Quantifying the Importance of Image and Perception to Bus Rapid Transit

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13. ABSTRACT

This study was designed to quantify the importance of image and perception to Bus Rapid Transit, by identifying the different underlying tangible and intangible factors that drive any perceived differences between BRT and other forms of rapid transit. "Tangible" service attributes refer to those that are functional and objectively quantifiable, whereas attributes that are abstract, subjective, and more difficult to measure and quantify are termed "intangible." Los Angeles was chosen as the study location because it features a wide range of rapid transit modes, including "BRT-Lite" (Metro Rapid), "Full-Service" BRT (Metro Orange Line), Light Rail Transit (Gold Line and Blue Line) and Heavy Rail Transit (Red Line). A series of focus groups were conducted in late 2007, followed in 2008 with an attitudinal survey of 2,400 transit users and non-users in the Los Angeles area.

Survey data analysis showed that statistically significant differences existed in the overall ratings achieved by the alternative transit modes, which were separated into four different tiers (ordered in terms of lowest to highest overall rating):
Tier 1: Local bus service; Tier 2: Metro Rapid and Blue Line LRT; Tier 3: Orange Line and the Gold Line; Tier 4: Red Line HRT
These overall ratings were compared against the level of investment associated with each mode, defined in terms of capital cost per mile. Given that the investment level associated with the Metro Rapid is much closer to that of the local bus than to any of the other modes, it was concluded that the Metro Rapid performs remarkably well in terms of overall rating achieved per dollar of investment, and therefore represents a very cost effective form of BRT. The Orange Line BRT also performed well in terms of overall rating achieved per dollar of investment, though not to the dramatic level associated with the Metro Rapid.

It was found that intangible service attributes have a significant influence on modal perceptions - the Gold Line LRT and Orange Line BRT both achieved higher overall ratings than the Blue Line LRT due to higher ratings on key intangible attributes like safety while riding, safety while at the station, and other riders that use the service. It was hypothesized that these differences in intangible attribute ratings were related to the issue of urban context, and it appears that the urban area through which a rapid transit service runs has a larger impact on overall perceptions than whether it is based on bus or rail technology.

Overall, these findings showed that BRT (even in its lower investment forms) can compete with rail-based transit (at least in the perception of the general public) in return for lower capital cost investments. The question of whether these perceptions translate into similar levels of ridership attraction is a topic for further research.

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1 yard (yd)	=	0.9 meter (m)	1 meter (m)	=	3.3 feet (ft)
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			1 kilometer (km)	=	0.6 mile (mi)
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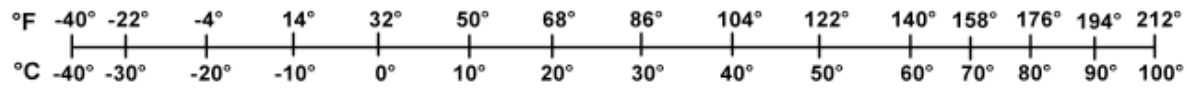

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Foreword

Bus-based public transit in the United States suffers from an image problem. If bus transit is to be perceived as more than just a social service, it must be able to perform at a level comparable to the private automobile, and convey the high quality image typically associated with rail. Bus Rapid Transit aims to do just that: emulate rail, but at a lower capital cost. Though many have an opinion on whether or not BRT can achieve this, little quantitative evidence exists. This study was commissioned in order to assess the extent to which BRT can capture the image of rail-based transit, and to understand and quantify the underlying tangible and intangible factors that drive any perceptual differences that may exist between the two modes. "Tangible" service attributes refer to those that are functional and objectively quantifiable, whereas attributes that are abstract, subjective, and more difficult to measure and quantify are termed "intangible."

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Executive Summary

Bus-based public transit in the United States suffers from an image problem. If bus transit is to be perceived as more than just a social service, it must be able to perform at a level comparable to the private automobile, and convey the high quality image typically associated with rail. Bus Rapid Transit aims to do just that: emulate rail, but at a lower capital cost. Though many have an opinion on whether or not BRT can achieve this, little quantitative evidence exists. This study was commissioned in order to assess the extent to which BRT can capture the image of rail-based transit, and to understand and quantify the underlying tangible and intangible factors that drive any perceptual differences that may exist between the two modes. "Tangible" service attributes refer to those that are functional and objectively quantifiable, whereas attributes that are abstract, subjective, and more difficult to measure and quantify are termed "intangible." The following core questions were defined:

a) Do people perceive alternative rapid transit modes differently?
b) If differences exist, where do they originate? Can they be attributed to specific tangible or intangible factors?
c) If differences exist, do they translate into different levels of ridership attraction potential? To what extent can differences in ridership attraction potential be quantifiably attributed to each tangible and intangible factor?
d) What variations exist with regard to socio-economic/geographic factors?

Given the focus of the study on public perceptions, the project was designed around two market research exercises, a series of focus groups followed by an attitudinal survey. Los Angeles was chosen as the location for these exercises because it features all the different rapid transit modes, including "BRT-Lite" (Metro Rapid) and "Full-Service" BRT (Metro Orange Line), as well as Light Rail Transit (Gold Line, Blue Line) and Heavy Rail Transit (Red Line). Also, Los Angeles is an auto-dominated city with significant congestion problems.

Fourteen different performance variables were evaluated. The 14 variables were divided into two groups; those that are "tangible" and those that are "intangible," as follows:

Tangible Variables:

- Travel Cost
- Door to door travel time
- Frequency of Service
- Hours of service
- Convenience of service
- Reliability of service

Intangible Variables:

- Safety while riding
- Safety at the station/stop
- Comfort while riding
- Comfort at the station/stop
- Customer service
- Ease of service use
- Other riders
- Avoiding stress/cost of car use

While the ultimate goal was to assess modal differences in ridership attraction potential, respondents residing in different parts of Los Angeles would not be in a position to provide useful information on their likelihood of riding the different geographically dispersed transit services (except perhaps for the more ubiquitous local bus and Metro Rapid networks). To overcome this, rating each service from "very poor" to "very good" was used as a proxy for ridership attraction, as riders could better assess a general opinion

across the different services regardless of their location relative to the service.

Survey data analysis showed that statistically significant differences existed in the overall ratings achieved by the alternative transit modes, which were separated into four different tiers (ordered in terms of lowest to highest overall rating):

– Tier 1: Local bus service
– Tier 2: Metro Rapid and Blue Line LRT
– Tier 3: Orange Line and the Gold Line
– Tier 4: Red Line HRT

These overall ratings were compared against the actual level of investment associated with each mode (defined in terms of capital cost per mile in 2005 dollars). This analysis showed the large disparity in investment level, with the Red Line costing approximately one thousand times the capital cost per mile of the local bus service and Metro Rapid. Focusing on the Tier 2 services, it was observed that the Metro Rapid achieved a slightly higher rating than the Blue Line (although in statistical terms these two are considered to have the same rating) for a fraction of the investment cost per mile ($0.355M versus $59.1M). Given that the investment level associated with the Metro Rapid is much closer to that of the local bus than it is to any of the other modes under consideration, it must be concluded that the Metro Rapid performs remarkably well in terms of overall rating achieved per dollar of investment, and therefore represents a very cost effective form of BRT. Considering the Tier 3 services, it was observed that the Orange Line achieved a slightly higher rating than the Gold Line (though again, in statistical terms these two are rated at the same level) for approximately one third of the investment cost per mile. This indicates that the Orange Line also performs well in terms of overall rating achieved per dollar of investment, though not to the dramatic level associated with the Metro Rapid. Overall, these findings showed that BRT (even in its lower investment forms) can compete with rail-based transit (at least in the perception of the general public) in return for lower capital cost investments. The question of whether these perceptions translate into similar levels of ridership attraction is a topic for further research.

Why do the statistically significant differences described above exist? Clearly, level of investment plays a role, with local bus having the lowest investment level and the lowest rating, and the Red Line having the highest investment and the highest rating. However, besides these two obvious extremes, the ratings achieved by the remaining transit services were clearly not simply proportional to respective level of investment. Further investigation focused on determining the cause of the different ratings achieved by each transit service.

Why were the Blue and Gold Lines rated differently, even though they are essentially the same mode at approximately the same level of investment? Further investigation showed that the higher overall rating achieved by the Gold Line can be attributed primarily to higher ratings for key intangible variables: safety (both at the station and onboard), and to perceptions of other riders. Qualitative research performed within this study suggests that this finding speaks to the wider issue of urban context – the hypothesis being that the urban context through which a transit service runs exerts a significant impact on the relative attractiveness of that service. Given that the Blue Line runs through some of the most economically deprived

areas of the city, while the Gold Line serves relatively affluent areas, it seems reasonable to hypothesize that the difference in overall rating between these two light rail lines originates in the respective differences in urban context.

How was the Orange Line able to achieve an overall rating that was equivalent to the Gold Line and significantly higher than the Blue Line for approximately one-third the capital investment level? A comparison of the Orange and Blue Lines showed that these two services achieved comparable tangible attribute ratings, and that the primary differences lay in significantly lower ratings for the Blue Line on the intangible attributes of ride safety, station safety, and other riders. Given that these are the same three factors responsible for the disparity between the Gold Line and the Blue Line, it is hypothesized that urban context also plays a role here. It appears that the influence of the urban area through which a rapid transit service runs has a larger impact on overall perceptions than whether it is based on bus or rail technology. Given that the Orange Line achieved similar ratings to the Gold Line in terms of both tangible and intangible attributes, it can be concluded that "Full Service" BRT is capable of replicating both the functionality standards (tangible attributes) and image qualities (intangible attributes) normally associated with LRT, at least in the perception of the general public.

It was important to understand how the two different forms of BRT, representing opposite ends of the BRT investment spectrum, are viewed by the public. It was found that the Orange Line's significantly higher overall rating originated in higher ratings on both the tangible and intangible attributes, though by far the largest single difference was in relation to station comfort. This implies that the Orange Line is superior in the eyes of the public both in terms of tangible service attributes like span, frequency and reliability, and also on intangibles like comfort and safety, and is thus more likely to succeed in attracting the coveted "potential rider" market segment (people that could ride transit but choose to travel by private auto instead). However, while the Orange Line is perceived as superior, it should be noted that the Metro Rapid achieved an overall rating that was only slightly lower, while costing around 100 times less to provide.

Finally, it was important to understand why BRT-Lite systems like the Metro Rapid achieve significantly higher ratings than the local bus system, given that both make use of the same mixed traffic runningway type. The most significant differences were found in relation to travel time, followed by frequency and reliability. So while the Metro Rapid also achieved higher ratings on important intangible attributes like safety and comfort, it appears that the attraction of "BRT-Lite" over local bus relates to perceived higher levels of functional service performance. This finding was corroborated in the focus groups, where BRT-Lite was typically perceived as the high-performance version of the regular bus network.

Some progress was made in understanding the influence of different tangible and intangible factors on modal perceptions. In terms of overall importance, the tangible attributes of reliability and service frequency received the highest overall ratings, along with the intangible attribute of ride safety. These were closely followed by the tangible attribute of service span and the intangible attribute of station safety. Thus, it is clear that the public consider

both tangible and intangible factors in determining their overall opinion of alternative transit services, and that reliability is the most important tangible factor and safety is the most important intangible factor. Interestingly, modal perceptions of reliability also tended to increase roughly in line with relative investment level, with local bus rated lowest, followed by Metro Rapid, followed by the Orange Line and the two light rail lines at the same level, with the Red Line achieving the highest reliability rating. Given the importance of safety, it is also worth noting that local bus and Blue Line received much lower ratings for ride safety and station safety compared to the other modes.

High correlations between tangible and intangible attributes made it impossible to isolate the contribution of individual attributes to ridership attraction potential by mode, so an index regression model was developed to investigate the explanatory power of different factor groups. In general, the model reinforced the hypothesis that a mix of tangible and intangible attributes combine to determine ridership attraction potential. Interestingly, reliability was not included in the model despite being rated the most important tangible attribute, and neither was cost. The factor weightings were found to be relatively consistent across the different modes, suggesting that the relative explanatory power of the different tangible and intangible attributes are not mode specific. However, ratings for the local bus were found to be more heavily influenced by the tangible attribute group that included travel time, service span and service frequency, while the rail modes were more heavily influenced by the intangible safety/comfort factor group. Further research could test the hypothesis that functionality is more of a determinant for the attractiveness of lower-investment bus-based services, which tend to focus on 'no-frills' provision of basic mobility, while intangible aspects like safety and comfort are more influential in determining the attractiveness of higher investment BRT and rail-based modes. It is conceivable that once basic mobility needs have been met, riders then turn their attention to intangible aspects like safety and comfort. Such behavior would be consistent with Maslow's famous Hierarchy of Needs theory (38), in which basic human physiological needs are required to be met before other higher-level needs such as self-esteem can be considered. Perhaps the same is true of mobility.

In summary, there were significant differences in overall opinions of different transit services, which were influenced by both tangible and intangible variables. The models provided a clearer understanding of the development of opinions about transit, but still only explained approximately 60 percent of the variance in the evaluation process. This was likely due to a combination of two factors; first, the inability to provide completely logical assessments of modes that cannot be feasibly used due to geographic or other availability considerations, and second, the potential for some other variable or variables in the evaluation process that were not measured. Additional research starting with a qualitative study reviewing survey results with respondents might provide insights into this issue.

One final point to note is that these findings were obtained in just one U.S. urban area. Thus, they must be regarded as context-specific and cannot be generalized to other urban areas until further research has been conducted.

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1. Introduction

1.1 Background

Bus Rapid Transit (BRT) is a term used to define a bus-based rapid transit service that attempts to emulate the high-quality service of rail-based transit modes, at a fraction of the capital cost. Initially pioneered in Latin-America, BRT is a relatively new mode in the United States, and transportation professionals, local government officials, and politicians are still coming to terms with the concept and its potential applications. Viewed by advocates as a cost-effective solution to urban mobility problems, the role of BRT is becoming increasingly associated with the wider objective of congestion reduction. If transit is to be perceived as more than just a social service, it must be able to attract "choice riders" (i.e. people with access to a private vehicle) away from their cars. The traditional view is that this requires some form of rail-based transit service, due in part to the distinct "image benefits" associated with rail. Can BRT capture the image of quality and status typically associated with rail-based modes? Though many opinions exist on whether or not BRT can achieve this, little quantitative evidence exists. This study was commissioned to assess the extent to which BRT can capture the image of rail-based transit, and to understand and quantify the underlying tangible and intangible factors that drive any perceptual differences that may exist between the two modes. "Tangible" service attributes refer to those that are functional and objectively quantifiable, whereas attributes that are abstract, subjective, and more difficult to measure and quantify are termed "intangible."

1.2 Study Objectives

The study was designed to address the following core questions:

a) Do people perceive alternative rapid transit modes differently?
b) If differences exist, where do they originate? Can they be attributed to specific tangible or intangible factors?
c) If differences exist, do they translate into different levels of ridership attraction potential? To what extent can differences in ridership attraction potential be quantifiably attributed to each tangible and intangible factor?
d) What variations exist with regard to socio-economic/geographic factors?

1.3 Study Methodology

Given the focus of the study on public perceptions, the project was designed around two market research exercises, a series of focus groups followed by an attitudinal survey. Los Angeles was chosen as the location for these exercises because it features all the different rapid transit modes, including "BRT-Lite" (Metro Rapid) and "Full-Service" BRT (Metro Orange Line), as well as Light Rail Transit (Gold Line, Blue Line) and Heavy Rail Transit (Red Line).

Task A: Literature Review

A review of pertinent literature on the subject was conducted, leading to the development of a Project Problem Statement. See Chapter 3.

Task B: Focus Groups

A series of four focus groups were conducted in Los Angeles in November 2007. The objective of this task was to identify the range of different tangible and intangible service attributes that affect user and non-user perceptions of alternative rapid transit modes. It was also hoped that qualitative analysis of these sessions would provide an understanding of the factors that influence the relative attractiveness of BRT versus other modes, particularly rail transit and the private automobile. See Chapter 4.

Task C: Attitudinal Survey

The objective of this task is to quantify the influence of different tangible and intangible factors, and to determine the impact of each on ridership attraction potential. The survey was conducted in Los Angeles in late summer/Fall 2008, and was administered to samples of users of the different rapid transit modes, conventional bus users, and non-users. See Chapter 5.

Task D: Final Report

The objective of this task is to synthesize the information collected during the different study phases, highlighting the main study findings. This document is the Final Report.

2. Study Context

2.1 Defining BRT: From "BRT-Lite" to "Full-Service" BRT

When considering the image of BRT it is important to note that the term "BRT" covers a wide spectrum of applications. Though there are many different ways in which to subdivide these applications, Figure 2.1 does so primarily on the basis of runningway type, which plays a central role in determining the investment cost and performance of the overall system.

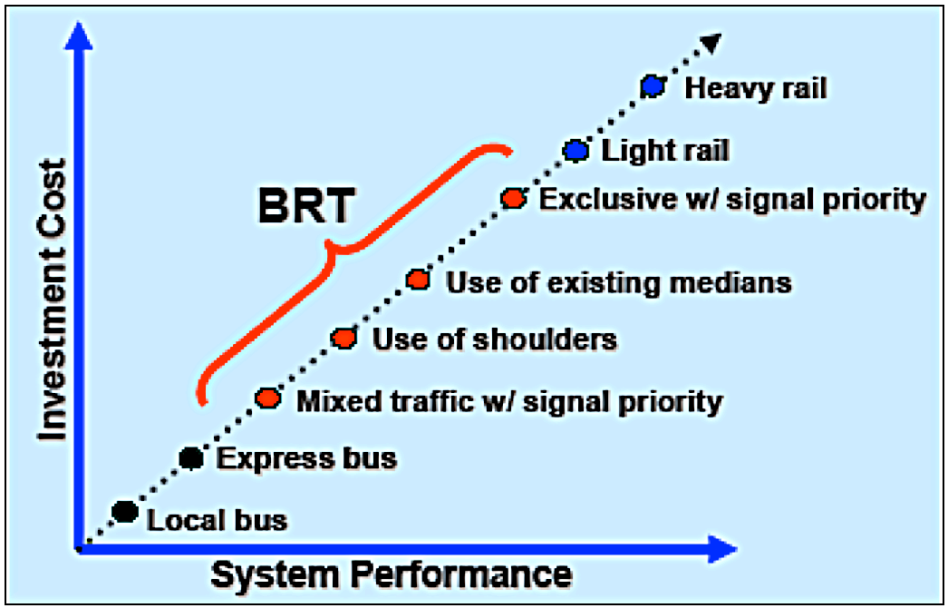


FIGURE 2.1 – Traditional Conceptualization of BRT's Range of Application

[Source: Tindale Oliver & Associates, Inc]

As illustrated in Figure 2.1, the BRT mode is often viewed as bridging the gap between the conventional bus system and light rail transit[1]. However, this gap is significant, covering a wide range of applications. At the lower end of the investment spectrum lie the "BRT-Lite" systems (also known as "Rapid Bus" or "low-level BRT") that typically run in mixed traffic, using relatively low cost applications like Traffic Signal Priority, intersection queue jumps, headway-based schedules, and far-side stops to provide improved commercial speeds and reliability levels. One of the best known and most successful examples of this approach is the Metro Rapid in Los Angeles.

[1] The authors recognize that the "conventional" view of BRT as simply a low-cost alternative to LRT, as exhibited in Figure 2.1, is an oversimplification. Recent research (39), (40), has shown that BRT and LRT are distinctly different modes, each with their own strengths and weaknesses. While it has been argued that BRT can match or even surpass the performance of LRT under certain circumstances, this is not reflected in Figure 2.1.

BRT systems often feature some form of segregated runningway, in order to guarantee high commercial speeds and reliability levels during peak periods. The most basic form of segregation is a shoulder bus lane, which can be provided at minimal cost by the simple restriping of an existing lane, or using a lane formerly designated for parking or loading and unloading. An added advantage of the bus lane approach is that it may be designated to specific sections of a route, or to operate during specific time periods, such as the AM and PM Peak (see Figure 2.2). However, effective enforcement is critical if the lane is to operate effectively. Systems that feature this approach on sections of their routes include the Kansas City Max and the Silver Line in Boston.

Median bus lanes and median busways represent the next level up in terms of performance and investment. Locating the bus lane in the median tends to reduce the number of conflicts caused by side-street access arrangements, illegally parked cars, and other obstructions, thus providing higher performance levels. While typically more expensive than median bus lanes, median busways provide the added advantage of physically separating the runningway from other traffic. Eugene's EmX provides a good example of median busway and median bus lane applications.

At the high end of BRT investment and performance lie exclusive busways. Often described as "Full-Service" BRT or "high-level BRT," these require obtaining the necessary Right-of-Way, which can often be achieved by making use of existing transit alignments such as abandoned rail lines. Though complete grade separation is impossible, exclusive busways are designed to minimize the number of at-grade intersections[2]. Modern applications of this high-investment approach generally feature amenities more commonly associated with rail systems, including high quality permanent stations, level-boarding, off-board fare payment, and stylized vehicles (though these features are increasingly being provided at lower levels of investment as well). An example of this approach is the Metro Orange Line in Los Angeles.

Though oversimplified, this section has attempted to illustrate the range of different BRT applications, and introduce the reader to terms that will be used later in the report. With respect to this study, it is important to note that BRT is an umbrella term covering an extremely wide range of different applications. Any discussion of the "image" of BRT needs to bear this in mind.

