LOCAL SUPPORT OF LIGHT RAIL IN THE TWIN CITIES

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ABSTRACT

Existing research regarding light rail has approached a number of topics relevant to the mode of transportation but has largely ignored the relationship of perception towards light rail and effect on support for such projects. Connecting such support to smaller scale planning issues is a way to give planners more agency over a given project's success. Using data from a Twin Cities Metropolitan Area survey on travel behavior, public transportation, and perceptions of neighborhood change, this paper looks to connect existing research to factors affecting support for Light Rail. An ordered logistic regression of the question "What is your overall opinion of light rail?" on a number of different factors reveals important connections to neighborhood change around ease of parking and traffic safety along walking routes. Expected improved traffic safety shifts answers more positive, as does expected worsening of parking. The first result fits with existing understandings, while the second provides a counterintuitive result possibly relating to respondent's conceptions of the question. In both cases, these results identify factors important to support of light rail that are malleable for practitioners on a useful scale.

Keywords: Light Rail, Neighborhood Change, Parking, Traffic Safety

INTRODUCTION

The topic of attitudes towards public transit and especially light rail in particular has become increasingly relevant in recent years. After half a century of dominance by the automobile, nascent awareness of the negative effects of cars on public health, community, the environment, coupled with questions on oil reliance and more have contributed to a light rail boom with new lines going up all across the country. But approval of rail on one side often garners backlash on the other as residents of surrounding neighborhoods react to perceived and anticipated change and disruption. Especially for infrastructure intensive projects, local buy in is key to efficient project development as well as sufficient use once a project is off the ground. The best transit line is only as good as the people who support it (or do not). A history of heated battles over development of the Southwest Green Line Extension in the Twin Cities illustrates this point (*1*). The question of what differentiates supporters and opponents of transit and light rail races to the forefront of concern for regions looking to develop light rail networks. While transit agencies cannot draw routes according to where supporters live, increased understanding of the dynamics underpinning support for light rail could mean better engagement, streamlined planning, avoidance of conflict, increased ridership, and more positive outcomes leading to cost savings and other added benefits for transit agencies and metropolitan areas at large.

LITERATURE REVIEW

While there has been a surge of research on the general topic of light rail in recent years, much of this research has focused on understanding the effects of light rail lines' effects on people and places rather than the other way around. One question clearly in writers' minds is the effects of light rail lines on land values. In the Twin Cities, Urban residents have been found to generally expect positive neighborhood change from fixed rail transit, and the Twin Cities first light rail line has generated such change in the form of increased land value for some of the homeowners in its proximity (*2-3*). In light of ever more crowded highways, another study concluding that light rail service has helped to slow the increase of traffic in Denver helps to further make the case for light rail as positive infrastructure (*4*). And given growing epidemics of obesity and diabetes among other illnesses, it is no surprise that people are also investigating the effects of light rail on the human form as well as the built environment. Barbara Brown and Carol Werner unsurprisingly found that in a Salt Lake City Neighborhood designated for a new light rail stop, that regular riders of the line were healthier and more active, and also importantly for this study, held more positive attitudes about urban living, reporting in particular that "light rail enhances city livability" (*5*). Another study published in the American Journal of Preventative Medicine discusses very similar findings (*6*).

But while these questions may inform early planning stages and persuade key officials as to projects' value, planners ultimately need more information about the reverse question, how people and place affect lines, in order to best support the success of such projects. With one new line open and two more planned in the Twin Cities, the region offers an excellent opportunity to explore what shapes residents' opinions of light rail in the context of an expanding system. In order to capitalize on the potential of these projects, planners need to be able to identify key determinants of light rail support as well as small scale ways to manipulate those factors.

A great deal of research on travel behavior with more or less relevance to light rail exists, but not often with the above lens of more immediate usefulness for practitioners. A great deal is often somewhat tangentially related to light rail, focusing on auto use, cycling, or general transit use. Birgitta Gatersleben and Katherine Appleton found in a study on commuting by bike in the

UK that safety and perception of the mode are two key factors limiting more wide spread adoption (*7).* A larger study conducted by Mark Wardman, Miles Tight, and Matthew Page echoes these concerns over safety, noting the importance of safe biking routes in increasing cycling share (*8*). Another study led by Yasavi Popuri reiterates the importance of perception of a mode, this time regarding public transport (*9).* Neither should economic incentives towards transit ridership be discounted. Ample free parking is one detractor from transit ridership, and different pay schemes can help to encourage transit use (*10*). Donald Shoup, in his work *The High Cost of Free Parking* gives a wider perspective of just how much travel behavior preferences root themselves in parking issues (*11*). Given the intersectionality of mode choice, the conclusions may well be applicable to light rail in some form, but more direct tie in is needed.

