disruptions (*Service Disruptions*) decrease, while travel times in the private vehicle (*Student Weekly Travel Time in Private Vehicle* and *Respondent Weekly Travel Time in Private Vehicle*) remain relatively unchanged. Of note, the percentage of White respondents (*White*), decreases from 79.1% to 76.2%, suggesting an oversampling of White households in the survey. The survey was only offered in English, which may limit the ability of some households to complete the survey and be present in the data.²⁸ For the remainder of this work, the ZIP code weights will be applied to the data.

Column 3 of Table 3 notes the number of observations recorded for each variable. While the data have 5,452 observations, not every respondent was asked about their travel time and service reliability. 1,156 observations were ineligible for the detailed transportation section, which explains the majority of the missing data for these items.²⁹ The remaining missing observations may be due to a respondent answering

²⁶The data on ZIP code level household counts was provided by WCPSS via private communication.

²⁷Specifically, the weights were designed by totaling the number of households across the district and then dividing the ZIP code level count by the total. Therefore, the sum of the weights is equal to one.

²⁸Based on communications with WCPSS, 21.4% of households report having at least one member who does not speak English.

²⁹Respondents may have been ineligible for detailed transportation if they reported their student has no assigned school bus, or if the respondents reported they do not typically use the school bus or the private vehicle.

only one question needed to complete the travel time calculation.³⁰ Every respondent saw the demographic questions in the survey. Respondents were apparently reluctant to answer the household income question, even when the possible responses were income ranges. The question about race also had a lower response level.³¹ Hispanic status was asked in a separate question from race and had a “prefer not to say” option. 255 respondents skipped this question and 280 selected “prefer not to say.” *Number of Children in Household* refers to any person residing in the household who is 17 years old or younger and could include children not currently enrolled in WCPSS.³² *Employed Full-Time* and *Retired* are indicators generated from the same question. Respondents were also asked their residential ZIP code and 5,118 respondents answered the ZIP code question. Taken together, respondents may have been reluctant to disclose what they felt was sensitive or personal information in this survey.

Table 4 presents summary statistics based on baseline travel behavior. Column 1 corresponds to mixed mode respondents who report using both the school bus and a private vehicle in a typical week. Column 2 represents respondents who report exclusively using the school bus and Column 3 represents respondents who exclusively use a private vehicle. Mixed mode respondents report the lowest average number of *Service Disruptions*, while households using only the car have the highest average number of *Service Disruptions*. Mixed mode and car rider respondents report higher average travel times on the school bus and in the private vehicle.³³ Respondents who report using the bus exclusively are, on average, less likely to be White, have fewer household vehicles, and have lower household incomes. This is consistent with prior work (Weinstein et al, 2022; Libde et al., 2020 for example). Table 1.5 shows the current travel behavior for selected students in the survey sample. Respondents may report multiple travel modes for their student, so these categories are not mutually exclusive. Figure 1.11 presents the distribution of baseline school bus travel time and student private vehicle travel time, and Figure 1.13 presents the reported number of service disruptions in a typical week. Figure 1.13 presents the frequency the selected students use the school bus in a typical week, with the dashed line denoted the mean frequency of 5.6.

Table 5 reports the number of students in a respondent’s household and the distribution of the randomly selected students. The majority of selected students are oldest students in the household, as to be expected given the high number of only students reported by respondents.

³⁰For example, in the bus focused questions there are two questions about travel time, one for the morning trip and one for the afternoon trip. If the respondent skips the afternoon trip question, then the weekly travel time calculation cannot be completed and the observation appears as missing in the dataset.

³¹While the question about race was a “select all that apply” question, *White* in Table 3 is an indicator variable. It equals one if the respondent picked the “White” option and zero if that option was not selected.

³²Such as an infant or toddler too young to enroll in WCPSS kindergarten.

³³There may be some reporting or recall bias in these travel time estimates. However, if the respondent perceives these travel times to be accurate, then these travel times are used in the decision making process and should therefore be utilized in analysis.