[2] The Metro Orange Line has been criticized for its level of performance, with commercial speeds limited by the number of at-grade intersections and lack of signal preemption, as well as capacity problems due to unexpectedly high levels of demand. Other exclusive busways, such as those in Ottawa and Pittsburg, feature much greater levels of grade separation and associated performance benefits.

FIGURE 2.2: Different BRT Treatments:
Bus Lane in Kansas City (top left); Metro Orange Line in Los Angeles (top right)
EmX in Eugene (bottom left); Metro Rapid in Los Angeles (bottom right)

2.2 A Description of the Los Angeles Transit Modes Considered in this Study

Following is a description of the different transit modes in Los Angeles that were considered in this study. In addition, Table 2.1 provides summary statistics for each mode.

2.2.1 Metro Local

Metro Local is the conventional bus service that operates throughout Los Angeles County, generally making frequent stops along major thoroughfares. Metro Local's route network provides local, limited-stop, and shuttle services throughout Los Angeles County. Buses are distinguished by their bright orange color, although a number of older buses remain white with an orange stripe. For FY2008, Metro Local's annual boardings were 308.4 million, with weekday boardings averaging 850,553.

FIGURE 2.3 – Metro Local Bus

2.2.2 Metro Rapid (BRT-Lite)

With the goal of improving bus speeds in urbanized Los Angeles County, two pilot lines known as the Metro Rapid Demonstration Program were launched in June 2000. Since its original inception, the Metro Rapid has grown into an extensive network of lines providing service throughout Los Angeles County. When complete, the Program will operate 28 routes across a network of 450 miles of service.

FIGURE 2.4 – Metro Rapid

One of the key elements of the program is the signal priority system, which grants priority to buses by extending the green phase or shortening the red phase of traffic signals. The system also provides frequent service, with buses arriving as often as every 2.5-10 minutes during peak commuting times; limited stops, spaced about ¾ mile apart at most major intersections and transfer points; a simplified route structure; level boarding/alighting to decrease dwell times; headway-based schedules; and enhanced stations that provide amenities including canopies, information, lighting, and "Next Bus" displays.

Most Metro Rapid vehicles are low-floor CNG buses distinguished by their red and silver livery, although some remaining older Rapid buses have a red and white livery. Rapid Buses are identified not only by their distinctive red color, but also by the unique teardrop "Rapid" icon found at each Rapid stop. Where sidewalk space is available, a simple, modular canopy system marks the exact stop location. For FY2008, Metro Rapid's annual boardings were 71.7 million, with weekday boardings averaging 242,000.

FIGURE 2.5 – Metro Rapid Canopy

2.2.3 Orange Line (Full-Service BRT)

The Metro Orange Line, one of the first Full Service BRT systems in the United States, began operating in October 2005. Its 14-mile dedicated busway runs east and west through the San Fernando Valley, between the North Hollywood Metro Rail Station and Warner Center. The Orange Line features high-capacity articulated buses, rail-inspired stations, level boarding, off-board fare payment, and headway-based schedules. In order to give the Orange Line a premium service image, Metro has branded the route as one of its rail lines. The route is included on the rail system map, the vehicles are painted in the same silver and gray color pattern as Metro rail vehicles, and it is the only bus line that has been given a color-coded name designation. The Orange Line also has an interactive website that explains how to use the service. The 60-foot, articulated "Metro Liners" are powered by compressed natural gas and feature aerodynamic styling, panoramic windows, low floors, wide aisles, three extra-wide doors, wheelchair ramps to allow level boarding, space for two bikes and two wheelchairs, and on-board video monitors.

FIGURE 2.6 –
Metro Orange Line Vehicle

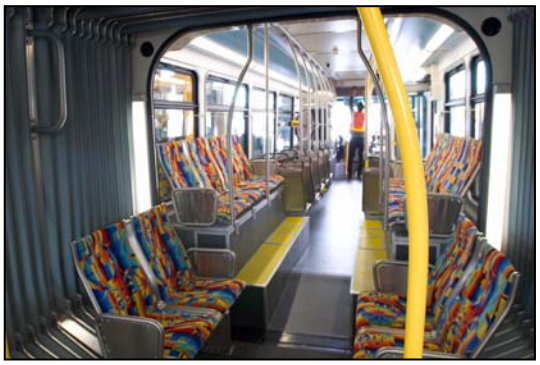


FIGURE 2.7 –
Orange Line Vehicle Interior

All Orange Line stations have the same basic design and construction, ensuring a consistent, recognizable brand identity. Stations offer various amenities such as bicycle racks and lockers, covered seating, ticket vending machines, telephones, lighting, spacious sidewalks, and security cameras. Seven stations have lighted park-and-ride lots, supplying a total of 4,717 free parking spaces. Artwork can be found at each station, including terrazzo paving, colorful porcelain steel panels, sculpted seating, and a variety of landscaping designs. Sound walls and irrigated landscaping along the busway help the Orange Line to blend into the surrounding environment. As an added benefit to the community, the design of the Orange Line includes 14 miles of bikeway and eight miles of pedestrian paths, complete with fencing and crosswalks to ensure safety. For FY2008, the Metro Orange Line's annual boardings were 7.5 million, with weekday boardings averaging 20,138.

FIGURE 2.8 –Terrazzo
Paving at Station

2.2.4 Blue Line (Light Rail)

The first of MTA's modern light rail lines, the Metro Blue Line, commenced operation in July 1990. Situated on 22 miles of track running north and south between downtown Los Angeles and downtown Long Beach, the Blue Line is the longest of the Metro Rail system's lines. The line serves 22 stations and traverses much of the densely populated, low-income area south of downtown L.A., through South Los Angeles, Watts, Willowbrook, Compton, and Long Beach. The Blue Line operates in the median of city streets in downtown Los Angeles and much of Long Beach proper, but for most of its journey uses the same track as the discontinued Pacific Electric Railway.

As of January 2009, MTA estimated that the Blue Line had 74,803 average passengers per day and 24.6 million passengers per year, making it the second busiest light rail line in North America. Although the line was originally designed for two-car trains, three-car lengths have become the norm due to unexpectedly high ridership. In June 2007, MTA reported more than 792 accidents and upwards of 87 motorist and pedestrian fatalities at Blue Line crossings since the line's opening in 1990. A 1998 study commissioned by MTA identified the Blue Line's high ridership as a possible contributor to its poor safety record.

FIGURE 2.9 – Metro Blue Line

Another major area of concern for the Blue Line is crime, particularly theft and physical assault. Security is provided at grade crossings, station platforms, and on trains by a special division of the Los Angeles County Sheriff's Department. Added security measures include a station-to-central control intercom system and closed-circuit surveillance cameras posted in stations and on platforms.

2.2.5 Gold Line (Light Rail)

The Metro Gold Line light rail line commenced service in July 2003. Spanning 13.7-miles from Union Station in downtown Los Angeles to the eastern border of Pasadena, the line runs along a disused railroad right-of-way adjacent to two heavily-congested freeways, the Pasadena Freeway and the Foothill Freeway. The Gold Line serves the communities of Chinatown, Lincoln Heights, Highland Park, South Pasadena, and Pasadena. Tourist attractions that can be accessed via the Gold Line include the Southwest Museum, Chinatown, and Old Town Pasadena. Connections to the Red Line subway, Metro Local, Metro

FIGURE 2.10 – Metro Gold Line

Rapid, Amtrak, and Metrolink commuter rail can be made at Union Station.

To complement the architecture, public spaces, and culture of local communities, each station incorporates unique landscape and urban design, paving, and wall treatments. A combination of free and paid reserved parking can be found at eight of the Gold Line's 13 stations, while all stations except Lake provide free bike parking. Unlike the other Metro Rail lines (and also the Orange Line and Metro Rapid), Gold Line stations are not equipped with electronic marquees displaying next train arrival information. The Gold line uses two-car trains, with the exception of one-car trains used on evenings and weekend mornings.

For FY2008, the Metro Gold Line's annual boardings were 6.6 million, with weekday boardings averaging 22,543. Lower-than-projected ridership on the Gold Line has resulted in mid-day and nightly service cuts, as well as the elimination of Express Service. This may change with the Phase II plans for a 24-mile eastern extension of the line into Claremont in San Bernardino County.

2.2.6 Red Line (Heavy Rail)

FIGURE 2.11 – Metro Red Line

The first modern heavy-rail subway in Los Angeles, the Metro Red Line, opened in several segments. The first segment, from Union Station to MacArthur Park, began operating in 1993. A western extension into Koreatown, which opened in 1996, was extended to the intersection of Hollywood and Vine in 1999 and then to North Hollywood in 2000. Today the line spans 17.4-miles, operating solely underground and forming the backbone of the city's public transit system. Downtown employees use the Red Line as a lunch hour shuttle and to connect to MetroLink at Union Station. Union Station also provides connections to AmTrak, Metro Local, Metro Rapid, and the Metro Gold Line; the Metro Blue Line can be accessed at 7th St/Metro Center; and transfers to the Metro Orange Line BRT can be made at the end of the line in North Hollywood.

Unlike MTA's other rail lines, the Red Line runs entirely within the Los Angeles city limits. Security is provided by the Los Angeles Police Department. In addition, stations contain surveillance cameras and station-to-central control intercoms. Paid parking is available at Union Station and Hollywood/Vine, while the North Hollywood and Universal City stations offer free parking. Free bicycle parking is available at most stations. The railcars feature air conditioning, emergency intercom, wheelchair spaces, emergency braking, and automatic train control capability. For FY2008, the Metro Red Line's annual boardings were 43.6 million, with weekday boardings averaging 140,943, making it the busiest rail line in Los Angeles. The Red Line providing high-speed service to the city's most densely populated areas, from Union Station in downtown Los Angeles, through the jewelry, retail, and financial districts, and MacArthur Park in the Westlake District. The line then branches in two directions, one towards the Mid-Wilshire/Koreatown area (recently designated the

Purple Line), and the other to Hollywood and the San Fernando Valley. Points of interest along the line include the famous intersection of Hollywood and Vine, the Hollywood Theatre District, the Hollywood and Highland shopping area, the Hollywood Walk of Fame, Universal Studios, Universal CityWalk, and the Noho Arts District.

TABLE 2.1 – Summary Statistics for Each LA Transit Mode[3]

	Local Bus	Metro Rapid[4] (BRT-Lite)	Blue Line (LRT)	Orange Line (BRT)	Gold Line (LRT)	Red Line (HRT)
Opening Year		2000	1990	2005	2003	1993
Av. Weekday Boardings	850,553	242,000	74,803	20,138	22,543	140,943
Annual Boardings (FY2008)	308.35M	71.72M	24.56M	7.46M	6.58M	43.59M
System Length (Mi)	2,831[5]	369	22	14	13.7	17.4
Capital Cost	$206.2M[6]	$123.3M	$877M	$330M	$859M	$4.5B
Capital Cost / Mile	$91,228	$354,798	$39.9M	$23.6M	$62.7M	$258.6M
Capital Cost (2005 dollars)	$206.2M[7]	$123.3M[7]	$1,300M	$330M	$912M	$5.6B
Capital Cost / Mile (2005 dollars)	$91,228[7]	$354,798[7]	$59.1M	$23.6M	$66.6M	$321.8M
# of Stops / Stations	15,424	543	22	14	13	16
# of rail cars / buses in fleet	2,261[8]	452	69	30	24	104
Peak Headway (minutes)	varied	2.5-10	5-7	4-5	10	4-6
Off-Peak Headway (minutes)	varied	10-20	12-20	10-20	12-20	6-19
Weekday Service Span (hrs)	varied	15	22.1	21.8	21.3	20.9
Service Area	City-wide network	City-wide network	South L.A., Watts, Compton, L. Beach	South San Fernando Valley	Highland Park, South Pasadena	Downtown L.A., Hollywood, N. Hollywood

[3] Statistics courtesy of LACMTA staff and website www.metro.net

[4] Metro Rapid data is for LACMTA operated Rapid lines (25) only.

[5] From FY08 National Transit Database (NTD) Motor Bus (MB) Directly Operated (DO) Directional Route miles from the S-10 Report. The Local Bus data is annual NTD number minus Metro Rapid Bus stated amount in the matrix.

[6] Total annual capital project cost from the LACMTA FY09 Budget Book for projects in the following categories: Bus Acquisition, Bus Facility Improvements, Bus Maintenance, and ITS (3 projects – TOAST, ATMS and TAP Clearinghouse).

[7] The local bus and Metro Rapid capital costs are an aggregation of costs accrued incrementally over time. Thus, they have not been adjusted to 2005 dollars.

[8] From FY08 National Transit Database (NTD) Motor Bus (MB) Directly Operated (DO) Revenue Vehicle A-10 report total buses owned minus Metro Rapid Bus stated amount in the matrix.

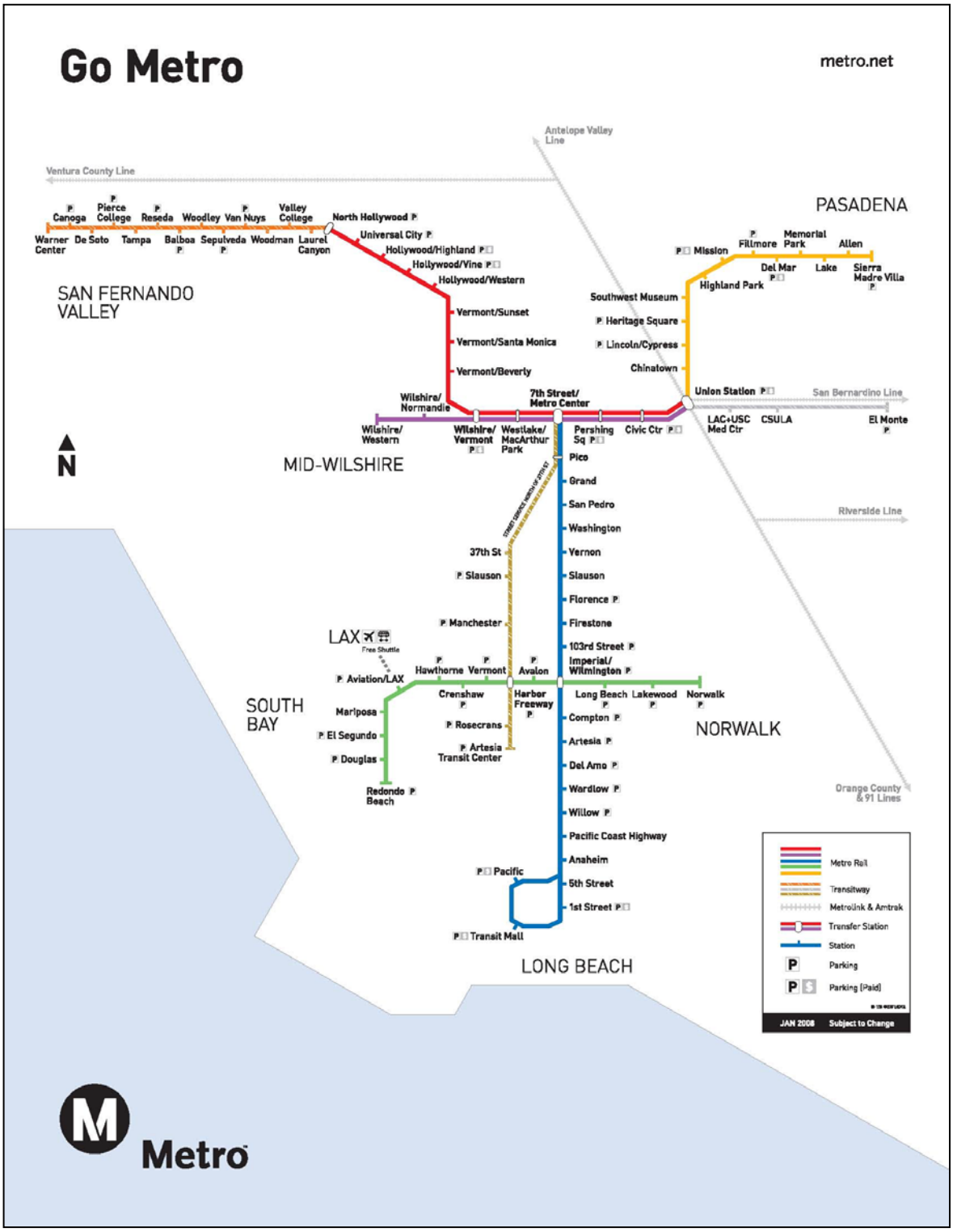


FIGURE 2.12 – Los Angeles Metro Rail System Map
[Source: Los Angeles County Metropolitan Transportation Authority, www.metro.net]

FIGURE 2.13 – The Metro Rapid Network Map

[Source: Los Angeles County Metropolitan Transportation Authority, www.metro.net]

3. Literature Review

3.1 What is 'Image'?

Image is concerned with attitudes and perceptions, and is ultimately formed in the mind of the consumer (7, 8). Image includes not only things which consumers can see, but all things encompassing the senses. A crucial part of image formation is the articulation of distinctiveness for a specific product or service (9). Thus, image provides the mental foundation for consumer discrimination. A strong image has the power to change consumer perceptions and forge an emotional connection, increase profits and secure market positions, and change the behavior of consumers by educating and informing them.

Transit Cooperative Research Program (TCRP) Report 63 (1) defines image as "the set of ideas and impressions, both rational and emotional, which major stakeholders form about [an] organization or industry." Hess and Bitterman (10) elaborate further, stating that the image of transit includes not only logos, branding, and colors, but also the chime of the bus arriving at the station and the comfort in the vehicle seats. It is important to note that TCRP Report 63 also mentions that image is inherited by the image of the industry and can be based on uninformed perceptions and ideas about the organization.

Image is also mentally associated with specific lifestyle values, particularly in the practice of branding (8), and targeting consumers by their values has proven to be an effective marketing strategy (11). A strong image draws upon the needs, values, and lifestyles of consumers to imbue added value to a product or service, setting it apart from all others (8, 12).

3.2 The Image of the Automobile

People think of their cars as anything from basic transportation to a statement of prestige to an extension of their personalities. Because of these various perceptions of the car, automotive branding relies heavily on image and personality. To set their vehicles apart from the rest, automakers spend over $40 billion a year to advertise the idea that cars provide prestige, comfort, seclusion, and freedom, portraying an image of "lifestyle choice" rather than just a way of getting from A to B. Image isn't the only reason people purchase personal vehicles, but it strongly influences consumer decisions and may in fact be responsible for major trends in sales. Considering that less than 15% of SUV owners ever take their vehicles off the road, it is clear that something other than practical needs is at work (7). Car advertisements convey far more than a series of functional specifications; indeed, information on price, performance, and optional features is often shown in small print, almost as an afterthought (13).

Cars have overwhelmingly been advertised by being shown, from billboards, to showrooms, to the actual highway, making design a primary factor in the marketing of automobiles (14). Automobile advertising schemes often blur the line between function and meaning, displaying some relationship between physical properties and their meanings (7, 15). For example,

a heavy-duty pickup truck may be seen as "tough" because of its powerful engine, sturdy body, and rugged off-road capabilities. Vehicle designers are well aware of this relationship, and design vehicles to project meanings that are consistent with the desired image of a particular car or truck model (12, 14).

More recently, the communications revolution has provided the opportunity to enhance the image of the car. The idea of managing risk through security technologies is now a common element in enhancing themes of safety and protection. The romance with speed has been tempered with an enthusiasm for "smart" cars integrated with advanced communications systems that offer precision guidance as well as information and entertainment capabilities. Features such as cruise control, voice activation, GPS navigation, and parking guidance systems produce what might be termed a "cybercar" (15: 229). As the task of driving a car has been largely computerized, the image of "modern" technological progress has come to mean "not just looking fast and airborne, but being linked to computers and all they connote" (14: 4; 15). The car's entry into the world of computers has also coincided with a change in design emphasis from outer to inner space. In this "movement of interiorization," with its growing attention to climate control, comfortable seating, driver ergonomics, voice controls, and digital music systems, the car becomes the ultimate "wraparound experience" (14: 7; 16).

Lifestyle choices (including consumption) are driven, not only by functional needs, but by the desire to shape one's identity (7). The concept of the lifestyle brand is supported by recent research showing that the ownership and use of a car can be a crucial element of an individual's lifestyle. A survey of owners of hybrid-electric vehicles (HEVs) in Oregon revealed that many view their cars as "socially responsible," as communicating a "green image," and as representing "environmental stewardship" (17). For these people, it is not only the vehicle that is important, but the lifestyle practices that it enables.

Studies have shown that people sense a "fit" between themselves and their vehicles, and that consumers' self-concepts (both actual and ideal) affect their attitude toward certain cars, influence purchase goals, and can be linked to ownership of particular vehicles. For instance, a consumer may buy a minivan because he wants to fulfill the role of "family man" and sees this type of vehicle as supporting that role. These studies also suggest that people stereotype themselves as similar to people who have the same vehicle, and make assumptions about the intelligence, life satisfaction, and behavioral tendencies of themselves and others based on the vehicle they own (7).

As previously mentioned, image is partially borne out of mental associations with specific lifestyle values. To explain the emotional draw of the car, particularly in the United States, psychologists and market researchers have emphasized that the image of the automobile draws upon the cultural values of individuality, freedom, and self-mastery (13, 18). Many car drivers appreciate the sense of autonomy, as well as the mobility, conveyed by the automobile (19). Tantamount to the ideal of personal freedom is the widespread association of the automobile with convenience. In contrast to the clock-based scheduling of public transportation, Urry points out that automobility enables "a more individualistic timetabling of one's life," allowing one "to leave late by car, to miss connections, to travel in a relatively time-less fashion" (16).