Of the existing research focused specifically on light rail support and use, a good deal is often not on a very transferrable level for practicing planners on the ground. Much of it is rather situationally focused, often anecdotally focused and suggesting rather than cementing avenues for shoring up projects. Werner and Brown's study in Salt Lake City is interesting but provides a relatively small sample, the conclusions of which should be transferred with care (*5*). Another study on perceptions of automobiles vs. transit provides interesting insight into how light rail differentiates itself from other modes in the minds of people, but doesn't provide much direction for capitalizing on that differentiation (*12*). Milena Scherer further explains how attitudes towards light rail interact with sometimes lower than forecasted demand for the mode (*13*). In another aspect of perception, sense of place has been shown to link with revitalization of an area (*14*). Connecting light rail to these understandings could be invaluable for future projects.

Finally, a good deal of work relates more strongly with the intent of this paper to look factors affecting light rail support but doesn't provide easily accessible tools for planners. High level factors such as distance to station (line alignment is often relatively inflexible), weather conditions, primary land use, etc. may be accounted for around the edges, but don't provide everyday approaches to improving support and ridership. Density, jobs available, and CBD proximity are examples of such factors (*15).* Different distances to stations according to mode have been related to ridership, but means for influencing these factors, like building park & rides as suggested in one study, are relatively limited (*16, 17*).

Some research exists on a scale that fits with planners' more regular activities, considering how different neighborhood characteristics affect light rail ridership. Living on a more walkable block, for example, has been shown to relate to regular light rail use (*18*). These sorts of connections are the ones needed for better support of light rail on a practical scale. A number of reliable tools and studies exist, such as the Irvine-Minnesota Inventory, which might be leveraged to help inform planners every day work on this more micro scale in order to better shape factors connected to light rail support (*19, 20*).

METHODOLOGY

Data set

Data for the following analysis comes from the residential portion of Transit & Neighborhood Social Change: A Survey Conducted by the University of Minnesota for the Transit way Impacts Research Program (*2*). Researchers collected data for the survey from 2009-2011, asking respondents questions on a number of topics including household information, travel behavior, perceived and expected neighborhood change, and more. Researchers randomly sampled households in neighborhoods along several major transit ways within the Twin Cities

metropolitan area. For the purposes of the following analysis, focus is placed on respondents' perceptions of neighborhood change as they relate to opinions of light rail as a transportation mode.

Regression Analysis

An ordered logistic regression model was developed around the question "What is your overall opinion of light rail?" as the dependent variable. Responses to this question were on a scale of one to five where one signified "strongly negative" and five signified "strongly positive." First, a core model was developed with independent variables chosen that from the literature were understood to influence transit support, were available given the mentioned data set, were situationally relevant to the given locality, and also were significant at the .10 level when the regression was run. After the development of a core model, a series of questions on expected neighborhood quality changes was investigated in order to further link possible explanatory factors to the dependent variable, factors that might provide more utility to planners and policy makers vs. broader demographic features that are difficult to affect.

RESULTS

The independent variables included in the final regression models were:

- Lives in neighborhood bordering central corridor (binary, in adjacent neighborhood or not), identifies as non-white (binary)
- Expected future impact of CCLRT project on the neighborhood (1-5 scale, strongly negative to strongly positive)
- Expected ridership twice weekly (binary)
- Achieved at least a bachelor's degree (binary)
- Commutes thirty minutes or more to work (binary)
- Moved to current residence 2005 or later (binary)

Additionally, a set of variables regarding expected change of neighborhood qualities was included. For this entire set, researchers asked "Do you think you'll see more, no change or less of each of the following neighborhood qualities over the next five years?" and respondents answered they expected either more, no change, or less of the quality. Responses to these questions were only included in the regression models if survey respondents, in reply to the question "How related do you think each change will be to the Central Corridor light rail project? Not related at all, slightly related, somewhat related, or mostly related? Don't answer if you anticipate no change." answered either somewhat or mostly related. It is possible that a respondent might have unconsciously associated an expected change with the light rail project, but there would be no way to differentiate the influence of other neighborhood change, and so this explicit association is the best control here. These qualities included in the regression were:

- Sense of security, like low crime
- Ease of finding parking in the neighborhood
- Well-maintained/well-kept buildings and yards
- Inexpensive housing
- Ease of driving on major streets or low congestion
- Quietness of neighborhood streets
- Entertainment, like restaurants, clubs, theaters, events nearby
- Neighbors with similar incomes and education levels
- Neighbors from your own race or ethnic group

- Shopping areas nearby
- Good schools nearby
- Traffic safety along walking routes

TABLE 1 Ordered Logistic Regression Models for Overall Opinion of Light Rail

Variable	Model 1	Model 2
Lives in Neighborhood Bordering Central Corridor	0.4469***	.4440***
Identifies as non-white	0.4193***	.4199***
Expected future impact of CCLRT project on neighborhood	1.9108***	1.8243***
Expected ridership twice weekly	3.8566***	3.6354***
Achieved at least a Bachelor's degree	1.7057*	1.7965**
Commutes 30 minutes or more to work	0.4091***	.4247***
Moved to current residence 2005 or later	0.8715	.8500
Sense of security, like low crime	1.2657	-
Ease of finding parking in the neighborhood	0.5042**	.5655**
Well-maintained/well-kept buildings and yards	0.6946	-
Inexpensive housing	1.10603	-
Ease of driving on major streets or low congestion	0.8791	-
Quietness of neighborhood streets	1.3602	-
Entertainment, like restaurants, clubs, theaters, events nearby	0.9306	-
Neighborhoods with similar incomes and education levels	1.2507	-
Neighbors from your own race or ethnic group	0.9566	-
Shopping areas nearby	1.0963	-
Good schools nearby	0.8442	-
Traffic Safety along walking routes	2.2875***	2.4992***

N=316 observations for both models,
Model 1 Pseudo R-squared =.1724
Model 2 Pseudo R-squared=.1641
- Indicates variable not included in 2nd model

Table 1 shows the results of two final regression models run for this study. In model one, the authors regressed "what is your overall opinion of light rail" on all of the above mentioned independent variables. Lives in neighborhood bordering central corridor, identifies as non-white, expected future impact of CCLRT project on neighborhood, expected ridership twice weekly, achieved at least a bachelor's degree, commutes thirty minutes or more to work, ease of finding parking in the neighborhood, and traffic safety along walking routes were all significant at the .1 level in this model. Lives in neighborhood bordering central corridor, identifies as non-white, commutes thirty minutes or more to work, and ease of finding parking have odds ratios of less than one, indicating negative relationships to the dependent variable. Expected future impact of CCLRT project on neighborhood, expected ridership twice weekly, achieved at least a bachelor's degree, and traffic safety along walking routes all present odds rations of greater than or equal to one, indicating positive relationships to the dependent variable.

The second regression was run excluding all of the neighborhood quality questions except for the two that were significant in the 1st model, ease of finding parking in the

neighborhood and traffic safety along walking routes. This second model's Pseudo R-squared value shrunk only slightly from the prior model's, down to .1641 from .1724, demonstrating the strength of the remaining variables' relevance as explanatory factors regarding overall opinion of light rail. Odds ratios for the variables remained relatively stable. The largest shift was a .2212 decrease for expected ridership twice weekly. None of the odds ratios shifted from below one to equal to or above or vice versa, indicating that the directions of relationships to the dependent variable remained stable.

TABLE 2 Predicted Probabilities for Overall Opinion of Light Rail Variables

Variable Inputs	Strongly Negative (%)	Somewhat Negative (%)	Neither Negative Nor Positive (%)	Somewhat Positive (%)	Strongly Positive (%)
Lives in Neighborhood Bordering Central Corridor					
No	0.5	0.4	-	10.8	88.0
Yes	1.2	0.9	-	20.8	76.6
Identifies as non-white					
No	0.5	0.4	-	10.8	88.0
Yes	1.3	1.0	-	21.7	75.6
Expected future impact of CCLRT project on neighborhood					
Strongly Negative	3.2	2.3	-	38.4	54.8
Somewhat Negative	1.8	1.3	-	27.3	68.9
Neither Negative Nor Positive	1.0	0.7	-	17.7	80.2
Somewhat Positive	0.5	0.4	-	10.8	88.0
Strongly Positive	0.3	0.2	-	6.3	93.1
Expected ridership twice weekly					
No	0.5	0.4	-	10.8	80.4
Yes	-	-	-	3.3	88.0
Achieved at least a bachelor's degree					
No	1.0	0.7	-	17.5	80.4
Yes	0.5	0.4	-	10.8	88.0
Commutes 30 minutes or more to work					
No	0.5	0.4	-	10.8	88.0
Yes	1.3	0.9	-	21.5	75.8
Ease of finding parking in the neighborhood					
Less	0.3	-	-	6.5	92.9

No Change	0.5	0.4	-	10.8	88.0
More	1.0	0.7	-	17.3	80.6
Traffic Safety Along walking routes					
Less	1.4	1.0	-	22.4	74.7
No Change	0.5	0.4	-	10.8	88.0
More	-	-	-	4.7	94.8

- Indicates that a result was not significant and so has not been displayed.