6 Empirical Model

Consider a representative respondent, n , with J transportation mode options. A respondent's utility from any given transportation mode, j , can be written as

$$U_{nj} = V_{nj} + \epsilon_{nj} \quad (1)$$

where V_{nj} is the observed, deterministic component of utility and ϵ_{nj} is the unobserved, idiosyncratic component. V_{nj} can be decomposed further as

$$V_{nj} = \beta_{j0} + \beta_1 TT_{nj} + \beta_2 SD_{nj} + \beta_3 P_{nj} + \lambda_j Z_n \quad (2)$$

where TT_{nj} is the travel time of transportation option j for respondent n . SD_{nj} denotes the level of service disruptions experienced by respondent n when using transportation option j . P_{nj} denotes the monetary price of transportation option j .³⁴ Z_n is a vector of observable respondent characteristics. Assuming ϵ_{nj} is distributed iid Type I extreme value, the probability of respondent n selecting transportation alternative j for any given trip is

$$P_{nj} = \frac{\exp(\mu V_{nj})}{\sum_{j=1}^J \exp(\mu V_{nj})} \quad (3)$$

where μ is the scale parameter. In the subsequent independent analyses, μ is assumed to be one. The role of the scale parameter will be revisited in section NUMBER when conducting a joint analysis.

7 Revealed Preference Analysis

In this section, I analyze revealed preference data for households who are eligible for school bus transportation, including households who use a private vehicle exclusively, households who use a mix of the school bus and a private vehicle, and those who use the school bus exclusively.³⁵ Baseline travel data collected in the survey includes information on what mode(s) of transport are currently used, the frequency of school bus use (if applicable), travel times for the school bus and private vehicle regardless of which mode

³⁴*Price*, in this study, is assumed to be zero for the private vehicle and the school bus, and only enters the regressions when including data from the driver service question.

³⁵I therefore exclude any respondent who reports their student does not have an assigned school bus, or any respondent who does not use a private vehicle and does not use the school bus.

is used, and the number of service disruptions in a typical week (regardless of whether the school bus is used). When leveraging the model outlined in the previous section, observations are weighted based on reported baseline use of travel mode. For example, a respondent who reports to only use the school bus receives an observational weight of 10, as would a respondent who reports only using the private vehicle. For mixed mode respondents, those who report using both the school bus and the private vehicle, the observation is duplicated, with the first row representing school bus use and the second representing private vehicle use.³⁶

From the initial 5,452 observations, 1,385 observations were dropped from the original sample due to missing data regarding baseline travel times or service disruptions. Additionally, 501 observations are dropped because the baseline frequency of school bus use is missing.³⁷ This leaves 3,566 observations in the revealed preference estimation.

7.1 Revealed Preference Results

The revealed preference results are presented in Table 6. Column 1 includes only the transportation attributes of student travel time and service disruptions, while Column 2 adds respondent characteristics and household information. The dependent variable in these regressions is modal choice between the school bus and private vehicle.³⁸ As expected, the coefficient on *Travel Time* is negative. Therefore, as the difference between travel time on the bus and in the private vehicle increases, the probability of choosing the school bus declines. The same is true for *Service Disruptions*: as the number of service disruptions increases, the likelihood of choosing the school bus decreases. Additionally, the results in Column 2 suggest White respondents and respondents with additional household vehicles are less likely to use the school bus, aligning with the existing literature (Rafiq & Mitra, 2020).

After controlling for demographics in Column 2, the marginal rate of substitution rises to -47.71 minutes, with a standard error of 10.70. Both results are statistically significant and suggest respondents are willing to trade substantial amounts of student travel time to avoid service disruptions.

³⁶For example, a respondent who reports using the school bus four trips per week would have a duplicated observation. The first row would represent choosing the school bus and have a weight of four, while the second row would represent choosing the private vehicle and have a weight of six.

³⁷This information is missing due to an error in the original survey instrument. These 501 observations are one student households who report using both the private vehicle and the school bus, and therefore their frequency of bus use cannot be determined. Because of the critical nature of this baseline information and the likelihood that one student households travel differently than multi-student households, the average frequency of school bus use cannot be used to replace these missing values. 966 one student households report *only* using the school bus, and therefore their frequency of use is assumed to be 10.

³⁸To be more detailed, the choice indicator equals one if the school bus is chosen and equals zero if the private vehicle is chosen.