Furthermore, unlike public transportation, the car provides an outer clothing or mini-environment for downtime from social interactions in public contexts. This fact, coupled with numerous "technologies of insulation" designed to shield the driver from much of the environment they pass through, supports the argument that cars also symbolize the "North American flight into privacy" (15; 18: 8). Numerous other social values, such as youth, speed, control, safety, practicality, career success, environmental awareness, and family, are deeply embedded within the image of the car (16, 17, 20).

Clearly, car purchases are seldom based on rational economic choices alone, but are also rooted in more complex aesthetic, emotional, and sensory responses (15). The emotional attachment between cars and their drivers is so strong that some people find themselves speaking directly to their car, calling it by name, and feeling proud of or resentful toward it (16, 18, 20). These days, car ownership equates with being a "full social adult" for most people, and the acquisition of a driver's license is "now something as a rite of passage" (13: 3; 16; 20). The automobile has indeed become "an indispensable and loved member of American families" (1).

3.3 The Image of Public Transportation

Negative Attitudes

Public transportation in general and bus service in particular suffers from a severe image problem. Many people perceive public transportation as unreliable, time consuming, inaccessible, inconvenient, crowded, dirty, and unsafe (1). Transit is often viewed as an inferior way to travel, completely at odds with the mobility, convenience, and personal freedom afforded by the automobile. In fact, the numerous factors favoring car use are so pervasive that most people do not even see transit as an option worthy of consideration (21). Although the vibrant transit networks that once existed in the United States were extensive, fast, and convenient, public transportation today is often perceived as an inefficient welfare organization requiring subsidy to help disadvantaged segments of society (22). Due to this lack of prestige, many people are unable to envision themselves sitting on a bus, believing instead that public transportation is "for other people…not me" (1: 36).

Although not always accurate, perceptions regarding transit are not formed in a vacuum, and are often based on personal experiences. For instance, there may be certain "gaps" that need to be traversed during a journey by public transportation, such as walking from home to the bus stop, waiting at the stop, or transferring from one route to another (16: 10). Each of these gaps presents a possible source of inconvenience, uncertainty, or even danger, particularly for women, the elderly, and the disabled, and particularly when service is unreliable. Also, while the driver of a private car chooses who, if anyone, to share space with, many people experience a trip by transit as an invasion of privacy, a jarring experience accompanied by unwelcome noise and social interactions. This viewpoint is perhaps best illustrated by a reply to a 2002 mail-out survey of bus patrons in Edinburgh. (footnote: It should be noted that use of the private automobile is generally much less prevalent in the United

Kingdom, where lifestyle and urban form are different than in the United States. Thus, the results of this survey should not be assumed to reflect travel attitudes in the U.S.) When asked, "What do you like and dislike about traveling by bus?" one participant pointedly responded, "General dislike of public transport as have to travel with general public" (23). Other unwanted intrusions identified by the survey as barriers to a peaceful journey include bus crowding, loud noise, aggressive driving, the use of mobile phones, and loud noise from engines idling at layovers. Obviously, people feel more in control when they drive than when using public transportation.

Reasons for disliking noise or unwanted company on public transportation go beyond mere aggravation, however. Many passengers feel unsafe, particularly after dark, while traveling with loud, aggressive, or intoxicated people, or those of questionable mental health. Such unwanted co-travelers were described by their fellow transit riders as intimidating, abusive, and a source of fear (23). Such people were usually typified either by their condition ("drunk") or by their number and age ("groups of youths"). It has been suggested that buses may give an impression of lowered security because bus service is used primarily by low-income groups (3:108). One survey respondent stated, "Inspectors back on buses would make a lot of people feel more comfortable traveling and not just at night. Some younger passengers can be intimidating" (23). Another source of unease identified by the survey participants was the uncertainty of waiting for the bus, especially at night. This was shown to be more of a concern for females than males, and for low-income rather than high-income respondents.

Positive Attitudes

Obviously, attitudes will differ with individual circumstances such as peer-group attitudes, financial resources, previous experiences, and a multitude of other factors. Despite the prevalence of negative sentiment toward public transit, the news is not all bad. Many individuals have very positive perceptions. Among other things, people say they like public transportation because it is inexpensive, convenient, good for the environment, and reduces congestion (1). And while exposure to certain kinds of people is unwelcome by some passengers, others view a journey by public transportation as a chance to have positive social interactions with fellow passengers. For instance, survey respondents have stated, "like to relax and people watch," and "…you can meet different types of people" (23). Analysis of the survey suggests that females may have more of a tendency to view bus travel as an opportunity for social inclusion.

It is also interesting to note that quite a number of people appear to experience a state of mind in complete contrast to the irritations and unwelcome interruptions cited in the above section on negative attitudes. For some, the ideal bus journey is "being transported while switched off." It is "smooth, tranquil, undisturbed, relaxed, absorbed, engaged with the moment yet 'elsewhere,' and pleasurable without being ecstatic. This type of experience, which seems to be attractive to people of all ages and genders, is described by the responses, "Love the fact that I don't have to concentrate on the road," "I can switch off – and read a book, magazine, newspaper," and "I like sitting back watching the world go by."

It is encouraging that there are some positive perceptions regarding transit that can be built upon. Nonetheless, in order to strengthen the image of transit in the mind of the American public, there are many negative perceptions that must be overcome. As mentioned earlier, public transportation is often viewed as a social service for the elderly, disabled, and poor. Furthermore, perceptions of public transportation will always be shaped by its number one competitor: the automobile. According to a 1999 survey by Gallup/CNN/USA Today, 80% of Americans see their cars as necessities instead of luxuries, and 85% would want a vehicle, even if they did not need one to get by (1). Many are reluctant to abandon the car because public transportation (particularly the bus) is associated with high rates of crime (24).

TCRP 63 recommends that for any means of public transportation to be competitive, it must not focus on the negatives of the automobile. Instead, the focus should be on providing unparalleled service and creating an image of modern public transportation that is safe, efficient, clean, convenient, and easy to use. Because people tend to avoid what they do not know, potential passengers must be given as much information as possible about the transit services offered. Modern, efficient BRT systems may be one way to generate positive perceptions and increase familiarity with transit, ultimately leading to increased ridership.

3.4 The Image of BRT

"BRT is a flexible, rubber-tired rapid transit mode that combines stations, vehicles, services, running ways, and intelligent transportation systems (ITS) elements into an integrated system with a *strong positive identity that evokes a unique image.* BRT applications … can be incrementally implemented in a variety of environments." (TCRP 90, Volume 1)

Although rail has an advantage over conventional bus service in terms of ridership potential, there is limited information on how BRT compares to rail in this regard. However, recent research suggests that if functional service characteristics and infrastructure are comparable, BRT should attract riders at a level similar to light rail (3, 4). Studies have also found that, as with rail, a significant portion of BRT ridership gains cannot be explained by functional service attributes alone (5). These findings suggest that intangible factors play a role in the relative passenger attractiveness of rail and BRT. It is reasonable to infer that if BRT is to attract riders at a level similar to rail, it must be comparable to rail in terms of both functional and intangible attributes. To what extent this is the case is unclear.

There are two primary reasons why the system should strive to achieve a distinct image. One is to attract choice riders. According to TCRP Report 90 Vol. 2, a choice rider will be attracted to a "transit choice that they perceive as more closely resembling the "quality experience of driving than the background local bus system" (2:6-20). A positive image is important for attracting and retaining these passengers. A second reason is for advertising and publicity. The image of a system is portrayed on vehicles, stations, maps etc. Every passenger and non-rider that is exposed to this image will recall it and be able to identify the system. The image and identity of a vehicle can also be used for advertising and conveying information about routing and schedules. Ridership cannot be affected if passengers are not

informed. According to *TCRP Report 95*, only 55 percent of the United States public is familiar with transit (25). Familiarity is the best way for potential riders to gain comfort and become regular travelers. Since BRT systems are fairly new in the United States, strong marketing and promotion is needed to inform the public. If the public is constantly exposed to the design and logo of the system, it will become comfortable and familiar. The image of BRT and its attributes should be clearly expressed through the marketing of the system. It should include the use of logos, color, and branding throughout every aspect such as vehicles, stations, and maps. Marketing should also emphasize the unique service and properties of BRT such as speed, clean vehicles, reliability, segregation from traffic, and community identity (2:8-12).

For BRT, image is the consumer's overall perception of the style, aesthetics and compatibility of the system (9). The image of a BRT system determines how it is viewed among the set of other public transportation options. To increase its appeal to choice riders, an important objective for BRT is to establish an image and identity separate from local bus operations. The image of clean, modern, and efficient transportation can help achieve market differentiation and promote BRT as a premium, new "mode," which may increase ridership, particularly by choice riders. By dispelling the perception that public transportation is an inferior way to travel, the positive image of BRT may eventually translate into a more positive image of transit in general.

In regard to identity and image, there are some noteworthy differences between products and services. BRT, like all forms of public transit, provides a service. Services, by their very nature, are largely intangible and experiential. They cannot be seen, felt, tasted, or touched before purchase, and are therefore perceived as higher in risk than products (26, 27). Thus, an attractive image is actually more crucial for services than for products. To set a service apart from competitors, its image should be distinct, relevant, and have a tangible quality (28). Identity and image can impart tangibility and help customers get a "mental fix" on an otherwise undifferentiated service, transforming it into a virtual product. An image that successfully draws upon the needs and values of consumers can provide confidence, security, and a higher guarantee of consistent quality (27).

Because services are inherently abstract, the creation of a service's image is a formidable task. Firms may create tangible cues by designing physical facilities or personnel appearances to achieve specific imaging or marketing goals. The use of "authority symbols," such as uniforms and high-tech equipment is often employed to convey the provider's professional legitimacy and reduce the perception of risk (26: 130). Also, since many services "force the buyer into intimate contact with the production process," consumers are likely to equate the quality of service with perceptions of the service provider (26; 28; 29:34). Because customer perceptions depend so heavily on process-oriented interactions with the provider, service firms usually place a heavy emphasis on creating a pleasant service environment and carefully choosing and training their customer contact personnel to interact well with customers.

As mentioned earlier, it is recommended that the image of a service be distinctive, relevant, and have a tangible quality in order to distinguish that service from its competitors. An in-

tegrated BRT system with a quality image and unique identity can help potential customers get that "mental fix" on its product. To lend a tangible quality to BRT service, the most noticeable physical elements should be leveraged as much as possible. Distinctive logos, color combinations, and graphics should be consistently applied to vehicles, stations, running ways, and printed materials. Sleek, rail-inspired vehicles with spacious interior designs project a modern, upscale image, distinguishing BRT from older "shoebox" styled buses (30; 31). Attractive running ways and modern, comfortable vehicles and stations convey the idea that BRT service provides the style, amenities and capacity of rail. Image can also be enhanced with design features that are distinct and highly visible. Design that complements the brand identity of a BRT system can strengthen the image of the service and reinforce the core marketing message aimed at passengers. Most BRT systems have stations with design cues to distinguish BRT routes from regular local bus service. Unique, eye-catching architecture and design elements can also be used to indicate where to gain access to the system. Elements of BRT that may contribute to a positive image are discussed in more detail below.

Vehicle Styling

As mentioned above, because BRT is ultimately a service, physical components such as vehicles and stations must be leveraged as much as possible to contribute an element of tangibility to the image of BRT. In this regard, vehicles may be the single most important element of user and non-user perceptions of a BRT system's quality (31). Discussions with transit officials indicate that vehicle designs contribute significantly to increased use of BRT services, particularly by choice riders. The overwhelming popularity of rail-like BRT vehicles suggests that greater ridership will be attracted to BRT in the future as increasing numbers of manufacturers shift toward building more of these stylized vehicles. Because increased ridership is one of the overall goals of BRT service, this implies that a strong vehicle design is a necessary BRT vehicle component.

The styling and aesthetics of BRT vehicles play a primary role in dispelling the perception that buses are an inferior way to travel. The right vehicle design can help create a distinctive BRT "brand," presenting BRT as a new concept or "mode." Sleek, rail-like vehicles and interior designs help distinguish BRT from older "shoebox" styled buses, projecting a modern, upscale identity (30, 31). As shown in Figure 3.1, examples of advanced vehicle features include larger sizes for greater carrying capacity, aerodynamic designs, panoramic windows, multiple sets of doors with level boarding platforms, covered rear wheel wells, comfortable seats, and roomy, open standing areas, all of which add to the vehicle's rail-like feel.

The design of BRT vehicles is also strongly influenced by rail. New designs are encouraged to be "rail-like" in appearance. In the report *Bus Rapid Transit Ridership Analyses,* focus groups expressed the desire for sleek vehicle designs that resembled "a train on tires" (30). New systems with these types of designs were successful in places such as Las Vegas and Seattle, to the degree that other agencies were basing designs on similar vehicles. In some locations, these vehicles became tourist attractions and increase ridership just based on people wanting to experience this new and interesting transportation.

As mentioned in the section on automobile marketing, cars are overwhelmingly advertised by being shown, not only on billboards and television, but also on the highway. Likewise, attractive BRT vehicles out on the road can promote the image of a service that provides the style, amenities, and capacity of rail. Aerodynamically styled buses have been consistently chosen by the vast majority of focus group participants, who favor its attractive, "cool," "streamlined" appearance. Some transit agencies, such as the Greater Cleveland Regional Transit Authority (GCRTA), have decided to use stylized BRT vehicles after seeing the reactions they garner simply by driving around town. Speaking on riding the vehicle around a public square in Cleveland, GCRTA's Deputy General Manager of Engineering and Projects recalls, "People stopped in their tracks to check this vehicle out…The looks on the publics' faces were telling…They were in amazement and awe. Seeing these reactions was very influential." In Phoenix, people have been seen photographing the Valley Metro's BRT CompoBus, and tourists often ask how they can ride routes that operate the buses. In fact, riders that are greeted by a conventional bus are often disappointed, sometimes going so far as to write letters to the City to voice their displeasure. According to officials at Las Vegas RTC, most local residents claim to have found out about the MAX BRT service simply by seeing the Civis, a unique rail-like vehicle with a sleek European design. One rider referring to the Civis enthusiastically noted, "I don't ride the bus, I ride that!" Indeed, the Civis has become a tourist attraction in its own right, much like the city's casinos (30:25-26).

FIGURE 3.1: Different BRT Vehicles:
Orange Line Metroliner (top left); EmX Vehicle Interior in Eugene (top right)
EmX Vehicle (bottom left); Las Vegas MAX (bottom right)

Stations

The authors of *BRT vs. LRT* state, "Most users find traditional bus stops to be cold and impersonal, with minimal shelter from the elements" (page 18). To avoid this, BRT station design should include covered areas, benches, information displays, aesthetics, and enhanced lighting. In addition, passengers will be even more impressed with cleanliness and the use of décor and artwork which gives the station a contemporary and unique look. The stations of BRT have to compete with LRT and other rail stations which already incorporate many of these aspects. BRT must try to imitate and surpass the appearance and atmosphere of the LRT stations in order to distance itself from the conventional bus system.

FIGURE 3.2: Enhanced Stations and Amenities:
Kansas City MAX (left); Boston Silver Line (center); Las Vegas MAX (right)

Enhancing Service Quality with Advanced Technology

FIGURE 3.3 – Advanced Fare Collection

With their sleek, aerodynamic shapes and quiet, well-lit, and spacious interiors, many of the most popular BRT vehicles do exude a rail-like aura. However, although perception is primarily visual and aesthetic, it also relates to aspects of service quality such as reliability and comfort (31). Therefore, the image of BRT goes beyond "cool-looking" vehicles. Exclusive right-of-way and signal priority, defining characteristics of BRT service, improve speeds and ensure that service is more reliable. One study found that when bus lanes were provided, they were perceived as offering travel time savings over the car (32). Advanced fare collection systems, multiple doors, mechanical and electronic guidance systems, and precision docking reduce dwell times and enable levels of convenience in passenger boarding and alighting that approach rail (31). These and

FIGURE 3.4 – Real-time Passenger Information and Precision Docking

other advanced technologies, such as real-time passenger information, may also act as the "authority symbols" mentioned above, communicating the professional legitimacy of the service provider and increasing the perception of overall safety. Furthermore, because many BRT vehicles are designed to run smoothly and reduce noise levels and air emissions, BRT may help dispel the stereotype of the noisy bus, lumbering along while spewing dark clouds of polluting fumes.

Brand Identity

In addition to modern vehicles, uniquely branded livery (e.g., paint schemes, colors, and icons) can help achieve a distinct image, conveying important customer information such as routing and stations served, as well as alerting infrequent customers where they can board. The vehicle livery and icon should be different from regular buses, but should complement stops, stations, terminals, signs, maps, and other sources of information, further solidifying the identity of the system as a whole. A unified brand identity can also convey important customer information such as routing and stations served and help infrequent customers understand how to use the system (31).

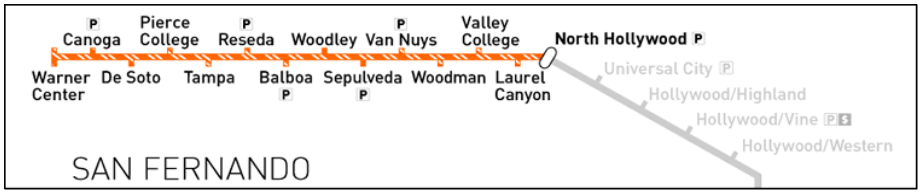


FIGURE 3.5 – Various Elements of Metro Orange Line's Unified Brand Identity

Contextual Design

When implemented as part of a holistic "package" of integrated strategies, BRT is capable of playing a role in the achievement of much wider objectives, such as sustainable mobility and urban renewal. On the whole, BRT projects that are designed with the local context in mind can play an important role in attaining safe, healthy, and sustainable communities. A well-designed BRT project complements the scale and character of the surrounding area, and can shape a community in ways that go beyond transportation benefits alone. Quality of life is enhanced when systems are designed to harmonize with their context and create a sense of place for the communities they serve. Designing BRT as an integrated part of the community can channel a wide spectrum of benefits relating to the environment, the economy, aesthetics, public health, and civic participation.

For instance, a well-designed BRT project can serve as a focal point that draws the community together. Unfortunately, public space is often neglected in the design of transportation projects, where the focus is on moving people around (33). Good public spaces provide a hospitable setting for people to stop and read, eat lunch, or meet with friends. To that end, introducing a BRT system into a community should be viewed as an exercise in urban design. BRT facilities can create a more welcoming, vibrant streetscape by incorporating amenities such as landscaping, sidewalks, lighting, street furniture, and recreational trails.

There are numerous detailed case studies where transit facilities with significant levels of amenities, irrespective of mode, have had a strong positive impact on surrounding communities. In addition, BRT improvements that correspond to adjacent land uses and provide capacity for future growth can catalyze new development and revitalization of existing neighborhoods and downtowns. Case studies documenting integral and contextual design approaches are presented in *TCRP Report 22,* "The Role of Transit in Creating Livable Metropolitan Communities" (34). In places including Boston, Houston, Seattle, Miami, and Pittsburgh, BRT and other quality bus facilities have demonstrated the ability to generate positive development and redevelopment when other factors such as the development market and local land use policies are supportive.

Accessibility and connectivity to the broader urban fabric should be emphasized as crucial elements of contextual design (35). Because transit facilities serve as a transition between different modes, they must be carefully tailored to balance the needs of pedestrians, bicyclists, transit riders, and motorists. Moreover, in addition to providing access for all, facilities must be designed to protect the most vulnerable users (33). BRT can make a significant contribution to community integration only when the system is accessible and usable to all segments of the population, regardless of physical or cognitive ability. The Americans with Disabilities Act (ADA) requires adequate circulation space within a bus shelter, provision of sidewalks, bus stops that are connected to streets and sidewalks by an accessible path, and readable bus route and schedule information.

FIGURE 3.6 – Various Accessibility Provisions in Eugene: On-board Bicycle Storage (left); Audible Crossing Signal (center); Near-level Boarding (right)

BRT is viewed as a contribution and benefit to the surrounding community; therefore, its appearance should enhance the nearby areas. Implementation of the system can be seen as

an "opportunity to improve and enrich streetscapes by incorporating new amenities such as landscaping and recreational trails" (2: S-9). During construction, many of the existing aspects such as sidewalks and lighting will be removed to make room for the segregated running ways. This provides the perfect opportunity to replace the existing environment with aspects that represent the new BRT theme. BRT should display an image that represents quality service and investment in the community. The system should identify with its surrounding and provide passengers with a sense of pride. To accomplish this, the following aspects (2) of design should be considered:

1. High Quality Design and Passenger Amenities – will increase the public perception of the system and terminate the previous negative image of the bus
2. BRT as an Urban Design Asset – Opportunity to improve the surrounding area
3. Elements of Continuity and Variability - Demonstrate an integrated system, with consistent themes and a distinct "brand".
4. Context-Sensitive Design – Create a flexible yet consistent image which will adjust to the unique characteristics of the various neighborhoods serviced by the BRT system
5. Relationship of Transit and Land Use – Integrate new system to the current and future land use
6. Community Participation – Design should be created with community involvement in order to generate support and sense of pride for system by users and nearby residents

3.5 Rail Mode Bias

The conventional wisdom within the transit industry holds that rail service is inherently more attractive than bus service, and is therefore a necessity for attracting choice riders (3). Studies have shown that, in order to draw choice riders, transit must not only offer high quality service, but also be complimented by an attractive image. Rail advocates often claim that positive perceptions of transit are a byproduct of rail, a benefit that a bus simply cannot provide. It is argued that, even if all functional service attributes are equal (such as speed, frequency, span) rail will attract more riders than bus. This implies that rail is superior to bus transit, not only in terms of functional attributes, but also when it comes to intangible attributes that are more subjective. For instance, rail travel is perceived by many as quieter, safer, cleaner, and more comfortable than on-street bus (3, 6). Design elements also provide intangible benefits that might add to the popularity of rail service; riders like routes that are clear and understandable and prefer vehicles and stations that are clean, comfortable, and attractive (24).