Marginal Effects

Beyond concerns of significance and direction of relationship, interpretation of odds ratios in ordered logistic regression is more difficult than for coefficients in an Ordinary Least Squares (OLS) regression. Odds ratios are not independent coefficients but rather represent the odds of success or failure given a result for a specific variable as related to all other variables in the regression. Computing marginal effects offers one avenue for evaluating a variable's practical significance in light of this problem. Under this method all variables except one are held at their averages, or in this case medians as is more appropriate, while the probability is calculated that a given outcome of the final independent variable will result in a given outcome for the dependent variable. In other words, this method shows what effect a give variable will have in the most typical case.

Calculating the marginal effects of the two expected neighborhood quality change variables, ease of finding parking in the neighborhood and traffic safety along walking routes, highlights that both of these variables carry practical as well as statistical significance. According to these results, if a respondent expects less ease of parking in the next five years, there is a 92.9% chance that person will rate overall opinion of light rail as strongly positive. In contrast, if a person expects more ease of parking, they are only 80.6% likely to make the same rating of overall opinion of light rail. Expectation of traffic safety change presents even more differentiated results here. If an individual expects traffic safety to decrease in the next five years, they are 75.0% likely to rate their overall opinion of light rail strongly positive, whereas if they expect traffic safety to improve they are 94.8% likely to rate strongly positive.

The marginal effects for other significant variables from the second regression model for the most part fall along relatively similar patterns. For all variables the probabilities of predicted outcomes from given inputs fall heavily on responses of somewhat and strongly positive overall opinion of light rail. Outside positive overall opinions of light rail, the highest probability of an input predicting an outcome is that if a median respondent rates strongly negative on Expected future impact of CCLRT project on neighborhood, they are 3% likely to rate strongly negative for overall opinion of light rail. In contrast, that same median respondent is 38% likely to rate overall opinion of light rail somewhat positive and 55% likely to rate it as strongly positive. Beyond most predicted outcomes leaning strongly towards outcomes somewhat or strongly positive for overall opinion of light rail, most are skewed especially towards rating strongly positive. The previously mentioned 38% is the highest probability of any input of any variable resulting in an opinion of somewhat positive, with the next highest being that a response of somewhat negative on the same variable having a 27% likelihood in resulting in an opinion of somewhat positive.

In addition to surveying the orientation of variables towards certain outcomes, it's also important to look at the variables internally to take note of which changes in inputs for different

variables are the most consequential. As previously noted, switching between expecting a decrease or an increase in traffic safety along walking routes over the next five years results in an almost 20 percentage point increase in the likelihood that a median respondent would note strongly positive for overall opinion of light rail. The largest jump within any variable is that switching from strongly negative to strongly positive on Expected Future Impact of CCLRT project on neighborhood results in a 38 percentage point increase in likelihood of rating overall opinion of light rail strongly positive. This is to be expected considering both the wider range of response for this question as well as its direct bearing upon the dependent variable, the two questions being differentiated but also related in nature. The other significant variables present somewhat quieter effects, with alterations to likelihoods of rating overall opinion somewhat or strongly positive shifting between 7 to 15 percentage points.

CONCLUSIONS

The results regarding traffic safety along walking routes, a positive relationship between expectation of improvement in this area and more positive perception of light rail, aligns with and supports existing research regarding walking and transit. The effects of alienating the pedestrian in a dangerous auto oriented landscape extend beyond immediate travel behavior choices. A person may reach a light rail line via different modes, but the relationship between these variables indicates the importance of pedestrian access in shaping neighborhood-level opinions of light rail. The pedestrian who faces difficulty and stress in reaching a light rail line may not only ride less, but may value that line less. And this effect may not be limited to the immediate proximity of a line as the original question asked respondents about traffic safety along walking routes in their neighborhoods generally. Residents are not calculating safety optimizing routes to transit as they respond to these survey questions. Rather, their responses more likely reflect general impressions of walkability as opposed to concrete thoughts. Generalized improvements to walkability, therefore, may stand to improve light rail's position with area residents. Neither is this necessarily tied to residents' concerns of being able to access the light rail line at all but also may reflect concerns of some individuals who don't intend to use the line but fear its construction will lead to deterioration of their pedestrian environment.