8 Stated Preference Analysis

While the previous section focused on revealed preference data, the current section now turns to stated preference data gathered via discrete choice experiments. These experiments are designed to identify the marginal rate of substitution between a student’s school bus travel time and school bus service disruptions and examine the likelihood of choosing the school bus under differing conditions. The impact of certain demographic characteristics is examined using both the full sample and sub-samples based on household composition.

1,212 respondents did not answer the choice experiment questions and are subsequently dropped from the sample. This includes respondents who report their student does not have an assigned school bus, exclusively walk to school, and any respondents who skipped the choice experiment questions. 184 additional observations are dropped due to missing baseline school bus travel time, service disruptions, and or baseline student private vehicle time. 622 observations are dropped because respondents saw implausible reliability levels in the choice experiment questions.³⁹ The resulting sample has 3,434 observations.

8.1 Experimental Design

While the service improvements and deteriorations each contain three questions, each choice experiment question captures information regarding a typical week with five school trips in the morning and five school trips in the afternoon. The question, as shown in Figure 6, asks a respondent to choose between using the school bus, the private vehicle, or a combination of the two. Given that there are ten trips in a typical school week, a respondent’s answer to the choice experiment question provides information on all of these ten trips.

The choice experiments have two attributes: a student’s travel time on the school bus and the service disruptions of the school bus. Travel time is measured in minutes and service disruptions is measured in the number of delayed or canceled trips in a typical week. The experimental design then applies a change to the baseline attribute level. Possible attribute changes are presented in Table 1. As discussed previously, respondents with current school bus riders see increased travel times and service disruptions, while respondents with students who use a private vehicle see decreases in travel times and service disruptions. In

³⁹These respondents had either very high or very low levels of service disruptions and the changes applied by the experimental design presented negative levels of service disruptions or levels of 11 or 12 disrupted trips. Given that there cannot be negative levels of disruptions and there are only 10 trips in a school week, these responses are dropped.

the instances where a respondent’s selected student uses both a school bus and a private vehicle for travel in a typical week, the respondent sees all six choice experiments, three with increased attribute levels and three with decreased attribute levels.

In the baseline data, weekly school bus travel time ranges from 100 minutes or less to 900 minutes, as the per trip ranges were ten minutes or less to 90 minutes or more. For service disruptions, already measured at the weekly level, a respondent may report anywhere from zero to ten disruptions per week.⁴⁰ Given the wide range of possible baseline levels, the magnitude of the attribute change is stratified into high and low levels, as shown in Table 1. If a respondent reports a baseline weekly school bus travel time that is greater than 300 minutes, then they are sorted into the high travel time category. Weekly travel times of 300 minutes or less are sorted into the low travel time category. Similarly, if a respondent reports baseline school bus service has more than three service disruptions per week, then the respondent is sorted into the high level category for service disruptions. Disruptions of three trips or less are the low level category.

8.2 Stated Preference Results

Table 7 presents results using the stated preference data, with Column 1 including only the choice experiment attributes and Column 2 incorporating demographic characteristics. Across both columns, as *Student Travel Time* and *Service Disruptions* increase, respondents are less likely to choose the school bus. Using the results in Column 2, the marginal rate of substitution is -81.91, with a standard error of 16.02. On average, respondents would trade roughly 82 minutes of student travel time per week to avoid one delayed or canceled school bus trip in the stated preference data.

9 Driver Service

The driver service section investigates the relationship between student travel time, service disruptions, and monetary price. Unlike the choice experiments, this section focuses on a student’s private vehicle travel time and holds school bus service fixed. I introduce a hypothetical third transportation alternative, referred to as the “driver service” within the instrument, that would provide transportation from a respondent’s residence to the student’s school for a fixed weekly fee. See Figure 4 for an example driver service question.

⁴⁰As discussed earlier, a disruption is a delay of five minutes or more, or an outright cancellation of school bus service on any given trip.

This section of the survey was particularly scrutinized by local Raleigh media. ABC 11 Eyewitness News, the local Raleigh affiliate, titled their article “Parents asked about hiring private driving service on WCPSS survey: ‘Safe and sufficient,’” a misquote of the survey, which stated “safe and *efficient*,” (emphasis added). Practically, this news coverage may have affected how respondents viewed and answered the survey, and to correct for this possibility, I include a control variable measuring if the response was recorded prior to the local news coverage.