Transit officials and consultants have also commented that the public perceives rail-based transit as the hallmark of a "world-class" city, and that implementing light rail service can improve the city's reputation and boost local economies (6: 31). This perception is evident in the view held by many city officials that light rail is a must for hosting Olympic events (24). Furthermore, by providing easy access to a range of popular destinations, such as symphonies, museums, and public libraries, rail service may draw interest to the city as a destination in its own right. Accordingly, positive attitudes toward rail transit may be informed by a "pro-urban value system" that links rail to a more livable image for the city itself (24: 148).

Thus, it is possible that choice riders equate rail service with an urbane lifestyle and the role of the contemporary professional, while likening bus travel as a low-quality option of last resort for the elderly, disabled, or disadvantaged. These impressions suggest that the disparity in image between bus and rail transit is a result of intangible as well as functional factors.

The supposition that rail is inherently more attractive than conventional bus service has been used as justification for employing "bias constants" in mode choice modeling. Bias constants are a measure of the degree to which, all else being equal, one mode is more or less attractive than another. It is assumed that a bias constant captures all of the intangible attributes not otherwise explained by the more easily quantifiable variables, such as travel cost and time. These intangible attributes include qualitative factors such as comfort, safety, security, ride quality, and service branding.

Despite the widespread use of a modal bias favoring rail over bus, recent research suggests a need to examine this issue further. According to Ben-Akiva and Morikawa (3), mode bias constants are the only quantitative treatment that has been applied to the problem of ridership attraction of rail versus bus, which has otherwise been discussed mostly in qualitative terms relating to intangible attributes. Intangible attributes present a challenge for empirical research because they involve subjective attitudes and perceptions and are thus difficult to measure and quantify, and even more difficult to cast in terms of monetary value. As mentioned previously, when a model includes only easily-quantifiable attributes (which is usually the case), less tangible attributes are assumed to be captured by the mode bias constant. The authors point out several problems in using mode bias constants to analyze mode choice. First, there is a basic data shortage, as travel behavior data from corridors where bus and rail coexist is very limited. In addition, the problem of co-linearity may create questionable causal linkages if several related variables are captured by the mode bias constant. Mode bias constants may also capture situational constraints that influence travel behavior.

The authors (3) performed an empirical study showing no significant preference for rail over bus travel when quantifiable service characteristics are equal. To sidestep the problems associated with mode bias constants, revealed preference (RP) and stated preference (SP) data were used to estimate models of choice among alternative travel modes. To obtain a preference order for four different transit modes under specific conditions, the analysis gave separate treatment to each of the four modes: Metro[9], commuter rail, express bus, and local bus. Analysis of the data revealed an overall preference for Metro over other modes under the conditions: (1) neither origin nor destination are in the central business district (CBD); (2) a Metro trip does not include the low frequency line; and (3) an express bus trip does not use a high occupancy vehicle (HOV) lane. Underscoring the importance of schedule frequency for increased transit ridership, express and local bus services were equally preferred to Metro under some corridor types, particularly for zero-car households in the low frequency Metro corridor. The preference toward Metro disappeared with the availability of express bus ser-

[9] Metro refers to the rail rapid transit system that serves the Washington, D.C. Metropolitan Area (officially Metrorail, but commonly referred to simply as Metro).

vice operating in an exclusive lane, especially for trips to or from the CBD, where the relative utility of the car decreases due to traffic congestion and parking shortages.

The authors believe their study indicates, not a strong preference for rail, but a strong dislike of transfers. They go on to state that, "Because existing HOV lanes do not exhibit all the features of a Metro-like service, it is reasonable to expect that a bus service with more Metro-like features will be even more attractive. Therefore, one can conclude that a high-quality express bus service with exclusive right-of-way may be equally attractive to Metro service" (3: 113). This implies that if functional service characteristics and infrastructure are comparable, BRT should attract riders at a level similar to light rail. However, the study concludes with the caveat that, "if the qualitative attributes of the rail and bus services under consideration vary, it is necessary to use more advanced demand estimation techniques that attempt to quantify the effects of these intangible attributes" (3: 116). The authors cite the following variables, though not usually specified in a model, as significant to the relative passenger attractiveness of rail versus bus:

1. *Reliability*. Because of its exclusive right-of-way, rail service is able to avoid interferences from other modes, such as congestion and unexpected delays from incidents. However, buses that run on exclusive rights-of-way may provide an even greater level of flexibility than rail service because bus systems have the flexibility to use alternate routes if necessary. Rail lines, on the other hand, can be entirely blocked by an obstacle on the track or the failure of a single train.

2. *Information availability*. Higher-frequency service and an easily identifiable right-of-way have conventionally given rail passengers greater ease than bus passengers in obtaining information regarding schedules, station locations, destinations served, etc. However, recent information technologies are closing this gap by enabling bus systems to operate reliably on headway-based schedules and to provide enhanced information in real time.

3. *Comfort*. Rail travel often has the advantage in terms of comfort because of roomier seats and a smoother ride, as well as the greater level of comfort usually found at rail stations when compared with bus stops.

4. *Safety from accidents*. Due to mechanized guidance, train control systems, and a lack of interference from competing traffic, rail service may have a perceived advantage in terms of safety.

5. *Security from crime*. Interestingly, buses are perceived as safer in terms of on-board crime because each vehicle has its own driver, while rail stations, because they are more heavily populated and can employ greater security measures, are perceived as more secure than bus stops. In addition, because buses are often used by low-income groups, there may be an impression of less security for buses.

6. *Availability*. While bus stops are generally within walking distance of a greater number of people, conventional bus service cannot compete with the frequency of rail. Thus, each mode holds its own advantage with respect to a particular type of availability.

These findings are further substantiated by the work of Currie (4), who concludes that BRT and rail should generate equal ridership when the total trip attributes of both alternatives (travel time, cost, ride quality, transfers, and quality facilities) are equal. To evaluate the relative patronage performance of BRT, Currie analyzes passenger behavior research to determine how passengers value perceived BRT attributes compared to those of other transit modes. He separates these attributes into variable factors (vehicle design, ride quality, comfort) and constant factors (station/stop quality, awareness and comprehension of the transit system). The results of the analysis indicate that passengers value trip attributes for BRT and rail modes in a broadly similar manner.

Studies have also found that, as with rail, a significant portion of BRT ridership gains cannot be explained by functional service attributes alone. Henke's article draws on the findings of several different studies to conclude that up to one third of median ridership gain observed across six new BRT systems could not be explained by quantifiable service improvements, and that most of this unexplained aspect was due to brand identity (5). This supports the idea that intangible factors do indeed play a role in the relative passenger attractiveness of rail and BRT.

In light of the findings from all of these studies, it is reasonable to hypothesize that for BRT to attract riders at a level similar to rail, it must be comparable to rail in terms of both functional (tangible) and intangible attributes. If BRT can in fact provide both the functional service and intangible image characteristics that attract choice riders to rail transit, it has enormous potential for restoring a positive image to public transit, increasing ridership, and ultimately reducing congestion- all at a more affordable cost than rail.

3.6 Quantifying Tangible and Intangible Factors

While the studies described in Section 3.5 offered a variety of suggestions for the possible different kinds of intangible factors, none took the step of trying to isolate and quantify the impact of each one on overall transit attractiveness. One study, however, did take that step. Krizek and Al-Geneidy (36) performed a research study comparing the preferences of transit users and non-users in the Twin Cities metropolitan area. They developed the following figure to illustrate their approach to segmentation of the transit market.

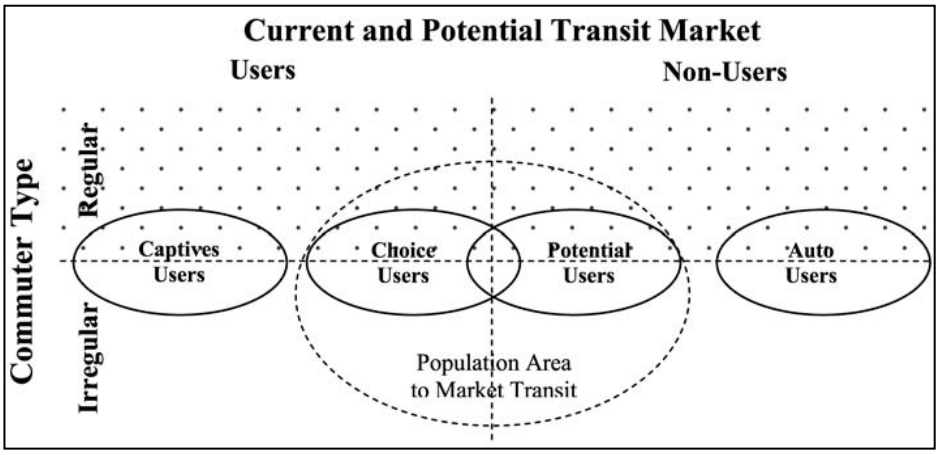


FIGURE 3.7 – Transit Market Segmentation
[Source: Krizek & Al-Geneidy (36)]

As illustrated above, four market segments were defined. People using transit were divided into "choice users" (people with access to a private vehicle) and "captive users" (people without other means of transportation). People not using transit were divided into "potential users" (people that could use transit but choose not to), and "auto users" (people without a transit option for their trips, also known as "auto captive"). The authors' contention was that while choice riders and potential riders are the market segments to which transit should be marketed, non-transit users (including "potential users") tended to be overlooked by the industry. They hypothesized that understanding the characteristics and needs of "potential users" would be the logical first step to designing services capable of attracting this group to transit, and thus increasing ridership.

From the perspective of our interest in identifying and quantifying tangible and intangible factors, this study was important because it did just that. Factor analysis was used to divide around 35 individual factors into factor groupings. For transit users these groups were driver's attitude, customer service, type of service, reliability, income and value of time, cleanliness and comfort, safety, and personal characteristics. For non-users the groupings were driver's attitude, safety and comfort, amenities and special requests, one way commute characteristics, reliability, location and type of service, service attractiveness, travel cost, presence of children, travel time, and personal characteristics. Cluster analysis was then used to determine the relative influence of each factor group on transit attractiveness.

The study concluded that there were "notable similarities" in the habits and preferences of the two groups of most interest to the study authors; choice users and potential users. They both prized reliability, travel time, type of service, and comfort. Irregular commuters (which could be either choice or potential riders) were concerned with driver's attitude and travel time, while regular commuters were more concerned with safety, comfort, reliability, type of service, and amenities.

While the study did not consider specific transit modes, it showed that tangible and intangible factors could be isolated and evaluated quantitatively, and offered a possible methodology for doing so.

3.7 Problem Statement

The creation of an image and identity separate from local on-street bus operations is an important objective of BRT. Research has shown that if transit is to attract choice riders it must not only offer competitive travel times and high-quality service, but also be complimented by an attractive image. Unfortunately, conventional bus service suffers from a severe image problem. Many people perceive the bus as an inferior way to travel, completely at odds with the mobility, convenience, and personal freedom afforded by the automobile. Some of the most common negative views regarding bus service are that it is unreliable, time consuming, inaccessible, inconvenient, crowded, dirty, and unsafe (1).

According to conventional wisdom within the transit industry, rail service is inherently more attractive than bus service, and is therefore a necessity for attracting choice riders (3). It is argued that, even if all functional service attributes are equal (speed, frequency, span, etc) rail will attract more riders than bus. There is a general impression that rail is superior, not only in terms of functional attributes, but also when it comes to more qualitative, intangible attributes. Rail travel is often perceived as quieter, safer, cleaner, and more comfortable than on-street bus (3,6). Design elements also provide intangible benefits that might add to the popularity of rail service (24); for instance, riders like routes that are clear and understandable and prefer vehicles and stations that are clean, comfortable, and attractive. Thus, it is a combination of both tangible and intangible factors that contribute to the perception of rail as the "premium" transit mode of choice.

The advantage of rail service over on-street bus service in terms of ridership attraction has been used as justification for employing "bias constants" in mode choice modeling. Bias constants are a measure of the degree to which, all functional attributes being equal, one mode is more or less attractive than another. It is assumed that a bias constant captures all of the intangible attributes not otherwise explained by the more easily quantifiable variables, such as travel cost and time. Intangible attributes present a challenge for empirical research. Because they involve subjective attitudes and perceptions, they are difficult to measure and quantify, and even more difficult to cast in terms of monetary value. Intangible attributes that may contribute to the "rail bias" include qualitative factors such as comfort, safety, security, ride quality, and service branding.

Although rail has a clear advantage over conventional bus service in terms of ridership potential, there is limited information on how BRT compares to rail in this regard. However, more recent research by Ben-Akiva and Morikawa (3) finds that when quantifiable service characteristics are equal, riders may find high-quality bus alternatives equally attractive to rail transit for CBD-oriented commutes. Currie (4) considers tangible and intangible factors in his argument that BRT and rail should generate equal ridership when the total trip attributes of both alternatives (travel time, cost, ride quality, transfers, and quality facilities) are equal. Henke (5) draws on the findings of several different studies to conclude that up to one third of median ridership gain observed across six new BRT systems could not be explained by quantifiable service improvements, and that most of this unexplained aspect was due to brand identity. These findings suggest that it is service attributes (both tangible and intangible), rather than mode category per se, that explain the relative passenger attractive-

ness of rail and BRT. In light of these findings, it is reasonable to hypothesize that for BRT to attract riders at a level similar to rail, it must be comparable to rail in terms of both tangible and intangible attributes. If BRT can in fact provide both the functional service and intangible image characteristics that attract choice riders to rail transit, it has enormous potential for restoring a positive image to public transit, increasing ridership, and ultimately reducing congestion, all at a more affordable cost than rail.

However, there remain many unanswered questions regarding the relative attractiveness of the different rapid transit modes. What can we learn about how intangible attributes influence the perceived desirability of one mode over another? To what degree do they explain the differences, if any, in ridership attraction between rail and BRT? Is high-quality BRT comparable to rail in terms of both tangible and intangible attributes? Figure 3.8 has been developed to illustrate the region potentially filled by BRT in the continuum of alternative transit modes, and the influence of tangible and intangible service attributes.

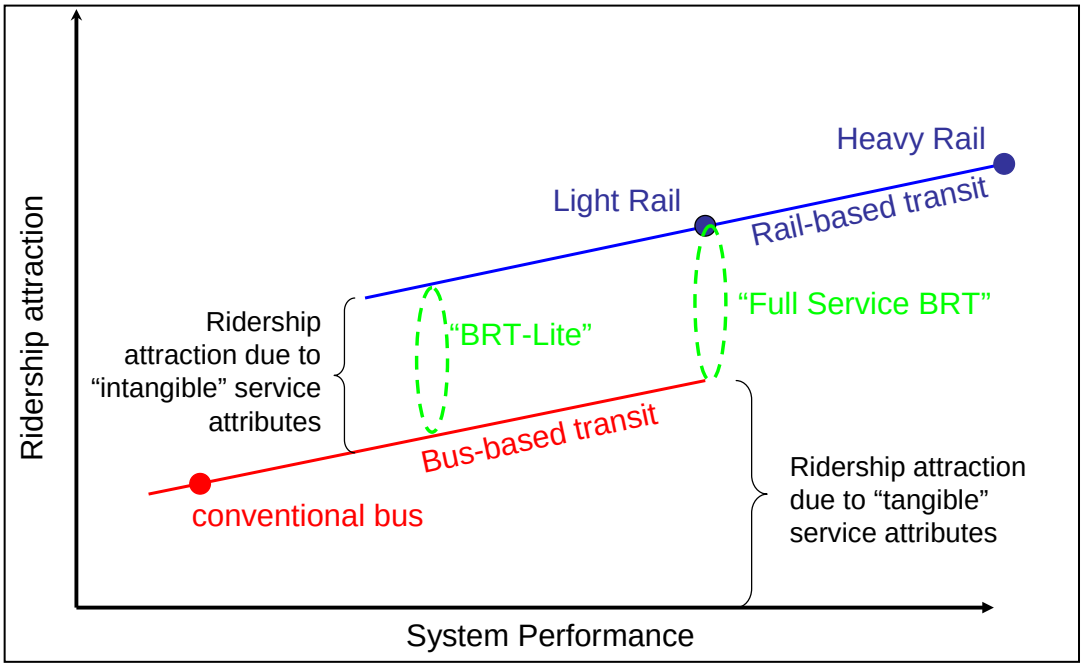


FIGURE 3.8 – Influence of Tangible and Intangible Factors on Ridership Attraction[10]

The figure considers the ridership attraction potential of different transit modes, in terms of approximate performance level, from conventional bus service up to heavy rail transit. As discussed in the literature, rail transit attracts more riders than conventional bus service, even if all functional service attributes like frequency, span, commercial speed, cost, etc, are the same. This is illustrated in the figure by the two parallel lines, one for bus and one for rail, based on the hypothesis that rail will attract more riders than conventional bus due to

[10] Please note that this figure has been included for illustrative purposes only, and is not attempting to quantitatively compare the ridership attraction potential of different transit modes, or the relative influence of tangible and intangible factors on ridership attraction.

various intangible factors like comfort, safety, and ride quality, where rail has a distinct advantage. Given these parameters, the question posed in the figure is "where does BRT place in terms of ridership attraction?" Clearly, in terms of system performance, BRT bridges the gap between conventional bus and rail, but to answer this question, one must consider the extent to which BRT captures the intangible attributes normally associated with rail. If BRT can indeed emulate the intangible attributes of rail, then one would expect the ridership attraction to be of a similar order to rail. If BRT only partially captures the intangible benefits of rail, then perhaps it only captures some of the ridership attraction potential. Finally, the situation is further complicated by the fact that there are many different types of BRT, from "BRT Lite" up to "Full Service" BRT, as discussed in Section 2.1. Each type will have its own set of tangible and intangible attributes, and thus its own specific ridership attraction potential. In summary, the following research questions were defined:

- Do people perceive alternative rapid transit modes differently?
- If differences exist, where do they originate? Can they be attributed to specific tangible or intangible factors?
- If differences exist, do they translate into different levels of ridership attraction potential? To what extent can differences in ridership attraction potential be quantifiably attributed to each tangible and intangible factor?
- What variations exist with regard to socio-economic/geographic factors?

4. Focus Groups

4.1 Objectives

The focus group exercise was designed to address the following objectives:

- Explore public attitudes towards the different rapid transit modes and the private auto
- Gain an understanding of the influence of urban context and socio-economic factors on public perceptions of different rapid transit modes and the private auto
- Identify the tangible and intangible factors that influence mode choice decisions

4.2 Methodology

It was decided that the study should focus on people with viable modal alternatives for their everyday travel needs. The concept of different transit market segments, developed by Krizek and Al-Geneidy (36), was used to define "potential users" and "choice users" as the groups of interest (see Section 2.6). Thus, people that were either "transit captive" or "auto captive" were screened out of the study.

A local market research firm was hired to perform sample recruitment and provide a venue for the focus groups, which were conducted in the Universal City area of Los Angeles in November 2007. The authors were responsible for group moderation and qualitative data analysis. Group sampling criteria was prescribed by the authors to ensure diversity in terms of age, income, ethnicity, and gender. The four groups were divided as follows:

- Two groups composed of individuals between the ages of 18 and 34, one composed of people with household incomes under $35,000 per annum, and one composed of people with household incomes over $35,000 per annum.
- Two groups composed of individuals between the ages of 35 and 65, one composed of people with household incomes under $35,000 per annum, and one composed of people with household incomes over $35,000 per annum.

Most of the participants were "choice users" of one or more of the different rapid transit modes, though a smaller sample of "potential users" were also recruited. Thus, all focus group participants had access to a private vehicle. This was to ensure that the people recruited for the focus groups had some level of mode choice available to them in their daily travel behavior. Sample quotas were defined to ensure representative "choice users" of each of the following modes: local bus, Metro Rapid ("BRT-Lite"), Orange Line ("Full-Service BRT"), Gold/Blue Line (LRT), Red Line (HRT), and potential users. The topic guide used to structure the sessions is provided in Appendix I.

4.3 Synthesis of Focus Group Findings

Audio recordings of the focus group sessions were transcribed for further qualitative analysis. The following is a synthesis of the main observations.

4.3.1 Traveling in Los Angeles

Traveling by car in Los Angeles was generally regarded as difficult, time consuming and stressful. Congestion was worst on the freeways and was perceived as existing for most of the day, "5a.m. to 10p.m." High gas prices and limited, expensive parking were also cited as major problems. For these reasons, these choice riders made use of public transit. Those using transit on a regular basis tended to do so for work-related purposes, though some would use transit for occasional leisure trips. Transit use was limited to trips to specific destinations where rapid transit services were available and overall, the geographical coverage of public transportation across the city was seen to be lacking. Service spans were also often regarded as inadequate.