Policy makers should not discount the difference between a person expressing a somewhat positive vs. a strongly positive opinion of light rail. The median respondent was 97% likely to express a positive opinion of light rail overall in some form even given expected worsening of traffic safety along walking routes, but the median respondent who expects improvements in traffic safety is nearly as likely (95%) to rank overall opinion of light rail a five. A full investigation into what differentiates those responding with fours and fives to the dependent variable presents an interesting question for further research, but the difference in meaning between four and five can be explored here. One interpretation of the difference between ranking a somewhat positive and a strongly positive overall opinion of light rail might be personal association with the project. The person ranking a four might see light rail as a generally positive but relatively abstract improvement, the benefits of which won't be personally tangible, like with the restoration of a run-down property. Along the same line of thinking, it's unlikely a person would rate a strongly positive overall opinion without some personal connection to the mode of transit, some expectation of personal benefit. The marginal effects of expected ridership twice weekly support this understanding to an extent. The median respondent is about 8 percentage points more likely to rate overall opinion of light rail a five if they expect to ride the line at least

twice weekly. This effect likely is somewhat small because there are a number of factors limiting this expectation. It isn't a completely free choice, but is dictated by location of work and home, budget, and more.

If this is one explanation for why people might differentiate on this ranking, the significance of this explanation for differentiation brings more importance. A person who perceives the personal benefit of a project is much more likely to tolerate inconvenience brought about by its development, whereas someone who only loosely appreciate that same project could conceivably switch their ranking more easily. The ideal environment for planners is one in which residents are universally willing to bear inconvenience for the sake of positive development, and the results from this study point towards one possibility for growing such tolerance through walkability improvements. If a median respondent notes a 1 for lives in neighborhood bordering central corridor, their likelihood of rating a five on overall opinion of light rail drops by about 11 percentage points. Concerns of not in my backyard style convenience likely account for this drop where the median respondent experiences the inconvenience of construction but will not necessarily experience the possible benefits of the completed line. At the same time, the effects of improved traffic safety along walking routes alone appear to bear equal wait, and certainly combined with other factors not accounted for here could help sway that respondent to rate light rail a five.

The results regarding expected change of ease of parking are somewhat more conflicted. The odds ratio of .57 for the final model indicates a negative relationship between expected future ease of parking and overall opinion of light rail. That is to say that as it gets more difficult to park in the neighborhood overall opinion of light rail goes up and vice versa, with the median respondent being about 12% more likely to rate overall light rail opinion a five with expectation of worsening parking in the coming years. This relationship goes against typical understandings of the relationship between these two concerns.

One possibility is that people's expectations of ease of parking may be serving as a proxy for their expectations of neighborhood vitality. Busier expected parking could reflect expectations of more vibrant business and entertainment activity in the neighborhood in respondent's minds. Light rail might then act as a sign of the continuation of such trends through the increased foot traffic it would bring. This understanding, focused on the future, could perhaps separate itself from respondents' conceptions of the frustrations associated with difficulty finding parking in the present that might have otherwise been represented by a positive relationship between ease of parking and overall opinion of light rail. If nothing else, the results here point to a strong link between parking and perceptions of light rail. Parking issues are commonly some of the most controversial in cities across the U.S., and researchers and planners alike would do well to further elucidate the interactions between parking and light rail so as to hopefully maximize benefit or at least minimize conflict.

The strong leanings of the marginal effects likelihoods towards rating overall opinion of light rail four or five on a one to five scale provides evidence for the relatively expected conclusion that light rail is not unwanted nor unpopular infrastructure. But still, as planners and other officials in many cities can attest to, light rail implementation is not without its roadblocks. Existing literature largely focuses its direction from light rail to its effects on environment and population, and studies from the other direction often lack wider applicability and practicality for those working on such projects. Analysis of this data set identifies two malleable factors for planners, traffic safety along walking routes and ease of parking in neighborhood, that bear relationship to perceptions of light rail, and several more neighborhood qualities that don't

appear to be related to such perceptions. Considering the primacy of safety and parking in many people's minds, these results fit within typical understandings of the subjects, and further research should seek to add more nuance to the relationship between these factors and perception of light rail in order to better inform planners on the ground as to how they can best support future projects.

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