9.1 Experimental Design

To investigate the relationship between student travel time, service disruptions, and monetary price, I introduce a hypothetical third-party transportation alternative, referred to as the “driver service,” within the survey instrument. This service would provide transportation from a respondent’s residence to their student’s school for a fixed weekly fee. Unlike the choice experiment section, the driver service holds school bus service fixed, and presents a travel time based on the student’s private vehicle travel time. Respondents are presented a combination of price, student travel time, and number of service disruptions and are asked whether or not they would enroll in this service. If a respondent does not enroll in the driver service, I assume they would choose their baseline travel mode. Therefore, in this section of the survey, respondents now have three transportation alternatives (the driver service, the school bus, and the private vehicle). Given the assumption that respondents would choose their baseline transportation mode if they do not choose the driver service, this section employs a conditional logistic regression with three choice alternatives.

9.2 Handling of “I’m not sure” Responses

Respondents had three possible responses to the driver service question: enroll, not enroll, or state “I’m not sure.” In the interest of providing conservative estimates, I treat “I’m not sure,” responses as “I would not enroll,” across respondents. Existing work in economics suggest that “don’t know” responses are similar to “no” responses in willingness to pay studies, and recoding “don’t know” responses does not alter the distribution of “yes” and “no” responses or the willingness to pay estimates (Carson et al., 1997; Grootuis and Whitehead, 2002). It is important to note that some of these non-enroll answers may be akin to protest votes, given the news coverage this section of the survey received, and the subsequent misinterpretation of this section of the survey in particular. 483 respondents answered “I’m not sure,” to the driver service question.

9.3 Driver Service Results

Table 8 presents conditional logit results, with Column 1 including only the driver service attributes and Column 2 including demographics. The demographics on the left hand side of Column 2 are interacted with the constant for the driver service, while the demographics on the left are interacted with the constant for the school bus. As in previous tables, missing demographic information is imputed to be the mean of a given variable. *Price* is not statistically significant in Column 2, but it does have the expected negative sign across both columns. *Student Travel Time* and *Service Disruptions* are both statistically significant and have the expected negative signs. Leveraging the results in Column 2, the marginal willingness to pay for improvements in travel time is \$0.39 per minute per week, with a standard error of 0.2074. Scaled up, this would be equal to \$23.40 per hour of weekly student travel time. For service disruptions, the marginal willingness to pay to avoid one delayed or canceled trip is \$20.30, with a standard error of 11.39.⁴¹ The marginal rate of substitution between student travel time and service disruptions is -52.35, with a standard error of 11.23.

10 Discussion and Conclusions

My work fills a substantial gap in the literature. To my knowledge, there is thus far little work examining the school transportation decision and household preferences for school transportation in an American context. I provide novel survey evidence from a large urban county in North Carolina, incorporate the role reliability plays in the decision making process, and estimate marginal rates of substitution for travel time and service disruptions using both revealed and stated preference data. Both the revealed and stated preference data find significant trade-offs between travel time and service disruptions, suggesting service disruptions have a high impact on households. In Section 7.1, I find respondents trade 48 minutes of weekly student travel time to avoid one delay or cancellation of school bus service. Under baseline conditions, respondents trade about five minutes per trip, assuming 10 trips per week, to avoid one delayed or canceled school bus trip. I then examine stated preference data collected via choice experiments in Section 8.2. The choice experiments provide both exogenous variation in attribute levels and create combinations of attributes that are not seen frequently in the revealed preference (baseline) data, therefore providing additional insight into respondents' preferences. Leveraging this data, I find respondents would hypothetically trade over an hour of weekly student travel time, nearly 82 minutes, to avoid one delay or cancellation in service,

⁴¹These values are statistically significant at the 10% level.

equivalent to about eight minutes per trip. Furthermore, I identify, to my knowledge, the first willingness to pay measure related to student travel time. In section 9.3, the value of an hour of student travel time is \$23.40 per week, while the value of one less service disruption is \$20.30.