4.3.2 Local Bus Transit

It was found that the "regular" bus system has a severe image problem, and is generally regarded as the mode of "lower-class" individuals. Riding the bus carries a "shame factor." Most of the choice riders would not consider using it, or if they did, they would feel ashamed and keep it a secret. It was generally regarded as slow, uncomfortable, polluting, and somewhat dangerous. The fact that regular buses run in mixed traffic, and thus are prone to unreliability and travel delays due to traffic congestion, was seen as a major drawback in comparison to the other grade-separated rapid transit modes. Other major problems identified were the type of people that use the regular bus services (homeless, mentally unstable, drunk, etc.), and the unsafe urban environments through which these services run.

"And last, but not least, there is another factor called the shame factor. I would be very embarrassed to tell my friends who know what kind of living I make (because I make a decent living- I'm not rich, but I'm well-to-do in my own way). I'm ashamed to tell that I am taking buses…In Europe, I wouldn't. But here, they would think, 'Did he lose his job? Has he gone mad?' There is a shame factor because you are going with a certain type of public that social workers should be taking care of, these bums, bi-polars, all of these crazy people that really need help. And they are homeless and I have to sit next to that person and listen to his stupid stories." - Male, 43, Metro Rapid user

"The shame factor is majorly big. I've never felt this way and I've lived in a lot of different places- the Bay Area, I took the MARTA train in Atlanta, I've taken the tube in London- I've never felt it except for this city. That's it. - Female, 37, Metro Rapid user

"When [the] *bus leaves, it throws exhaust, nasty…you know, that ethanol or whatever, oh man, it just…when you go to your job, you smell like a bus… You wear a white shirt and it becomes gray at the end of the day. I'm just saying that because I am on the bus a lot... It's just gross. I know in Pa-*

sadena they have some buses going around that are called green buses that are half electric. Why can't they do that?" - Male, 20, Red Line and Orange Line user

"The people you see on it...I'm just saying that when I was in L.A. and I was in the car and just looking in at the bus…the people getting on….it just seems scary..." - Female, 34, Orange Line user

"It's horrible. Plus, you get (excuse my French) some real bums on the bus, people who harass the ladies, people who are homeless, people who stink, people who haven't taken a shower for years. I mean, come on…we are professional people. I'm going to work. I don't want to stink, sitting next to a bum." - Male, 43, Metro Rapid user

"If I had to choose between paying high gas prices and having peace-of-mind in my own environment, my own scent, my own smells, if I want a conversation because I've started it; if I don't, there's nothing going on in my automobile…When my transmission went out, [taking the bus] *was a horrible experience for me.* - Female, 37, car only

"*Some of the bus stops are run down, or dirty, or you may have someone randomly sleeping. If my car broke down and I saw someone laying at the bus stop, I probably wouldn't take that bus."*
- Female, 28, Gold Line user

"Depending on the mood of the bus driver, they will pass you up. The bus stops are filthy. They smell like urine. It's horrible." - Female, 40, car only

"I just want to say the rail station runs great. I think it runs every couple of minutes. It's the MTA bus that I think is not so great. If only the frequency… like, you don't want to be standing on Santa Monica Blvd. or Sunset Blvd. waiting for a bus late at night." - Female, 37, Metro Rapid user

"The other factor here is the safety factor. I don't want to see my wife after 6pm going to the street taking a bus. I mean, I don't want to see any of these ladies here taking the bus after 6pm. And they know what I'm talking about…The Prime Minister of Switzerland- he goes to work every day to Parliament on his bicycle because Switzerland is such a safe country. But can we say that about this country, L.A., after 6pm…?" - Male, 43, Metro Rapid user

"Buses come late and sometimes they'll drive right by you. Because they are late and they don't want to stop, so they'll keep going." - Male, 29, Metro Rapid and Gold Line user

4.3.3 The Metro Rapid ("BRT-Lite")

The Metro Rapid was generally viewed as express bus service that was part of the regular bus network. For those that used it, it was highly regarded, mainly for functional reasons (frequent, relatively quick, good coverage, good real-time information). However, the general view was that this type of service was not BRT, and as part of the regular bus system was susceptible to the same negative perceptions associated with this transit mode.

"But I hate waiting too long- that's why I like the [Metro] *Rapid because it gets you from Point A to Point B faster."* - Male, 29, Metro Rapid and Gold Line user

"…even now, when I take the 780, which is a wonderful rapid bus, you still sit in the traffic, which does nobody any good. What I'd love to see is to do it like they do in those European and South American cities where the bus maybe takes the center lane and gets priority, doesn't have to sit in any traffic…People in their car would be saying, 'Oh, I can't get anywhere because those buses are going by me" and after a while, they'd say, 'Wait a minute- why do I need my car at all? I'm gonna jump on the bus." - Male, 60, local bus, Metro Rapid, Orange Line user

"But that's what I like about the [Metro] *Rapid...they don't stop at every single intersection and they have set stops. So it's like, OK, you know we're going to stop here anyway, and it reminds me more of a train, and I like the train because it doesn't stop every single time, and that's much better and more efficient.* - Male, 28, Gold Line user

"I mainly use a car but I have taken the bus and I didn't like it. It's too crowded. People are in your personal space, and they make lots of stops. If I had to choose any means of public transportation it would probably be like the Orange Line. The [Metro Rapid], *no, it's just not fun at all."*

- Female, 22, car only

"I find myself willing to pay the extra money for gas for a car ride anywhere I can because the normal transportation buses, like Rapid and all that stuff, aren't kept up very well at all in the Los Angeles area. They are kind of run down so I choose to stay away from them as much as possible. The Orange Line is different though. That seems to be pretty nice, but that's newer."

- Male, 20, Orange Line, Red Line, Gold Line user

"You do the Metro Rapid when you don't have a car because you have to take the bus. If you had a car, you wouldn't take it. That's just my opinion." - Male 31, Metro Rapid and Orange Line

"Sometimes those red rapid ones - you see the brown exhaust coming out and you're like, that's polluting the air more than my car, and we're all trying to be environmentally conscious and it seems the buses are kind of defeating the purpose of that. The Orange Line and the big blue buses in Santa Monica, to me, look like they don't even have an exhaust system. It's on its own [lane] and it's quieter. Image wise, it looks cleaner, it looks more appealing for you to get on. I feel like I'm helping out the environment because I'm riding it. - Male, 31, Metro Rapid and Orange Line

4.3.4 Metro Orange Line ("Full Service" BRT)

Views on BRT tended to fall somewhere between regular bus and rail. The Orange Line was highly regarded by several participants, who used terms like the "train-bus" or the "bourgeois bus" to describe the Orange Line service. These terms suggested that this "high-end" BRT system has succeeded in conveying the image of a premium rapid transit mode on a par with rail-based services. Some participants suggested that it should be used as a model for replication in other parts of L.A., stating that it was cheaper and quicker to implement than rail. However, others complained that it was too crowded during peak times, that the stops

are too far apart, that it wasn't rapid enough, and that it had severed the communities through which it runs. Some still thought that it simply wasn't as "classy" as rail-based transit, but found it difficult to say why.

"*I just have this image of the bus system here and I just had this fear of it. So that's why I didn't want to get on it. I was informed that what I take is the bus but I don't consider the Orange Line a bus. I think of it as a train.*" (This participant used rail and the Orange Line, but said she would never take "the bus.") - Female, 34, Orange Line and Red Line user

"*Just the Orange Line is the one I prefer. I live in the valley and it goes the places I need to go. I'd rather sit in my own car with my own radio than go bumper to bumper like on Wilshire Blvd. I see those buses stopping. They are right next to me and not going any faster than I am.*"
- Male, 31, Metro Rapid and Orange Line user

"*…my main issue is efficiency, speed...what I associate with that is the Orange Line, the subway system, the railways, any dedicated streets or maybe a dedicated lane.*"
- Male, 22, Metro Rapid and Gold Line user

"*The Orange Line I think is beautiful. If they could do that to Wilshire, Crenshaw, all the main strips, I think that would be a wonderful thing.*" - Male, 28, Gold Line user

"*This one* [Metro Rapid] *is with the other cars so you're still stuck in traffic. At least the Orange Line has its own busway. Nothing but buses. That's why I like it. And you have the clock thing when the next one's coming and you feel like it's a New York subway.*"
- Male, 31, Metro Rapid and Orange Line user

"*The Orange Line is really nice. It's clean. It's smooth. You're on a road, you're not on a rail, so…I like it.*" - Female, 18, Gold Line user

"*I think* [the Orange line]*…destroyed the Valley. It has disrupted neighborhoods with the fences they've made. If you are taking it, you have to know exactly where the stops are and know where you are going or you end up a mile out of your way sometimes. And then you have to take a local bus back again because the stops are so far apart…They should have gone with light rail…I think a light rail line where the Orange Line is would have been much better…The stops are not as far apart. I don't think it would have disrupted the neighborhoods as much.*" - Male, 53, Orange and Gold Line user

"*One of the reasons why a lot of different lines, including the Orange Line, aren't what they could be is because when they created it, it was supposed to go really fast…But then* [someone] *had an accident so they insisted that the Orange Line slow way down. So now, it's got all the downside, without the great upside of being almost like a bullet train, shooting through the Valley and getting someplace fast.*" - Male, 60, local bus, Metro Rapid, Orange Line user

"*Maybe because you do see the driver and the driver is there that might give you a sense of comfort. Because on the Red Line you don't. You're in your own little compartment. I mean not like the drivers are going to do anything, well maybe he will, but you know that the person is there. He's in control*" - Female, 18, Gold Line user

4.3.5 Rail Transit

As described above, significant differences in perceptions of the alternative transit modes were observed. For some, only rail-based transit was perceived as suitable. Interestingly, differences of opinion were observed in relation to the same mode in different locations, i.e. *"The Gold Line is cool but I would never ride the Blue Line."* Both the Gold Line and Blue Line are defined as LRT; however, the Gold Line runs through affluent South Pasadena, while the Blue Line runs through some of the most socially deprived areas of Los Angeles. This raised an important issue for further investigation: to what extent are public views towards different rapid transit modes influenced by the areas and clientele they serve? Could it be that LRT tends to attract more middle class riders because LRT systems are more likely to serve middle class areas? This observation seemed to reinforce the findings of other literature that it is the service attributes (both tangible and intangible), rather than the type of mode itself, that explain the relative passenger attractiveness of alternative rapid transit modes. A strong determinant of some of the intangible attributes (safety for example) seems to be the urban context in which the service runs. In general, focus group participants viewed rail-based transit as "classier" than bus-based transit. Rail transit was seen as serving the middle-class, while bus transit served the lower classes.

"It's like real estate; location, location, location. You're going through areas throughout the valley…Pasadena, Warner Center, Woodland Hills…it's just cleaner and nicer. Then you go to Hollywood. Hollywood is sketchy at night time. It depends upon what kind of mood you're in – if you don't mind being around sketchy people and you're having drinks and you really don't care then hop on a metro…the Gold Line and the Blue Line are totally different"

- Male, 31, Metro Rapid and Orange Line user

"I think [the Gold Line] *is probably a cleaner train than all the other ones. Like, I tried the Blue Line and it was horrible. There were just so many people on there. The times I take* [the Gold Line] *it's nice, it's not extremely packed. I just can't stand when the train is extremely packed. I feel safe and it's a little cleaner I think. The people that get on [the Blue Line] are a little…different."*

- Male, 29, Metro Rapid and Gold Line user

"It goes though the nicer part of Pasadena…south Pasadena. I like the Gold Line, I've taken it a lot.

- Female, 18, Gold Line user

"I feel like there are more business people [on the Gold Line]*, more professional looking people. The interior is cleaner. A little bit quieter….people aren't yelling when they are talking…the seats are more comfortable, I've had people sitting ON ME* [on the bus]. *The bus is more of an adventure."*

- Female, 28, Gold Line user

"I don't like going near downtown in the traffic, so for me it's just easier to go on the Red Line. I'll take it any time instead of having to drive there." - Female, 32, Metro Rapid user

"I like the Red Line a lot. They have good hours to Hollywood- you get there really fast. It's not that scary at night…it doesn't seem too sketchy to me." - Male, 18, Orange Line user

4.3.6 Identification of Tangible and Intangible Factors

As a major focus of the study, participant views on different tangible and intangible aspects of the different transit services were of particular interest to the authors. A wide range of factors were identified, as summarized in Table 4.1. Most of the tangible factors were previously identified in the literature as standard inputs into transit travel demand and mode choice models, though some sources identify "reliability" as one of the intangible factors typically captured by mode bias constants.

It was found that each individual typically mentioned a range of both tangible and intangible factors when comparing the different modes with each other, and with private vehicle use. Regular transit users tended to be more focused on the functional (tangible) attributes like service span, frequency, and cost, while less frequent users were more likely to cite intangible attributes (service is unsafe, buses are smelly, buses are overcrowded or uncomfortable).

Following the factor identification process, factors were then separated into factor groupings that attempted to classify each factor within one of a smaller number of overarching categories. These categories were selected on the basis of the common features of individual factors, and also took into account the findings of other research studies where factor analysis had been employed. The primary intangible factor groups were safety, comfort, service comprehension/ease of use, customer service, image, and modal differences/perceptions. These factor groups were used to inform the next phase of the study, helping to determine the types of questions used in the survey instrument.

TABLE 4.1 – Tangible and Intangible Factors Identified in Focus Groups

Tangible/ Intangible	Factor Groups	Factors
Tangible	In-vehicle travel time	In-transit time Dwell time
	Out-of-Vehicle travel time	Wait time Transfer time
	Fare/ travel/parking cost	
	Service frequency	
	Service span	
	Service availability / coverage / convenience	
	Parking availability	
	Service reliability	On-time performance Departure delay
Intangible	Safety	From accidents From crime
	Comfort	Noise; Temperature (heating, A/C); Comfort with fellow passengers Smell (exhaust fumes, other people); Ride quality (vibration, road surface, vehicle tilting, driver expertise); Seat availability; Cleanliness; Shelter from weather; Amenities
	Service comprehension / Ease of use	Information availability; information comprehension; route structure complexity; real-time information availability; regional fare integration
	Customer service	Operator Other transit staff Security staff
	Image	Aesthetics; branding; status of self versus other riders / transit "shame factor"; contextual design
	Modal differences / Values	Cost issues associated with car use Travel time issues associated with car use Reliability issues associated with car use Stress issues associated with car use Parking cost/availability issues Environmental concerns (associated with car use) Concern about DUI Recreational transit use (historic/fun/scenic) Transit use for health/exercise

5. Attitudinal Survey

This chapter is comprised of the main body of the report submitted by Redhill Group, Inc, in February 2009. Redhill Group was subcontracted to NBRTI to collaborate with NBRTI staff on the development of a survey instrument, to conduct the survey, analyze the data, and produce a report documenting the survey findings. The Redhill Group report has been re-formatted to retain consistency with the rest of this document.

5.1 Methodology

A sampling methodology was developed to yield valid and reliable demographic profiles that could be generalized to the universe of riders of each transit mode and for non-riders (+ 5% precision at a 95% confidence level). The objective of this project was to compare opinions and attitudes regarding alternative public transportation modes. One of the keys to respondents being able to provide valuable input is the potential for the respondent to be familiar with each of the alternate modes for which they are being asked to provide feedback. To this end, two corridors were selected that have access to a majority of the different modes being rated. The San Gabriel Valley Corridor offers parallel light rail, express bus (Gold Line / BRT-Lite), and local bus service. The San Fernando Valley Corridor offers parallel high-level BRT service (Orange Line), express bus, and local service. In addition, both corridors connect to the LA central business district and the Red Line which is the heavy-rail mode being evaluated.

These two corridors were selected because residents of these corridors are likely to have the highest level of awareness for the different modes being evaluated. The specific lines that were selected; the 70 and 150 for local service, and the 750 and 770 for Metro Rapid service, were selected because they most closely parallel the Gold Line and Orange Line in their respective locations, providing potential alternatives for respondents trying to reach the same destinations. The geographic proximity of these alternatives to respondents maximizes their ability to provide informed feedback to achieve the project's objectives.

Table 5.1: Target Sample Size by Mode and Associated Lines

Mode	Lines	N =
Low Level BRT	Metro Rapid: 750, 770	385
High Level BRT	Orange Line	385
Bus	Metro Local: 70, 150	385
Light Rail	Blue Line, Gold Line	385
Heavy Rail	Red Line	385
Non-riders	Areas surrounding lines	385

The following table provides average daily ridership, start year and average trip length for each line surveyed in this study.

Table 5.2: Average Daily Ridership by Mode

	LOCAL		LOW LEVEL BRT		HIGH BRT	LIGHT RAIL		HEAVY RAIL
	70	150	750	770	Orange	Blue	Gold	Red
Daily Riders	13,468	10,978	7,775	9,724	23,352	75,564	13,219	134,665
Started	> 10 Years	> 10 Years	2001	2007	2005	1990	2003	1993
Route Length	16	18	8.5	9	14	22	13.7	17.4

Data were collected using both on-board surveys and telephone surveys. Rider data were collected using on-board surveys while non-rider data were gathered using telephone surveys.

Field Survey

On-board surveys were collected across five different transit modes with 385 surveys being collected for each mode. The survey instrument is provided in Appendix II.

Prior to initiating data collection a pre-test was conducted on August 26, 2008 to:

- Determine if riders could understand and complete survey with minimal assistance,
- Gauge the approximate participation and completion rates based on survey design and length, and
- Pretest procedures and logistics.

Based on the pre-test it was determined data should be collected using a multi-method approach to ensure the widest level of participation and minimize biases due to:

- Literacy,
- Time constraints of the passengers, and
- Language barriers.

On-board surveys and phone numbers were collected in the field between September 17 and October 30, 2008. Surveys were collected Monday through Friday between the hours of 7:00 AM and 6:00 PM. In addition, phone numbers were obtained from transit riders who indicated that they wanted to participate but could not complete the survey while riding.

Survey respondents had the opportunity to complete the instrument in English or Spanish depending on their language preference. Respondents who completed a survey in its entirety were eligible for an incentive drawing of $200.00.

The survey team was ethnically diverse, gender balanced and generally representative of the target population and included bilingual Spanish surveyors. Surveyors were trained in the survey protocol prior to the beginning of data collection. Prior to an assignment, surveyors were provided with detailed work assignments and survey kits which included pre-marked envelopes for the completed surveys to ensure that data collected for each line was clearly identified.

Surveyors were periodically checked while on assignment to observe that data collection followed the approved protocol. At the completion of each assignment, the pre-marked envelopes containing the surveys and phone lists were returned to the shift supervisor.

During the sampling timeframe, 5,044 surveys were collected in the field. Of the surveys collected, 38 percent (1,910) were useable. The remaining 62 percent contained either partial information (27%) or were not useable (35%). Completed surveys were reviewed and were sorted into three categories prior to data entry. Surveys were categorized as follows:

Completed surveys:

- These surveys contained sufficient information for data entry and were considered complete.

Incomplete surveys with phone numbers:

- These surveys were partially complete and contained the respondent's phone number, allowing for follow-up.

Unusable/Incomplete surveys:

- These surveys were incomplete and contained no phone number to allow for follow-up with the respondent.

If a review determined that there were an insufficient number of completed surveys to meet the required sample size, partially completed surveys that contained phone numbers were mined. Respondents with partially completed surveys were contacted by phone and asked the questions that had been left blank. When a survey was completed, it was coded and data entered. Respondents who also just provided phone numbers were contacted in an attempt to complete a survey. This process was repeated until the sample size for each subset was satisfied. These efforts produced an additional 83 complete, logical surveys.

All surveys were logic checked with a particular emphasis on transit designation and travel time. For example, if the data were collected on the 770 Line, the respondent must have indicated that he or she used that line at least once. Travel times that were in excess of 180 minutes were flagged for follow-up and, where possible, the respondent was contacted to verify that the travel time indicated on the survey was correct.

The completed data sample used for the analysis was generated as follows:

Table 5.3: Target and Actual Sample Size by Target Mode / Line

Designation	Line	Target Sample Size	Actual Completes Used for Analysis
Low Level BRT	750	193	199
Low Level BRT	770	193	197
High Level BRT	Orange	385	396
Traditional Bus	70	193	193
Traditional Bus	150	193	193
Light Rail	Gold	193	193
Light Rail	Blue	193	225
Heavy Rail	Red	385	397
Total		1,925	1,993

Respondents from the onboard survey were categorized as transit-captive if they indicated that they "did not have a vehicle to make this trip." Those that did have a vehicle were categorized as choice riders.

Telephone Survey

A telephone survey was conducted with non-riders using random digit dialing (RDD). The total survey sample for non-riders was N= 385 with four sample subsets which were comparable to the service area for the transit users. Zip codes were used as a base for the generation of phone numbers within the target areas. Target demographics for the telephone sample were calculated using census data for LA County.

A pre-test was conducted on August 22. Data collection for non-riders was conducted from August 25 to October 31, 2008. Respondents were able to complete the survey in either English or Spanish. A total of 397 surveys were collected during the period.

Telephone surveyors were trained on the survey instrument prior to conducting surveys with respondents. Surveyors were randomly monitored throughout the surveying period to ensure that survey protocol was observed.

Respondents to the telephone survey were categorized as "auto-captive" or auto-potential based on their answer to the question "Would it be possible to use public transportation, such as buses, rail or subway, for at least part of your common trips, like commuting?"

Demographics of Survey Participants

The demographics for each transit mode and for non-riders are detailed in the following table with details for gender, age, ethnicity, income, and transit and being auto-captive.

Table 5.4: Demographic Profile of Each Mode

	Local	Rapid	Orange	Gold	Blue	Red	Non-Riders
Gender							
Male	50.9%	56.7%	52.7%	54.4%	60.0%	54.7%	44.1%
Female	49.1%	43.3%	47.3%	45.6%	40.0%	45.3%	55.9%
Age							
Under 20	18.5%	22.9%	29.2%	13.3%	11.1%	10.2%	6.0%
20-29	33.2%	34.3%	26.5%	44.2%	31.3%	37.4%	12.0%
30-44	23.7%	21.0%	20.6%	22.1%	30.9%	28.5%	26.1%
45-59	18.0%	16.9%	19.6%	16.6%	24.4%	19.9%	33.4%
60+	6.5%	4.9%	4.0%	3.9%	2.3%	4.0%	22.5%
Ethnicity							
Caucasian	22.3%	18.7%	30.0%	32.1%	20.2%	31.9%	32.9%
African Am.	12.3%	12.8%	20.2%	12.6%	35.4%	21.7%	6.2%
Hispanic	54.9%	58.5%	39.5%	39.5%	32.7%	37.5%	46.4%
Asian	9.4%	9.2%	9.0%	12.6%	10.3%	7.7%	13.0%
Other	1.0%	0.8%	1.3%	2.3%	1.3%	1.3%	1.6%
Income							
Under 20k	46.1%	42.8%	33.6%	29.5%	32.4%	37.3%	15.4%
20k-34,999	22.0%	18.0%	19.2%	21.8%	22.7%	21.4%	13.1%
35k-49,999	7.8%	12.2%	13.9%	8.3%	11.1%	12.3%	13.4%
50k-74,999	10.4%	9.1%	12.1%	14.5%	9.8%	12.3%	14.4%
75k-99,999	3.9%	5.1%	6.3%	9.8%	8.0%	5.0%	8.6%
100k+	2.8%	6.1%	5.8%	11.9%	8.4%	6.5%	21.7%
Refused	7.0%	6.8%	9.1%	4.1%	7.6%	5.0%	13.6%
Transit Captive							
Yes	76.3%	75.9%	66.6%	54.4%	55.4%	58.2%	NA
No	24%	24.1%	33.4%	45.6%	44.6%	41.8%	NA
Auto Captive							
Yes	NA	NA	NA	NA	NA	NA	47.9%
No	NA	NA	NA	NA	NA	NA	52.1%

There are significant demographic differences between the different transit services. The Orange, Gold and Red Lines have a higher proportion of Caucasian riders while the Blue Line has a higher proportion of African American riders. Hispanic riders are also a significantly higher proportion of riders on Metro Local and Metro Rapid than on the Orange Line and rail lines. Transit dependency is highest on Metro Local and Metro Rapid, declines by

about 10 percent for the Orange Line, and then declines 10 percent again to the mid-50's for the rail lines.

All transit riders were asked if they had a car available to make the trip they were currently making on transit. Table 5.5 on the following page shows that on average approximately two-thirds (66%) are transit-captive. Non-riders were asked if it would be possible for them to take transit for their normal commute, and approximately half (52%) said it would be possible.

Transit dependency varies by service with over three-quarters (76%) of Metro Local and Metro Rapid riders being captive. It drops to 67% for the Gold Line, and then about another 10% for the Orange, Blue and Red lines where transit-dependency is between 54 and 58%.

There are strong correlations between all demographic factors and transit and auto-dependency with a consistent, inverse relationship where auto-dependency for non-riders increases as transit-dependency for riders decreases.

With regards to gender, female transit riders are six percent more likely to be transit-captive, and female non-riders are six percent less likely to be auto-captive.

Age and income have an even greater impact on transit and auto-dependency. Transit dependency ranges from a high of 84% for those under 20 to a low of 56% for those 60 or older. Conversely auto-dependency ranges from a low of 17% for those under 20 to a high of 56% for those 60 or older. Similarly for income, transit dependency ranges from a high of 86% for those with less than $20,000 income to a low of 25% for those with $100,000 or more income. Auto-dependency ranges from a low of 32% for those with under $20,000 income to a high of 63% for those with $75-99,000 income, and then drops down again to 50% for those with $100,000 or more income.

Transit and auto-dependency are also related to ethnicity with Caucasians and Asians having the lowest transit-dependency (56 and 60%), and the highest auto-dependency (60 and 63%). Hispanics and African Americans are more likely to be transit-captive (73 and 67%) and less likely to be auto-captive (37 and 25%).

Table 5.5 on the following page shows complete details of variation in transit and auto-dependency based on demographic variables.

Table 5.5 Demographic Comparison of Transit-Captive and Transit Choice Riders, and Transit Potential and Auto-Captive Non-Riders

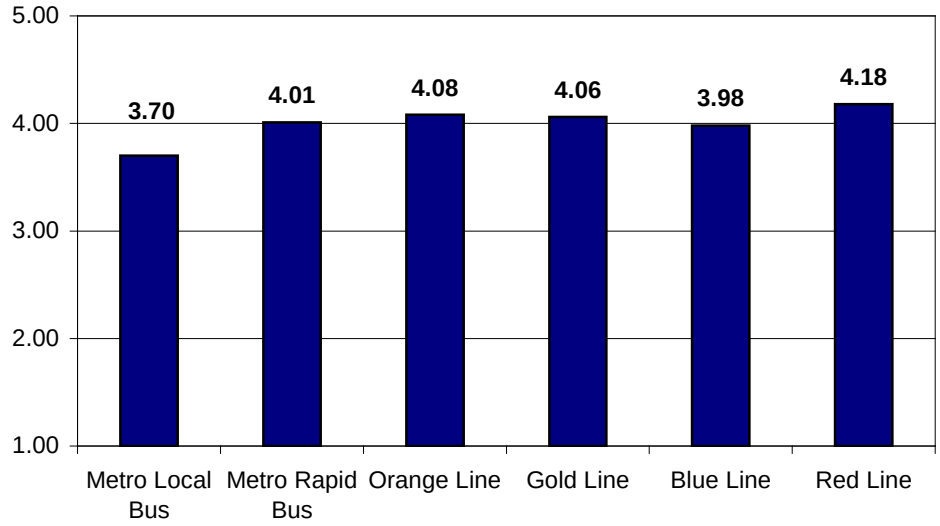
Mode	Transit Captive	Transit Choice	Auto Captive	Auto Potential
Local Bus	76.3%	23.7%	NA	NA
Rapid Bus	75.9%	24.1%	NA	NA
Gold Line	66.6%	33.4%	NA	NA
Orange Line	54.4%	45.6%	NA	NA
Blue Line	55.4%	44.6%	NA	NA
Red Line	58.2%	41.8%	NA	NA
Non-Riders	NA	NA	47.9%	52.1%
Total	66.2%	33.8%	47.9%	52.1%
Gender				
Male	63.6%	36.4%	51.4%	48.6%
Female	69.3%	30.7%	45.0%	55.0%
Total	66.2%	33.8%	47.9%	52.1%
Age				
<20yrs	83.9%	16.1%	16.7%	83.3%
20-29yrs	67.9%	32.1%	29.4%	70.6%
30-44yrs	58.4%	41.6%	50.0%	50.0%
45-59yrs	56.5%	43.5%	50.5%	49.5%
60+	56.0%	44.0%	56.4%	43.6%
Total	66.2%	33.8%	47.9%	52.1%
Ethnicity				
Caucasian	56.1%	43.9%	60.2%	39.8%
African American	67.3%	32.7%	25.0%	75.0%
Hispanic	73.4%	26.6%	37.0%	63.0%
Asian	59.6%	40.4%	62.5%	37.5%
Other	57.7%	42.3%	20.0%	80.0%
Total	66.2%	33.8%	47.9%	52.1%
Income				
Under $20k	85.8%	14.2%	32.4%	67.6%
$20k-34,999	66.8%	33.2%	37.8%	62.2%
$35k-49,999	56.1%	43.9%	40.0%	60.0%
$50k-74,999	45.7%	54.3%	50.0%	50.0%
$75k-99,999	30.2%	69.8%	63.0%	37.0%
$100k+	25.4%	74.6%	49.4%	50.6%
Refused	74.1%	25.9%	65.8%	34.2%
Total	66.2%	33.8%	47.9%	52.1%

5.2 Rating of Alternative Modes

One of the key objectives of this study was to assess perceived differences in overall opinion of the different levels of service; traditional bus service (Metro Local) BRT-Lite (Metro Rapid), Full-Service BRT (Orange Line), light rail (Gold and Blue Lines), and heavy rail (Red Line). Although the Blue and Gold Lines are the same mode of transit, they are reported separately throughout the report. The urban areas served by these two lines are different, and one goal of the study is to explore if the differences have an impact on perceptions of the different modes.

Respondents were asked to rate their overall opinion of each service indicating if it is very poor (1), poor (2), fair (3), good (4) or very good (5). The ideal goal was to assess the differences in ridership attraction. However, due to geographic positions of services and rider participants, respondents would not be able to provide ratings of likelihood to ride on an equal basis. To overcome this, "overall opinion" was used as the best substitute for ridership attraction, as riders could better assess this across all the different services regardless of their location relative to the service.

Figure 5.1 Average Overall Rating of All Modes by All Respondents



The chart above, which reports the combined results from all rider groups as well as the non-riders, shows that local bus service received the lowest overall rating. This is followed by the Blue Line and BRT-Lite (Metro Rapid) which are essentially the same at averages of 3.98 and 4.01 respectively. The Gold Line by itself received a similar rating (4.06) as the Full-Service BRT Orange Line (4.08). If the Blue and Gold Lines are combined into the light rail mode, then together they essentially match Metro Rapid (BRT-Lite). The Red Line received the highest average rating at 4.18.

The following table shows the average opinion rating for each mode in order from lowest to highest with statistically significant differences (at 5%) identified in green and non-significant differences in orange.

Table 5.6 Test of Statistical Significance – Overall Opinion Rating of Each Mode

	Average	Local	Blue	Rapid	Gold	Orange	Red
Local	3.70	NA					
Blue	3.98	YES	NA				
Rapid	4.01	YES	NO	NA			
Gold	4.06	YES	YES	YES	NA		
Orange	4.08	YES	YES	YES	NO	NA	
Red	4.18	YES	YES	YES	YES	YES	NA

Rating the different services from low to high, the above table shows that the rating for local bus service is lower than all other services by a statistically significant margin at a 95% confidence level. The Blue Line is lower than all other services other than the Metro Rapid, and the Orange Line is significantly higher than all lower rated modes with the exception of the Gold Line.

The ratings for the different transit services were then analyzed by current transit mode (or non-user), by demographic variables, and by transit and auto-dependency.

Table 5.7 Overall Ratings by Current Mode

Mode / Service	Local	Rapid	Orange	Gold	Blue	Red
Local Riders	3.89	4.09	4.02	3.99	3.93	4.12
Rapid Riders	3.72	4.19	4.03	3.98	3.97	4.15
Orange Riders	3.60	4.01	4.43	4.03	3.96	4.28
Gold Riders	3.49	3.80	3.90	4.40	3.85	4.09
Blue Riders	3.65	3.88	3.93	3.96	4.02	4.11
Red Riders	3.65	3.95	3.96	4.04	3.94	4.21
Non-Riders	3.79	3.98	4.14	4.20	4.17	4.21

When observing ratings by current mode (and non-rider group), the table shows that Metro Local always receives the lowest rating, and that each rider group rates their own mode of travel higher than the average rating for that mode. The Red Line received either the highest or second highest rating; falling to second only when riders rated their own mode of travel higher (which occurred for all but the Blue Line and Metro Local).

The non-rider respondents rated the alternative modes in order of lowest to highest cost with local bus at the low end followed by BRT-Lite, then Full-Service BRT, light rail and

heavy rail. There were significant differences between local bus and BRT-Lite, between BRT-Lite and Full-Service BRT, and between Full-Service BRT and Gold Line light rail. However, light rail and heavy rail were rated essentially the same.

Table 5.8 Overall Ratings by Demographics

Gender	Local	Rapid	Orange	Gold	Blue	Red
Male	3.68	4.00	4.08	4.06	3.97	4.20
Female	3.72	4.02	4.08	4.06	3.99	4.16
Age						
Under 20	3.83	4.14	4.15	3.96	3.94	4.22
20-29	3.61	3.96	3.99	3.98	3.85	4.08
30-44	3.63	3.94	4.00	4.03	3.95	4.15
45-59	3.71	4.01	4.22	4.24	4.17	4.32
60+	4.07	4.25	4.28	4.37	4.30	4.35
Ethnicity						
Caucasian	3.55	3.88	4.10	4.09	3.95	4.19
African American	3.70	4.05	4.14	4.06	4.09	4.26
Hispanic	3.83	4.11	4.07	4.08	3.99	4.17
Asian	3.53	3.81	3.91	3.94	3.83	4.07
Other	3.69	4.13	4.07	4.07	3.90	4.07
Income						
Under 20k	3.80	4.09	4.10	4.10	4.01	4.20
20k-34,999	3.73	4.06	4.07	4.03	3.98	4.16
35k-49,999	3.71	4.03	4.14	4.10	4.07	4.28
50k-74,999	3.64	3.94	4.02	4.05	3.93	4.19
75k-99,999	3.36	3.67	3.83	3.83	3.70	4.00
100k+	3.50	3.85	4.11	4.12	3.91	4.10
Refused	3.80	4.03	4.21	4.08	4.07	4.21

Cells highlighted in orange indicate "Not Significant"

The ratings for the different transit services are relatively consistent across demographic groups. The exceptions are for Metro Local and Metro Rapid service where Hispanics and African Americans provide higher ratings than Caucasians and Asians. Further, the ratings for these two services are inversely related to income with rating scores dropping slightly as income increases for respondents with less than $100,000 household income (source SPSS Demo-means).

Table 5.9 shows differences in overall service ratings based on transit and auto-dependency (with cells highlighted in green indicating results that are higher than their counterpart by a statistically significant amount). Transit-captive riders provide a higher rating for Metro Rapid than their non-captive counterparts. This, however, is the only pair where the difference is statistically significant.

Table 5.9 Overall Ratings by Transit / Auto Dependency

Transit Captive	Local	Rapid	Orange	Gold	Blue	Red
Yes	3.73	4.06	4.08	4.04	3.95	4.16
No	3.66	3.94	4.08	4.10	4.01	4.21
Auto Captive						
Yes	3.67	3.86	4.16	4.13	4.14	4.18
No	3.88	4.06	4.15	4.27	4.28	4.26

Transit riders (both captive and choice), follow the same overall pattern, rating Metro Local lowest followed by the Blue Line and Metro Rapid, then the Gold and Orange Line, and finally the Red Line with the highest rating.

Non-Riders exhibit different opinions with those that are auto-potential, still rating Metro Local lowest, but then differing, with Metro Rapid second lowest, the Orange Line second highest, and then all rail lines combined in the top category. Auto-captives follow the same pattern except that the rail lines score at the same level as the Orange Line. The auto-captives rate all transit options lower than their non-captive counterparts with the sole exception of the Orange Line which is rated the same. It should be noted that while it may appear that auto-potentials rate rail options higher than auto-captives, due to the relatively small sample size there is not a statistically significant difference.

5.3 Awareness of Services

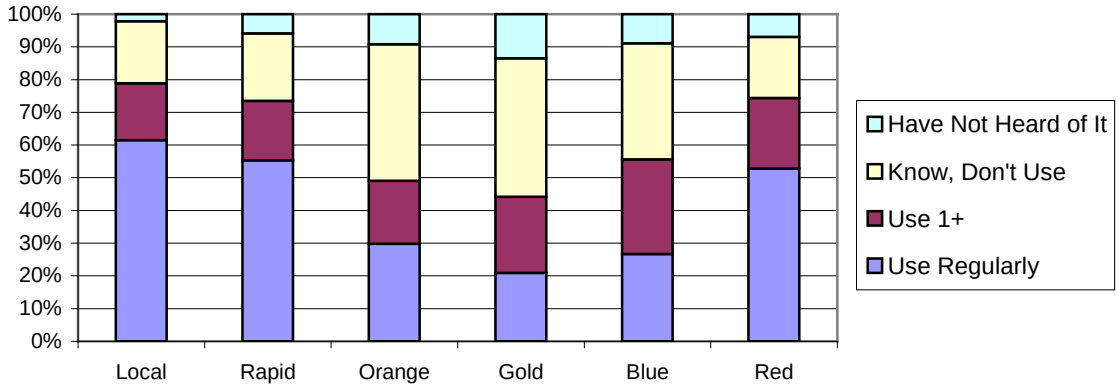
Respondents were asked to rate their familiarity with each of the services using their branded names: Metro Local bus, Metro Rapid bus, the Orange Line, the Gold Line, the Blue Line and the Red Line. For each service they were asked to indicate if they 1) have not heard of it, 2) know it, but have not used it, 3) have used it at least once, or 4) use it regularly.

As would be expected, Metro Local bus which is available to people throughout the County received the highest familiarity rating at an average of 3.38 using the rating scale above. Metro Local is followed closely by Metro Rapid and the Red Line at 3.23 and 3.20. The Blue (2.73), Orange (2.70) and Gold Lines (2.52) have lower awareness, which is not surprising as they each serve a limited geographic area and have lower ridership. The chart below details the different levels of awareness for each mode.

Table 5.10 Overall Awareness Ratings by Ridership

	Local	Rapid	Orange	Gold	Blue	Red
Overall	3.38	3.23	2.70	2.52	2.73	3.20
Local Riders	3.85	3.56	2.71	2.46	2.67	3.17
Rapid Riders	3.77	3.90	2.67	2.49	2.72	3.25
Orange Riders	3.62	3.49	3.86	2.49	2.69	3.51
Gold Riders	3.34	3.15	2.45	3.92	2.81	3.51
Blue Riders	3.37	3.16	2.35	2.53	3.86	3.48
Red Riders	3.44	3.40	2.77	2.80	3.02	3.85
Non-Riders	2.27	1.90	1.79	1.65	1.89	1.91

Figure 5.2 Overall Awareness of Each Mode



The following table shows that the differences in awareness between the various modes are statistically significant other than the Red Line and Metro Rapid, and the Orange Line and the Blue Line.

Table 5.11 Test for Statistical Significance of Awareness Ratings

	Averages	Local	Rapid	Red	Blue	Orange	Gold
Local	**3.38**	NA					
Rapid	**3.23**	YES	NA				
Red	**3.20**	YES	NO	NA			
Blue	**2.73**	YES	YES	YES	NA		
Orange	**2.70**	YES	YES	YES	NO	NA	
Gold	**2.52**	YES	YES	YES	YES	YES	NA

As can be seen in the following charts, non-riders are less familiar than all rider groups with each mode of transit. Metro Local service generally has the highest familiarity level for segments other than each rider-group's familiarity with its own mode, and the Blue and Gold Line riders which have higher familiarity with the Red Line which connects with these lines.

Similar to the overall opinion of transit services, service familiarity is higher for Hispanics and African Americans than Asians or Caucasians for Metro Local and Metro Rapid. Age is also correlated with familiarity for these two services, decreasing as age increases.

Those that are transit-captive are more familiar with every transit mode than those that are not transit-captive. The reverse is also true for Auto-captive respondents for Metro Local and Metro Rapid, but there is no correlation between auto-captive and Full-Service BRT, light rail or heavy rail.