Leveraging these willingness to pay estimates, saving one student one hour of travel time per week across 40 weeks of school would be worth \$936. If this measure is scaled up to 61,000 school bus riders, the ridership value of the 2021-22 school year, the direct value of time saved would be worth about \$57 million per academic year, assuming a fixed level of school bus ridership (Patterson & Walkenhorst, 2024). For service disruptions, reducing the number of delays or cancellations in a typical week by one trip would be worth \$812 per student in a typical academic year. Scaled up to a ridership of 61,000, the reduction in service disruptions would be worth about \$48.8 million per academic year (assuming a fixed level of school bus ridership). These calculations do not account for any potential changes in school bus ridership or spillover affects to students' academic performance or well-being that may arise from shorter bus rides, nor do they account for potential spillovers to the wider community. However, these calculations illustrate the value of the school bus system to its direct consumers and the value of potential service improvements.

This work does have limitations. First, the setting of Wake County may not be representative of other areas of the state of North Carolina, especially the more rural counties. Work in other states and regions would provide additional insights and provide an opportunity to understand the external validity of my findings. Second, I have grouped service delays and service cancellations under a broad term "service disruptions," when it is likely that service cancellations are more inconvenient for households than service delays. Future work should investigate the nuances of service disruptions by separating cancellations of service from delays of service in analysis and valuation. This would provide greater nuance regarding the importance of service reliability and aid policymakers in managing school bus staff and network designs. Lastly, I have limited insight into potential benefits to both students and the wider community. Changes in school bus service likely have direct impacts on students' well-being, school attendance, and academic performance, but at this time I cannot provide any insight regarding these dimensions. There are also likely community impacts when school bus service changes. Travel times and roadway delays and congestion are directly related to school bus service, and future work examining these community level effects would help quantify the role of school bus service in local communities.

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Table 1: Choice Experiment Attributes.

	(1)	(2)
	Low Level Deltas	High Level Deltas
Weekly School Bus Travel Time (minutes)	-90, -60, -30 or 30, 60, 90	-180, -90, -45 or 45, 90, 180
Service Disruptions (trips per week)	-1, -0.5, 0 or 0, 0.5, 1	-2, -1, 0 or 0, 1, 2

Table 2: Driver Service Attributes.

	(1)
	Levels
Price	\$100, \$150, \$200, or \$250
Travel Time Delta	25 or 50 minutes
Service Disruptions	0.5 or 0.25 per week

Table 3: Unweighted versus Weighted Summary Statistics.

	(1)	(2)	(3)
	Unweighted Observations	Weighted Observations	Number of Observations
Student Weekly Travel Time on School Bus	312.1 (194.4)	298.0 (191.0)	4,234
Service Disruptions (per week)	2.79 (2.863)	2.62 (2.794)	4,147
Student Weekly Travel Time in Private Vehicle	215.3 (106.8)	213.2 (105.5)	4,223
Respondent Weekly Travel Time in Private Vehicle	361.5 (192.1)	358.6 (191.3)	4,199
Age	44.35 (6.559)	44.43 (6.536)	5,262
College Degree	0.842 (0.365)	0.846 (0.361)	5,192
Employed Full-Time	0.734 (0.442)	0.734 (0.442)	5,270
Retired	0.00847 (0.0916)	0.00867 (0.0927)	5,270
Female	0.783 (0.412)	0.777 (0.416)	5,201
Hispanic	0.054 (0.225)	0.055 (0.228)	5,197
White	0.791 (0.407)	0.762 (0.426)	5,026
Household Income (2022)	164,984 (84,915)	165,432 (84,546)	4,776
Number of Adults in Household	2.05 (0.582)	2.07 (0.594)	5,258
Number of Children in Household	2.16 (0.926)	2.17 (0.948)	5,259
Number of Licensed Drivers in Household	2.05 (0.699)	2.07 (0.694)	5,254
Number of Household Vehicles	2.07 (0.733)	2.08 (0.736)	5,249

¹ Mean coefficients reported; standard deviations in parentheses² Both columns include weights for the number of students in the household. Column 2 includes ZIP Code-level weights.

Table 4: Split Sample Summary Statistics.