Figure 5.3 Overall Awareness- Metro Local Bus

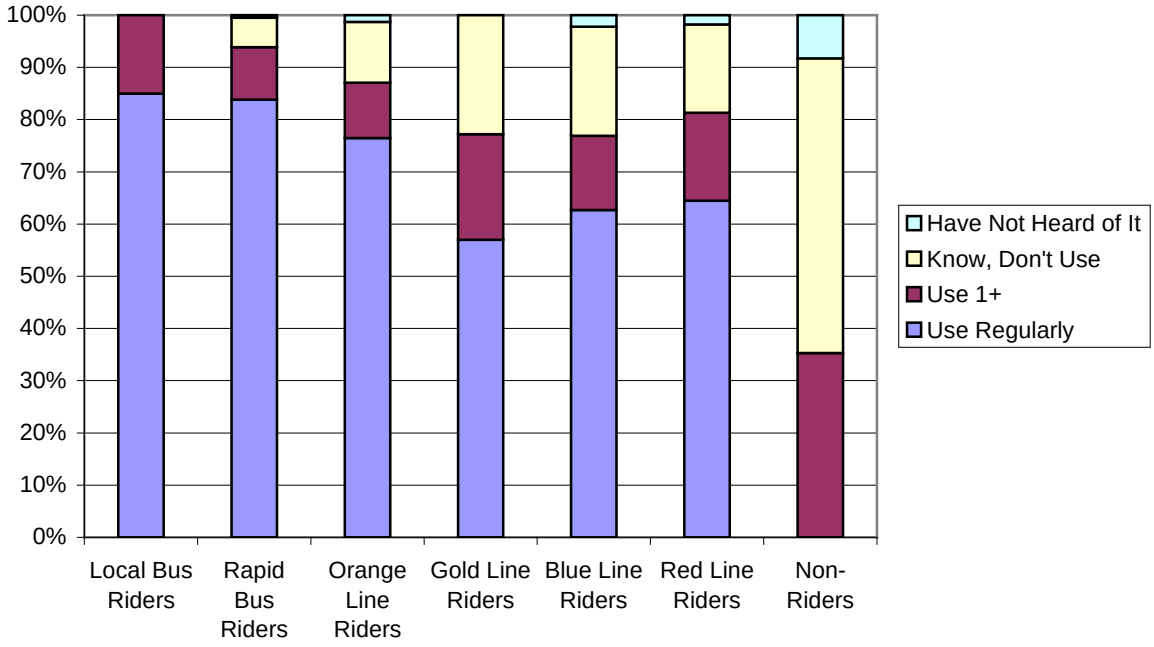


Figure 5.4 Overall Awareness-Metro Rapid Bus

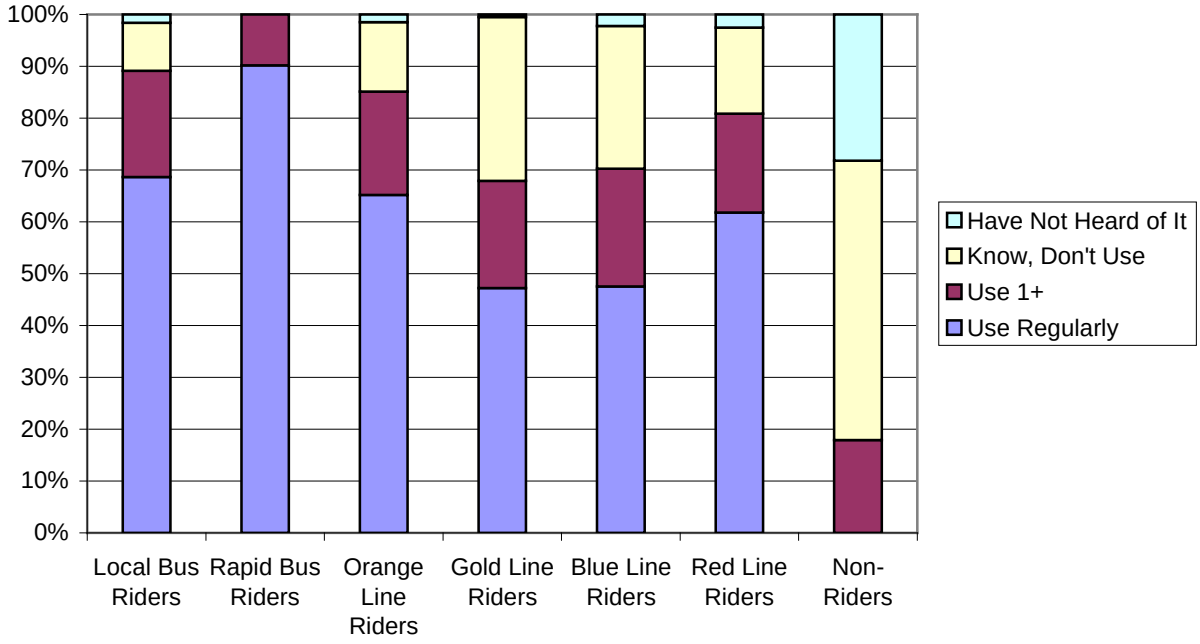


Figure 5.5 Overall Awareness-Orange Line

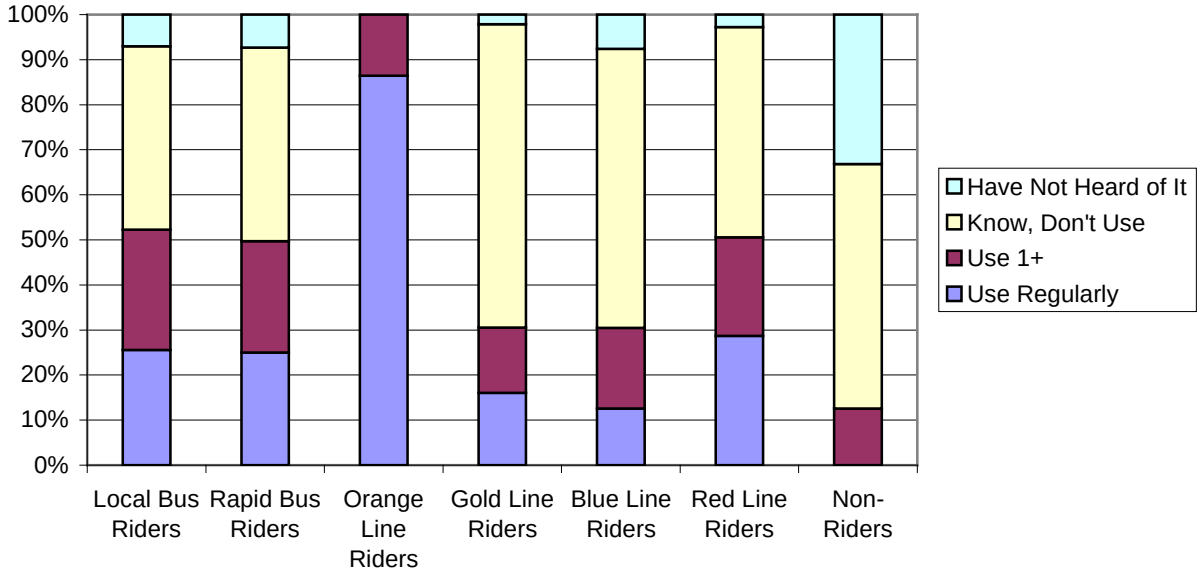


Figure 5.6 Overall Awareness-Gold Line

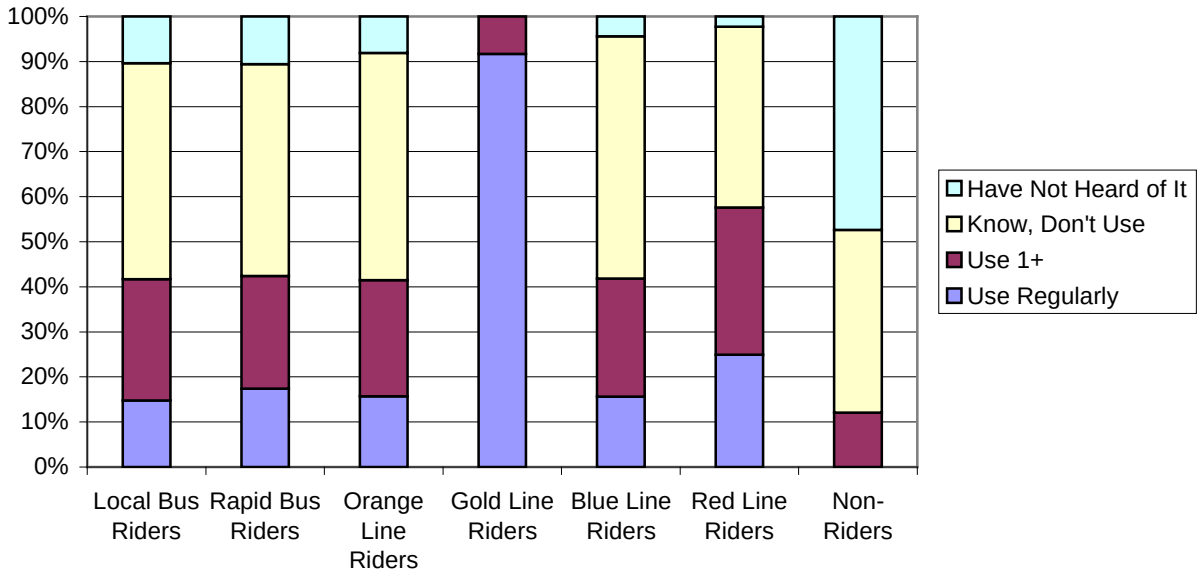


Figure 5.7 Overall Awareness-Blue Line

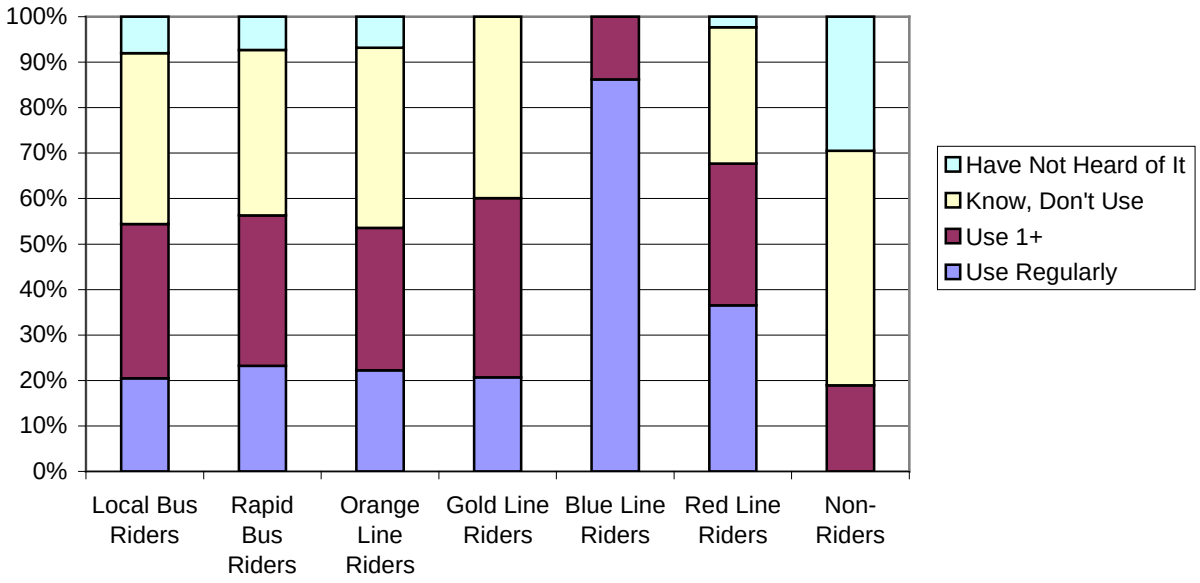
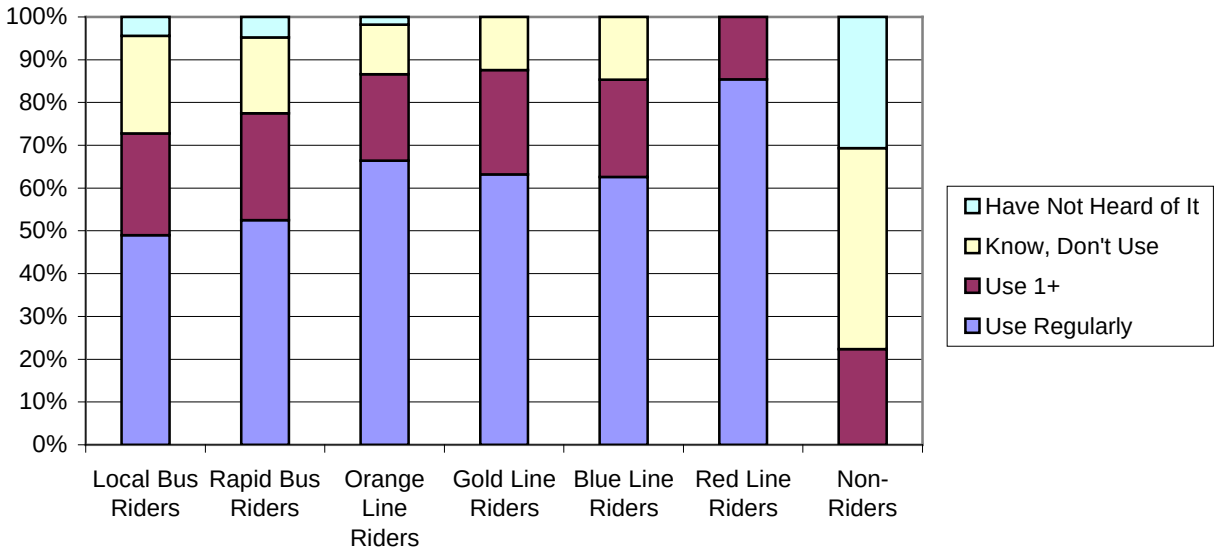


Figure 5.8 Overall Awareness-Red Line



The following table shows the relationship between awareness and overall opinion. As can be seen in the table the average overall opinion rating increases with familiarity with the transit mode (Metro Local is the only one where the difference is not statistically significant at the 5% level). In addition, the modes with lower awareness show greater differences in overall ratings with increased familiarity. Metro Local, which has the highest overall level of familiarity, shows the smallest change in opinion with average awareness increasing only 0.1 from "know, but don't use" to "use regularly." Conversely, the Orange and Gold Lines which have the lowest level of familiarity, increase 0.43 and 0.41 respectively with increased familiarity. The Blue Line, which has awareness essentially on par with the Orange Line, shows a smaller increase in overall rating with familiarity indicating that the experience that comes with familiarity is more positive for the Orange Line than for the Blue Line.

Table 5.12 Average Overall Ratings by Awareness of Each Mode for All Respondents

	Overall Opinion					
Awareness	**Local**	**Rapid**	**Orange**	**Gold**	**Blue**	**Red**
Not Heard Of	NA	NA	NA	NA	NA	NA
Know, Don't Use	3.64	3.84	3.90	3.93	4.05	3.91
Use Once	3.64	3.90	4.07	4.05	4.10	3.95
Use Reg.	3.74	4.11	4.33	4.34	4.26	4.09

The following tables show tests of statistical significance for the differences in overall opinion based on different levels of awareness for each transit mode. As noted above, Metro Local is the only service where increased awareness does not result in a statistically significant difference in overall ratings for the service. Metro Rapid, the Red Line and the Blue Line show significant differences from the lowest to the highest level of awareness, and the Orange Line and Gold Line show significant differences between each step in increased awareness.

Table 5.13 Test of Significance for Overall Opinion Ratings by Awareness of Each Mode

Local

	Avg.	Know, Don't Use	Used Once	Use Reg
Know, Don't Use	3.64	NA		
Used Once	3.64	NO	NA	
Use Reg	3.74	NO	NO	NA

Gold

	Avg.	Know, Don't Use	Used Once	Use Reg
Know, Don't Use	3.93	NA		
Used Once	4.05	YES	NA	
Use Reg	4.34	YES	YES	NA

Rapid

	Avg.	Know, Don't Use	Used Once	Use Reg
Know, Don't Use	3.84	NA		
Used Once	3.90	NO	NA	
Use Reg	4.11	YES	YES	NA

Blue

	Avg.	Know, Don't Use	Used Once	Use Reg
Know, Don't Use	3.91	NA		
Used Once	3.95	NO	NA	
Use Reg	4.09	YES	YES	NA

Orange

	Avg.	Know, Don't Use	Used Once	Use Reg
Know, Don't Use	3.90	NA		
Used Once	4.07	YES	NA	
Use Reg	4.33	YES	YES	NA

Red

	Avg.	Know, Don't Use	Used Once	Use Reg
Know, Don't Use	4.05	NA		
Used Once	4.10	NO	NA	
Use Reg	4.26	YES	YES	NA

Table 5.14 Awareness Comparison of Transit Captive and Transit Choice Riders, and Transit Potential and Auto Captive Non-Riders

Overall Awareness of Each Mode	Transit Captive	Transit Choice	Auto Potential	Auto Captive
Local	3.71	2.95	2.37	2.20
Rapid	3.59	2.75	1.98	1.82
Orange	2.88	2.45	1.80	1.85
Gold	2.64	2.35	1.68	1.70
Blue	2.86	2.56	1.91	1.89
Red	3.38	2.96	1.90	1.97

With regard to awareness, it is not surprising that those that are transit captive are more familiar with all transit services than their choice rider counterparts. Non-Riders are less aware than either class of transit riders with the auto-captives exhibiting lower awareness for Metro Local and Metro Rapid (than their auto-potential counterparts), but slightly higher awareness for the Red Line.

5.4 Importance Ratings of Performance Variables

Fourteen different performance variables were evaluated using a five-point scale where "1" is not at all important, and "5" is extremely important. The 14 variables were divided into two groups; those that are "tangible" and those that are "intangible." The two different groups are as follows:

Tangible Variables:

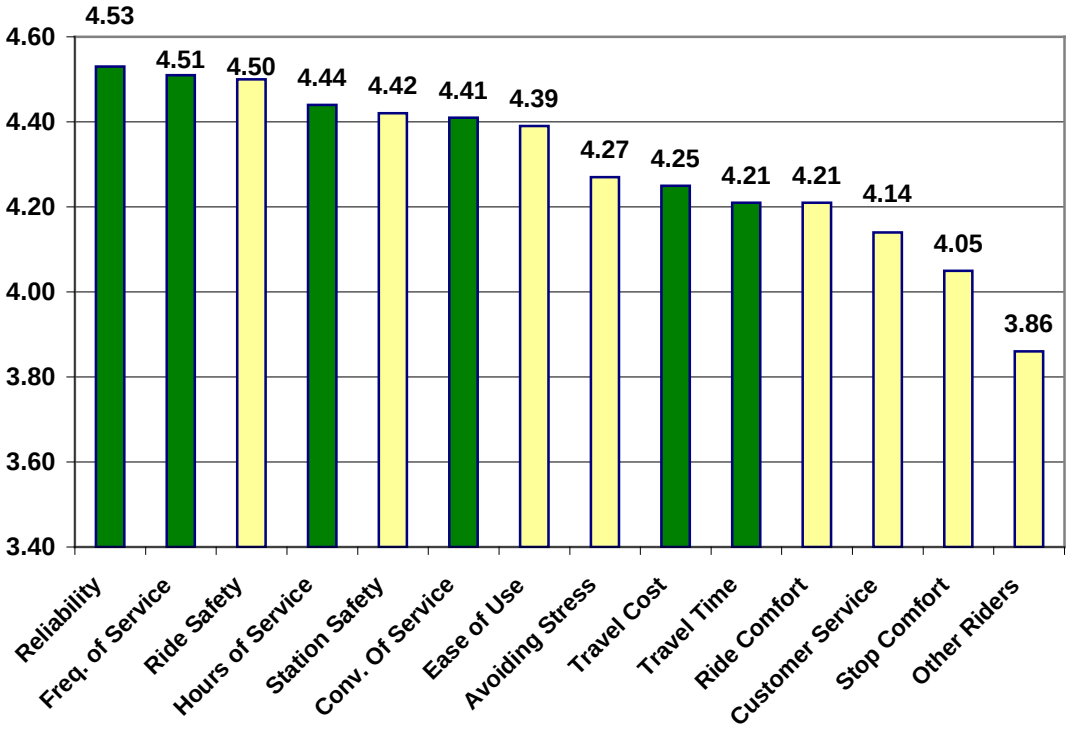
- Travel Cost –transit fares, plus related costs like parking
- Door to door travel time
- Frequency of Service – how often the service runs
- Hours of service – how early or late service runs, and/or weekend hours
- Convenience of service – goes where you need to go/parking availability
- Reliability of service – does the service run on time?

Intangible Variables:

- Safety while riding the service – safety form accidents and/or crime
- Comfort while riding – seats available, temperature, smooth ride, cleanliness, etc.
- Safety at the station/stop – safety from accidents and/or crime
- Comfort at the station/stop – shelter from weather, amenities, etc.
- Customer service – provided by drivers and other transit service staff
- Ease of service use – clear service info, routes easy to figure out, etc.
- Other riders – feeling secure/at ease/compatible with others using the service
- Avoid stress/cost of car use – traffic, parking, accidents, tickets, etc.

The overall importance ratings ranged from a high of 4.53 for reliability, to a low of 3.86 for other riders. Service frequency and span, safety at the stop and while riding, and convenience of service were the other five variables that had an average score above 4.40. The tangible variables are shown in green and the intangible variables in yellow. The top two intangible variables are safety while riding and while at the station.

Figure 5.15 Overall Importance



As shown in Table 5.16 on the following page, the differences between the average ratings of the various performance variables are statistically significant for all but the most closely rated pairs. The table on the following page shows which differences are statistically significant at the five percent level (green) and which are not (orange). Reliability, frequency and ride safety are the three most highly rated performance factors and are statistically equivalent. All three are significantly higher, however, than all other variables.

Table 5.16 Test for Statistical Significance: Differences in Average Importance Ratings

	Average	Reliability	Frequency	Ride Safety	Span	Station Safety	Convenience	Ease	Stress	Cost	Time	Ride Comfort	Service	Station Comfort	Other Riders
Reliability	4.53	NA													
Frequency	4.51	NO	NA												
Ride Safety	4.50	NO	NO	NA											
Span	4.44	YES	YES	YES	NA										
Station Safety	4.42	YES	YES	YES	NO	NA									
Convenience	4.41	YES	YES	YES	NO	NO	NA								
Ease	4.39	YES	YES	YES	YES	NO	NO	NA							
Stress	4.27	YES	YES	YES	YES	YES	YES	YES	NA						
Cost	4.25	YES	YES	YES	YES	YES	YES	YES	NO	NA					
Time	4.21	YES	YES	YES	YES	YES	YES	YES	NO	NO	NA				
Ride Comfort	4.21	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	NA			
Service	4.14	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA		
Station Comfort	4.05	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA	
Other Riders	3.86	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA

The average importance rating of each performance variable was cross-tabulated against current mode of ridership (and non-riders) to determine if there are significant differences in the weight given to the various variables based on current mode. The results are generally consistent across modes with the only key differences being between riders and non-riders as detailed in the next table.