	(1)	(2)	(3)
	Mixed Mode	Bus Riders	Car Riders
Student Weekly Travel Time on School Bus	303.3 (207.3)	267.2 (160.1)	368.7 (214.2)
Service Disruptions (trips per week)	2.346 (2.581)	2.386 (2.900)	3.482 (2.328)
Student Weekly Travel Time in Private Vehicle	221.3 (94.7)	205.2 (110.6)	226.1 (102.9)
Respondent Weekly Travel Time in Private Vehicle	389.8 (149.2)	340.2 (211.0)	402.2 (170.6)
Age	44.99 (6.458)	44.48 (6.875)	44.72 (7.186)
College Degree	0.885 (0.319)	0.820 (0.384)	0.859 (0.348)
Employed Full-Time	0.770 (0.421)	0.793 (0.405)	0.688 (0.464)
Retired	0.00806 (0.0895)	0.00824 (0.0904)	0.01008 (0.1)
Female	0.767 (0.423)	0.735 (0.442)	0.808 (0.394)
White	0.791 (0.407)	0.663 (0.473)	0.839 (0.368)
Household Income (2022)	178,402.1 (83,805.36)	154,565.9 (83,874.06)	173,065.9 (84,931.39)
Number of Adults in Household	2.1 (0.602)	2.051 (0.637)	2.044 (0.539)
Number of Children in Household	1.914 (0.874)	1.897 (0.849)	1.93 (0.902)
Number of Licensed Drivers in Household	2.067 (0.622)	1.946 (0.687)	2.112 (0.669)
Number of Household Vehicles	2.096 (0.624)	1.889 (0.728)	2.228 (0.823)
<i>N</i>	1,154	2,214	814

¹ Mean coefficients reported; standard deviations in parentheses² Households who are ineligible for the school bus have been dropped from this table.

Table 5: Number of Students.

	(1)	(2)
	Number of Students	Student Selected
1 Student/Oldest	2,487	3,845
2 Students/Second	2,329	1,375
3 Students/Third	535	208
4 or more Students/Fourth	101	24
<i>N</i>	5,452	5,452

Table 6: Revealed Preference Results.

	(1)	(2)
	Choosing the School Bus No Demographics	Choosing the School Bus Demographics
Service Disruptions	-0.0575*** (0.0132)	-0.0824*** (0.0147)
Student Travel Time	-0.00174*** (0.000219)	-0.00173*** (0.000226)
Recorded Prior to News Coverage		-0.0391 (0.0952)
Age		0.00537 (0.00743)
College Degree		-0.132 (0.143)
Employed Full-Time		0.480*** (0.102)
Retired		0.461 (0.446)
Female		-0.132 (0.111)
White		-0.585*** (0.124)
Household Income		-0.195** (0.0672)
Number of Adults in Household		0.240* (0.0967)
Number of Children in Household		-0.0253 (0.0550)
Number of Licensed Drivers in Household		-0.140 (0.0948)
Number of Household Vehicles		-0.467*** (0.0791)
Marginal Rate of Substitution	-33.00*** (9.06)	-47.71*** (10.70)
<i>N</i>	3,354	3,354
Log pseudo-likelihood	-144.87	-130.61

¹ Log odds coefficients; Standard errors in parentheses

² * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Choice Experiment Results.

	(1) Choosing the School Bus No Demographics	(2) Choosing the School Bus Demographics
Service Disruptions	-0.0972*** (0.0136)	-0.103*** (0.0138)
Student Travel Time	-0.00103*** (0.000165)	-0.00126*** (0.000163)
Recorded Prior to News Coverage		-0.0139 (0.0708)
Age		0.00869 (0.00540)
College Degree		-0.367*** (0.107)
Employed Full-Time		0.399*** (0.0790)
Retired		0.386 (0.375)
Female		-0.0868 (0.0824)
White		-0.417*** (0.0902)
Household Income		-0.228*** (0.0485)
Number of Adults in Household		0.304*** (0.0798)
Number of Children in Household		0.0712 (0.0415)
Number of Licensed Drivers in Household		-0.239** (0.0903)
Number of Household Vehicles		-0.331*** (0.0680)
Marginal Rate of Substitution	-94.06*** (20.79)	-81.91*** (16.02)
<i>N</i>	3,434	3,434
Log pseudo-likelihood	-1535.91	-1467.86

¹ Log odds coefficients; Standard errors in parentheses² * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ³ *Household Income* has been divided by 10,000.

Table 8: Driver Service Results.

	(1)	(2)
	Choosing Driver Service No Demographics	Choosing Driver Service Demographics
Price	-0.0159*** (0.000989)	-0.00446 (0.00234)
Service Disruptions	0.156*** (0.0127)	-0.0906*** (0.0149)
Student Travel Time	-0.000182 (0.000213)	-0.00173*** (0.000228)
Recorded Prior to News Coverage		0.134 (0.300) -0.0679 (0.0995)
Age		-0.00771 (0.0208) 0.00781 (0.00765)
College Degree		-0.854* (0.358) -0.0726 (0.148)
Employed Full-Time		0.602 (0.334) 0.471* (0.108)
Retired		1.742 (0.985) 0.202 (0.462)
Female		0.0699 (0.317) -0.158 (0.118)
White		-1.925*** (0.285) -0.632*** (0.127)
Household Income		0.0658 (0.214) -0.225** (0.0704)
Number of Adults in Household		0.394 (0.226) 0.176 (0.102)
Number of Children in Household		0.249 (0.187) 0.0757 (0.0578)
Number of Licensed Drivers in Household		-0.790* (0.310) -0.141 (0.0919)
Number of Household Vehicles		-0.164 (0.236) -0.424*** (0.0791)
Reminder of Potential Time Savings		0.107 (0.269)
<i>N</i>	3,020	3,020
Log pseudo-likelihood	-181.19	-144.86

¹ Log odds coefficients; Standard errors in parentheses

² Left hand demographics are interacted with choosing the driver service. Right hand demographics are interacted with choosing the school bus.

³ * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Action Plans

WCPSS is committed to providing safe and efficient transportation services to all Wake County students and their families. From time to time, the school district considers new action plans that enhance the transportation services it provides. We would now like to ask you about potential action plans that WCPSS is not currently considering, but might consider in the future.

We will present each of the action plans separately on the following pages. For each action plan, we will present the travel time and reliability that your oldest student would experience *if they rode the bus to and from school every morning and afternoon during a typical week*. For reference, we also provide the travel time and reliability you currently experience from busing services.

Assuming that the potential action plan is implemented, we want to know whether you would:

- have your oldest student ride on the bus;
- drive your oldest student;
- choose a combination of riding the school bus and driving to school.

Figure 1: Introduction to Action Plans.

Current Weekly Travel Times and Reliability

In the table below, "Your Oldest Student's Travel Time on the School Bus Per Week" assumes that *your oldest student rides the bus* in the morning and the afternoon five days a week. That means the table assumes your oldest student makes *ten total trips on the school bus*, five in the morning and five in the afternoon.

When the table refers to "Your Oldest Student's Travel Time in the Car Per Week" and "Your Travel Time in the Car Per Week," it is assumed that *you are driving your oldest student* to and from school five days a week in both the morning and the afternoon. This means there are *ten total trips to and from school*.

As a reminder, we define *service disruptions* as a delay of more than 5 minutes or a cancellation of school bus service.

Current Travel Times and Service Disruptions Per Week	
Your Oldest Student's Travel Time on the School Bus Per Week	350 minutes
Service Disruptions Per Week	4
Your Oldest Student's Travel Time in the Car Per Week	250 minutes
Your Travel Time in the Car Per Week	400 minutes

Figure 2: Current Travel Times and Service Disruptions.

Action Plan A

Below, we present the potential new route your oldest student would have under this action plan. As a reminder, when we say service disruptions, we are referring to delays of more than 5 minutes or outright cancellations of service. When we say travel time per week, we are referring to the travel time your student would experience if they rode the bus to and from school every morning and afternoon during a typical school week.

Under this action plan, only your oldest student's school bus route would change. If you have other students in your household who attend a different school and therefore have a different bus route, their bus route would remain the same as it is currently.

As a reminder, your oldest student's currently weekly travel time on the school bus is *350 minutes*.

You also report that your oldest student's school bus route has *4* service disruptions per week.

If this plan were to be implemented, would you have your student use the school bus or be driven to school?

Potential New School Bus Route	
Your Oldest Student's Travel Time Per Week	395 minutes
Service Disruptions Per Week	4

Figure 3: Action Plan A.

An Alternative to Busing - Driver Service

Some WCPSS families currently hire drivers to transport their student to and from school. Families that pay for these services have found them to be safe and efficient means of transportation, and they appreciate the time savings to both parents/guardians and students.

Suppose that you were able to hire a driver to transport your student to and from their school every morning and every afternoon during a typical school week, for a total of 10 trips per week. This service would

- cost you \$150 per week
- save you 575 minutes per week

The travel time for your student would be 300 minutes per week.

This service would have *one* service disruption *every month*, on average.

Would you enroll your oldest student in this service?

Figure 4: Driver Service Question.

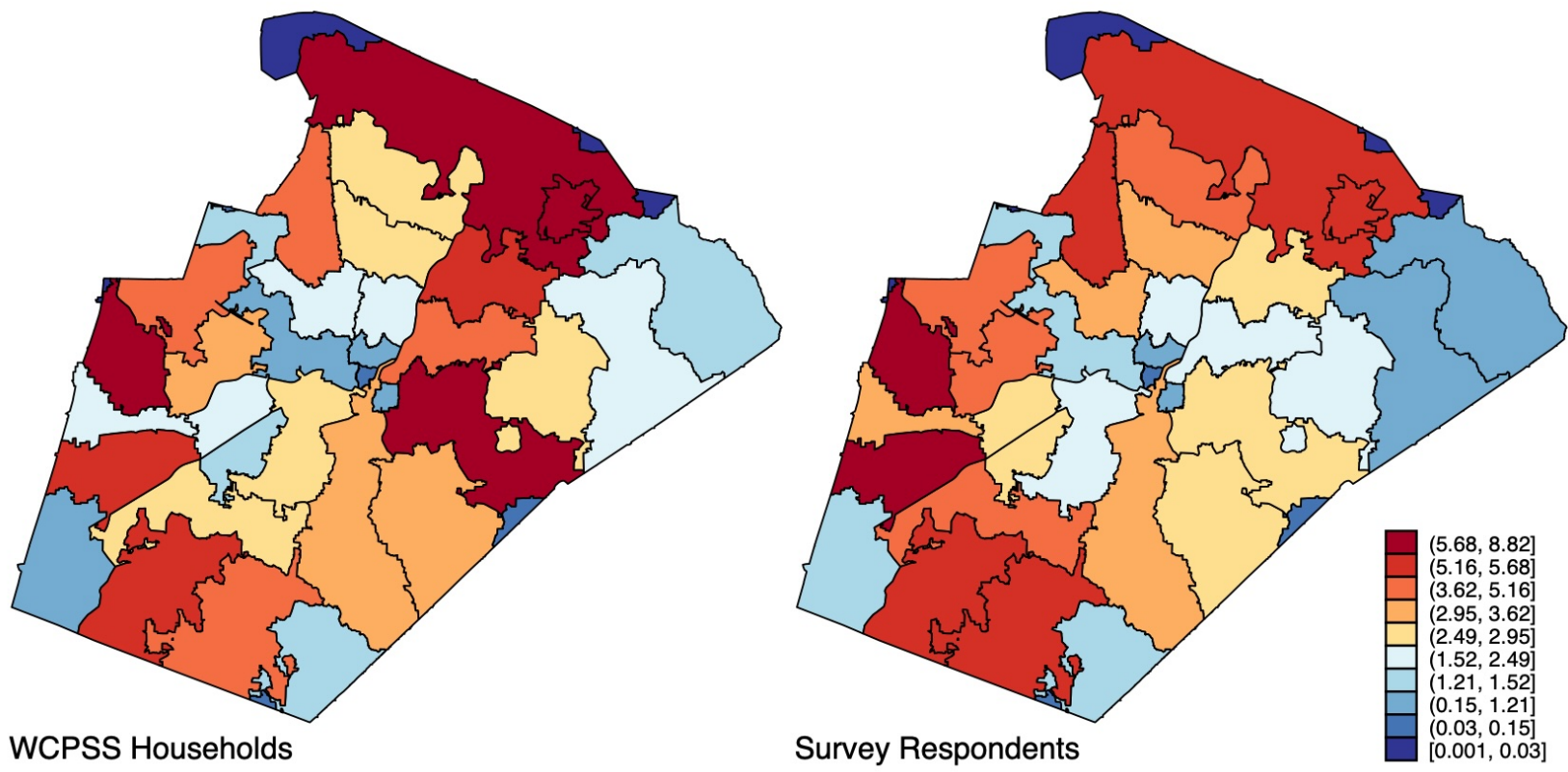


Figure 5: WCPSS Households and Survey Respondents by ZIP Code.