Table 5.17 Average Importance Ratings by Current Mode / Non-Riders

	Avg. Rating	Local Riders	Rapid Riders	Orange Riders	Gold Riders	Blue Riders	Red Riders	Non-Riders
Reliability	4.53	4.49	4.45	4.56	4.53	4.44	4.59	4.62
Freq. of Service	4.51	4.48	4.45	4.56	4.62	4.49	4.61	4.42
Ride Safety	4.50	4.54	4.39	4.54	4.37	4.47	4.43	4.66
Hours of Service	4.44	4.49	4.39	4.48	4.45	4.34	4.49	4.44
Station Safety	4.42	4.43	4.37	4.48	4.28	4.39	4.37	4.54
Conv. Of Service	4.41	4.47	4.26	4.41	4.38	4.32	4.44	4.54
Ease of Use	4.39	4.42	4.31	4.44	4.30	4.25	4.45	4.44
Avoiding Stress	4.27	4.31	4.15	4.27	4.28	4.24	4.41	4.20
Travel Cost	4.25	4.31	4.28	4.35	4.21	4.32	4.35	3.92
Travel Time	4.21	4.22	4.24	4.23	4.10	4.17	4.27	4.18
Ride Comfort	4.21	4.28	4.18	4.26	4.16	4.20	4.23	4.15
Service	4.14	4.27	4.14	4.11	3.89	4.11	4.06	4.25
Stop Comfort	4.05	4.16	4.03	4.05	3.93	4.06	4.12	3.94
Other Riders	3.86	4.08	3.78	3.89	3.80	3.95	3.92	3.64

There are statistically significant differences in the average rating of the importance of performance variables between riders and non-riders. Riders rate frequency, cost, station comfort and other riders higher than non-riders. Conversely, non-riders rate reliability, safety while riding and at the station/stop, convenience, and customer service significantly higher. The average ratings are provided in Table 5.18 below with variables that are statistically higher for either riders or non-riders highlighted in green. For non-riders, ride safety and station safety are the two most important intangible variables, and both are tied with reliability as the most important variable overall.

Table 5.18 Importance Ratings by Riders vs. Non-Riders

	Reliability	Frequency	Ride Safety	Hours	Station Safety	Convenience	Ease of Use	Avoid Stress	Cost	Time	Ride Comfort	Service	Other Riders	Station Comfort
Riders	4.51	4.53	4.46	4.45	4.40	4.38	4.38	4.28	4.31	4.22	4.23	4.12	3.91	4.07
Non Riders	4.62	4.42	4.66	4.44	4.53	4.54	4.44	4.21	3.92	4.17	4.15	4.25	3.63	3.94

The importance of the individual variables was also analyzed by trip-time to see if some variables were more important for longer trip riders than for short trips. Some of the performance variables such as reliability, frequency, hours of service, cost and time appear to be mildly correlated to trip-time, while the remaining variables do not appear to be related to trip-time.

Table 5.19 Importance Variable Ratings by Travel Time

	Reliability	Frequency	Ride Safety	Hours	Station Safety	Convenience	Ease of Use	Avoid Stress	Cost	Time	Ride Comfort	Service	Station Comfort	Other Riders
TRIP TIME														
1-10 MINS	4.53	4.45	4.59	4.33	4.54	4.41	4.43	4.21	4.17	4.08	4.32	4.31	4.17	3.91
11-20 MINS	4.51	4.47	4.60	4.39	4.43	4.44	4.39	4.24	4.19	4.19	4.26	4.17	4.06	3.80
21-30 MINS	4.48	4.44	4.50	4.44	4.42	4.32	4.42	4.30	4.11	4.16	4.20	4.16	3.98	3.89
31-45 MINS	4.54	4.55	4.45	4.42	4.43	4.39	4.38	4.21	4.26	4.21	4.17	4.12	4.08	3.83
46-60 MINS	4.60	4.61	4.52	4.51	4.47	4.49	4.45	4.41	4.34	4.34	4.19	4.10	4.07	3.93
61-90 MINS	4.59	4.60	4.49	4.54	4.42	4.34	4.34	4.18	4.37	4.40	4.16	4.07	3.98	3.77
91+ MINS	4.70	4.63	4.50	4.63	4.47	4.56	4.53	4.40	4.35	4.25	4.39	4.22	4.12	4.03

The relative importance of performance factors was also analyzed by transit and auto-dependency (see Table 5.20 below). Choice riders rate reliability, station safety, convenience, and travel time higher than their transit-captive counterparts. Conversely, Transit-captives put more importance on cost, station comfort and other riders.

Table 5.20 Importance Rating Comparison of Transit Captive and Transit Choice Riders, and Transit Potential and Auto Captive Non-Riders

Overall Importance Ratings	Transit Captive	Transit Choice	Auto Potential	Auto Captive
Reliability	4.47	4.62	4.66	4.60
Frequency	4.50	4.54	4.46	4.32
Ride Safety	4.47	4.54	4.66	4.55
Span	4.45	4.44	4.39	4.37
Station Safety	4.39	4.47	4.58	4.43
Convenience	4.35	4.48	4.50	4.59
Ease	4.37	4.41	4.46	4.37
Stress	4.23	4.32	4.18	4.11
Cost	4.30	4.18	3.99	3.74
Time	4.16	4.28	4.19	4.05
Ride Comfort	4.23	4.19	4.17	3.99
Service	4.16	4.11	4.24	4.24
Station Comfort	4.10	3.98	4.03	3.79
Other Riders	3.91	3.80	3.69	3.51

The importance of performance factors were cross tabulated across the various demographic variables. Due to the large sample size, most of them produced statistically significant differences, although they did not provide any actionable insights. For example, women rated safety while riding and at the stop, and "other riders" at a higher importance level than men. However, they also rated every other performance factor higher in importance as well.

5.5 Rating of Performance Variables for Alternative Transit Modes

The fourteen different performance variables were evaluated using a five-point scale for each of the six transit modes (with the exception of the situation where the respondent indicated they had not heard of the service). Respondents were asked to rate each variable for each service indicating if the service's performance on this variable is very poor (1), poor (2), fair (3), good (4), or very good (5).

Using this scale, the average variable performance ratings for each service are listed below with the bottom score highlighted in orange and the top score highlighted in green.

Table 5.21 Average Variable Performance Ratings for Each Mode – All Respondents

	Local	Rapid	Orange	Gold	Blue	Red
Reliability	3.52	3.82	3.97	3.94	3.94	4.08
Frequency	3.49	3.81	3.92	3.86	3.88	4.01
Ride Safety	3.88	4.01	4.05	4.05	3.91	4.07
Span	3.61	3.72	3.84	3.77	3.84	3.91
Station Safety	3.76	3.87	3.97	3.95	3.80	4.00
Convenience	3.73	3.92	3.98	3.97	3.95	4.09
Ease of Use	3.86	4.00	4.03	4.01	4.03	4.15
Stress	4.00	4.13	4.15	4.16	4.16	4.23
Travel Cost	3.78	3.81	3.81	3.77	3.80	3.84
Travel Time	3.60	4.07	4.00	3.94	3.94	4.20
Ride Comfort	3.64	3.82	3.91	3.94	3.87	3.98
Service	3.70	3.80	3.87	3.84	3.85	3.93
Station Comfort	3.33	3.46	3.71	3.68	3.63	3.76
Other Riders	3.48	3.63	3.70	3.71	3.59	3.70
Average Rating	**3.67**	**3.85**	**3.92**	**3.90**	**3.87**	**4.00**

As noted earlier, Metro Local received the lowest overall rating, and the Red Line received the highest overall rating. It is not a surprise then that Metro Local received the lowest rating on all performance variables with the exception of travel cost, and that the Red Line received the highest rating on all variables other than "other riders."

It is interesting to compare the performance ratings for the Blue and Gold Lines, which are both light rail, but which serve different geographic areas. The ratings are very similar for both lines for: reliability, frequency, convenience, ease of use, stress, travel cost, travel time and service. However, the Blue Line scores lower on safety (both when riding and at the station), other riders, and to a lesser extent, comfort (both riding and at the station). The sole positive point of comparison for the Blue Line is the performance rating for the span of service. Thus, it appears that the difference in overall rating between these two services is primarily due to the perceived performance level for intangible variables.

When comparing the Orange Line and Metro Rapid, the differences are the result of both tangible and intangible factors. The Orange Line received higher average ratings on almost all factors with the only exceptions being travel cost and travel time. The top five differences in ratings were a combination of tangible and intangible factors with the first and fifth being intangible (station comfort – 0.25 and station safety – 0.10) and second through fourth being tangible variables (reliability – 0.15, span – 0.12, and frequency – 0.11).

When comparing the Orange and Blue Lines, the Orange Line rated higher on both tangible and intangible variables. However, the Orange Line's higher overall rating is clearly more attributable to intangible variables. For tangible variables, the Orange line scored higher on reliability, frequency, and travel time, but the average difference was only 0.04. The Orange Line scored significantly higher for station safety, ride safety, other riders, and station comfort. For these intangible variables, the average margin was 0.12, three times the difference in ratings for tangible variables.

There are four tiers of perceived reliability for the alternative modes of transit, with perceived reliability increasing with level of investment. Metro Local is the lowest (3.52), followed by Metro Rapid (3.82). The Orange Line and both light rail lines (3.94-3.97) are equivalent to each other, but higher than Metro Rapid and lower than the Red Line, which is believed to be the most reliable, being rated at 4.08 on the five-point scale. Although the differences are not as large, ride comfort, customer service and station comfort also follow the same pattern of increasing performance ratings with the level of investment.

The following table shows tests of statistical significance (5%) for pairs of transit services for average ratings for each performance factor. Those where the row service is significantly higher than the corresponding column service are identified highlighted in green. Those that are significantly higher are highlighted in blue, and those that are not significantly different are highlighted in orange.

Table 5.22 Test of Statistical Significance: Performance Ratings of Each Mode

Reliability

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	4.08	NA					
Orange	3.97	YES	NA				
Gold	3.94	YES	NO	NA			
Blue	3.94	YES	YES	NO	NA		
Rapid	3.82	YES	YES	YES	YES	NA	
Local	3.52	YES	YES	YES	YES	YES	NA

Avoiding Stress

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	4.23	NA					
Orange	4.15	YES	NA				
Gold	4.16	YES	NO	NA			
Blue	4.13	YES	NO	YES	NA		
Rapid	4.13	YES	NO	YES	NO	NA	
Local	4.00	YES	YES	YES	YES	YES	NA

Frequency

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	4.01	NA					
Orange	3.92	YES	NA				
Gold	3.86	YES	YES	NA			
Blue	3.88	YES	YES	NO	NA		
Rapid	3.81	YES	YES	YES	YES	NA	
Local	3.49	YES	YES	YES	YES	YES	NA

Cost

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	3.84	NA					
Orange	3.81	NO	NA				
Gold	3.77	YES	YES	NA			
Blue	3.80	YES	NO	NO	NA		
Rapid	3.81	YES	NO	NO	NO	NA	
Local	3.78	YES	YES	NO	YES	YES	NA

Ride Safety

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	4.07	NA					
Orange	4.05	NO	NA				
Gold	4.05	NO	NO	NA			
Blue	3.91	YES	YES	YES	NA		
Rapid	4.01	YES	YES	YES	YES	NA	
Local	3.88	YES	YES	YES	YES	YES	NA

Time

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	4.20	NA					
Orange	4.00	YES	NA				
Gold	3.94	YES	YES	NA			
Blue	3.94	YES	YES	NO	NA		
Rapid	4.07	YES	YES	YES	YES	NA	
Local	3.60	YES	YES	YES	YES	YES	NA

Hours of Service

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	3.91	NA					
Orange	3.84	YES	NA				
Gold	3.77	YES	YES	NA			
Blue	3.84	YES	NO	YES	NA		
Rapid	3.72	YES	YES	YES	YES	NA	
Local	3.61	YES	YES	YES	YES	YES	NA

Ride Comfort

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	3.98	NA					
Orange	3.91	YES	NA				
Gold	3.94	NO	YES	NA			
Blue	3.87	YES	YES	YES	NA		
Rapid	3.82	YES	YES	YES	YES	NA	
Local	3.64	YES	YES	YES	YES	YES	NA

Table 5.23 Test of Statistical Significance: Performance Ratings of Each Mode (Continued)

Station Safety

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	**4.00**	NA					
Orange	**3.97**	NO	NA				
Gold	**3.95**	NO	NO	NA			
Blue	**3.80**	YES	YES	YES	NA		
Rapid	**3.87**	YES	YES	YES	YES	NA	
Local	**3.76**	YES	YES	YES	YES	YES	NA

Service

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	**3.93**	NA					
Orange	**3.87**	YES	NA				
Gold	**3.84**	YES	NO	NA			
Blue	**3.85**	YES	NO	NO	NA		
Rapid	**3.80**	YES	YES	YES	YES	NA	
Local	**3.70**	YES	YES	YES	YES	YES	NA

Convenience

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	**4.09**	NA					
Orange	**3.98**	YES	NA				
Gold	**3.97**	YES	NO	NA			
Blue	**3.95**	YES	NO	YES	NA		
Rapid	**3.92**	YES	YES	YES	YES	NA	
Local	**3.73**	YES	YES	YES	YES	YES	NA

Station Comfort

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	**3.76**	NA					
Orange	**3.71**	YES	NA				
Gold	**3.68**	YES	NO	NA			
Blue	**3.63**	YES	YES	YES	NA		
Rapid	**3.46**	YES	YES	YES	YES	NA	
Local	**3.33**	YES	YES	YES	YES	YES	NA

Ease of Use

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	**4.15**	NA					
Orange	**4.03**	YES	NA				
Gold	**4.01**	YES	NO	NA			
Blue	**4.03**	YES	NO	NO	NA		
Rapid	**4.00**	YES	YES	YES	YES	NA	
Local	**3.86**	YES	YES	YES	YES	YES	NA

Other Riders

	Avg.	Red	Orange	Gold	Blue	Rapid	Local
Red	**3.70**	NA					
Orange	**3.70**	NO	NA				
Gold	**3.71**	NO	NO	NA			
Blue	**3.59**	YES	YES	YES	NA		
Rapid	**3.63**	YES	YES	YES	NO	NA	
Local	**3.48**	YES	YES	YES	YES	YES	NA

5.6 Impact of Performance Variables on Overall Rating of Transit Modes

One of the key goals of this project was to build a model to predict ratings of the various transit modes, and then to assess the relative importance of each variable in terms of its predictive value. To this end, fourteen different performance variables were evaluated as potential causal variables using a five-point scale, and used to rate each of the six transit modes (with the exception of the situation where a respondent indicated they had not heard of the service).

The goal was to build a regression model using these variables. As would be expected, the results for these variable ratings were relatively highly correlated to each other (see the following table). As such it would not be possible to build a regression model using all 14 variables. Even if each variable was relatively independent, it would require a very large sample size to provide sufficient variance to support 14 significant variables.

Table 5.24 Average Correlations Between the 14 Performance Variables (Average of correlations for all six transit modes)

	Overall	Conven.	Reliability	Ease of Use	Frequency	Ride Comf.	Ride Safety	Stop Comf.	Time	Stop Safety	Stress	Service	Span	Riders	Cost
Overall	1.000														
Conven.	0.641	1.000													
Reliability	0.635	0.635	1.000												
Ease of Use	0.635	0.694	0.618	1.000											
Frequency	0.601	0.610	0.659	0.579	1.000										
Ride Comf.	0.593	0.621	0.601	0.600	0.551	1.000									
Ride Safety	0.580	0.581	0.581	0.579	0.535	0.658	1.000								
Stop Comf.	0.560	0.591	0.610	0.551	0.576	0.637	0.583	1.000							
Time	0.538	0.518	0.523	0.497	0.547	0.472	0.474	0.462	1.000						
Stop Safety	0.537	0.520	0.548	0.516	0.541	0.586	0.679	0.589	0.473	1.000					
Stress	0.531	0.535	0.532	0.544	0.474	0.497	0.510	0.480	0.435	0.459	1.000				
Service	0.528	0.505	0.587	0.518	0.504	0.539	0.516	0.528	0.431	0.504	0.437	1.000			
Span	0.516	0.544	0.553	0.513	0.612	0.492	0.465	0.506	0.464	0.454	0.398	0.484	1.000		
Riders	0.494	0.479	0.536	0.497	0.492	0.549	0.531	0.548	0.424	0.530	0.421	0.561	0.470	1.000	
Cost	0.439	0.433	0.453	0.463	0.439	0.438	0.422	0.430	0.374	0.432	0.400	0.441	0.479	0.423	1.000

Since the variables could not be used in their entirety, they were compressed into independent variables using factor analysis. Factor solutions were derived for two, three, four, five, and six factors for Metro Local, the Orange Line and the Red Line[11] to determine which would provide the most meaningful and predictive information. The five-factor solution provided the most logical and predictive results for these three selected modes. Solutions

[11] Metro Local, the Red Line and the Orange Line were selected as the lowest, highest and a medium investment option to provide a representative sample of the available options.

with four or fewer factors were not as explanatory and did not explain as much variance as the five-factor models. Conversely, the six-plus factor solutions provided additional factors that did not add a significant increase in explained variance, and did not provide additional clear insights. Accordingly the five-factor model was selected as the optimal solution (See Appendix J for five-factor solutions for all six transit modes).

The factor analysis approach provides models that explain 55 to 60 percent of the variance in ratings for the services and the factors are completely independent. However, there is a significant analytical drawback with this approach. Since there must be six different models, one for each transit mode, there would be six different factor solutions so it would not be possible to compare the factor loadings to assess their relative importance in predicting overall opinion across different modes.

To overcome this shortcoming, two additional modeling approaches were evaluated. The first was to select individual variables that most closely correlated to the factors selected in the factor solutions, and which had lower correlations to the other four variables being modeled. The second alternative was to select one or more variables (up to four for one factor) that loaded heavily with the factor in question, and which appeared to have a logical relationship. These variables were then combined into an index by adding their rating scores and dividing by the number of variables used to represent the factor. For example; for Index 3 below, the scores for stop safety, ride safety, stop comfort and ride comfort were added and then divided by four to create the index. This ensured that each index would have the same score-scale for the regression modeling.

The index approach started with five predictive "indices" as follows:

Index 1: Travel time / Hours of Service / Frequency of trips
Index 2: Avoiding stress / Convenience / Ease of Use
Index 3: Stop safety / Ride safety / Stop comfort / Ride Comfort
Index 4: Customer service / Other riders
Index 5: Cost

Although reliability is rated as the most important variable and has one of the highest correlations with overall service rating, it did not have as high a correlation with the first independent factor as travel time, hours of service and frequency. It also had higher correlations than these variables with the other independent factors. Since it does not explain as much variance within the context of the factor analysis, it was not included in the regression models.

The individual variable approach selected the optimal single variable from each set using high correlation to the factor it loads most highly to, and relatively low correlation to the other, independent factors. This provides variables that are least correlated to each other and should explain the highest proportion of variance in predicting overall opinions.

The five individual variables were:

- Frequency of service,
- Avoiding stress,
- Stop safety,
- Customer service, and
- Cost.

The factor-regression model explained 61 percent of the variance in overall rating scores for the local bus model. The index-regression model explained 60 percent, and the individual variable model explained 53 percent. The index model provides the advantage of having the ability to use the same independent variables for the regression models for each transit mode. It also provides a significantly higher predictive value (explained variance), and offers increased face validity based on the inclusion of several variables that would be likely to impact overall opinions of the various modes. Based on this, the index regression model was selected as the best option.

When conducting the regression modeling using the index approach, it became apparent that the last variable, cost, did not have a statistically significant t-value and the adjusted R-square for the model was still 60 percent without this variable. Accordingly, although cost would appear to be a logical addition, it was dropped from the model, leaving a four index-variable regression model.

The following table provides the R-square, constant, and the weights for each of the index variables for all six transit modes. The R-square ranges from a low of 55 percent for Metro Rapid to the high of 60 percent for Metro Local.

Table 5.25 Regression Model – Performance Factors

	R Square	Constant	Travel time/Span/ Frequency	Avoiding stress/ Convenience/ Ease of Use	Safety/Comfort	Customer Service/ Other Riders
Local	59.9%	-.011	.321	.437	.145	.097
Rapid	55.3%	.474	.250	.434	.130	.090
Orange	56.9%	.425	.274	.401	.179	.067
Gold	57.3%	.478	.211	.411	.226	.059
Blue	57.5%	.310	.201	.364	.292	.082
Red	56.7%	.473	.212	.344	.276	.086

The model shows that avoiding stress/convenience/ease of use is consistently the most important factor in overall rating of transit modes. This is followed at a much lower level by

travel time/hours of service/frequency of service, and safety/comfort (at both stops and while riding). The former variable is weighted more heavily for the bus services (local, rapid and Orange Line), while safety/comfort is rated more highly for both light and heavy rail.

The final variable, customer service/other riders, is significantly lower in impact, at about one-fifth the level of the preceding two variables. It is interesting to note, however, that this variable is higher for Local, Rapid, and the Blue and Red Lines, and less heavily weighted for the Orange and Gold Lines, which travel through more affluent areas.

Although there is some variation in the weighting across the different mode models, the order of the importance of the weights is consistent across all models with sole exception of safety/comfort being rated higher than travel time/span/frequency for the rail models. Other than this exception, avoiding stress/convenience/ease of use is always the heaviest weight, followed by travel time/span/frequency, then safety/comfort, and finally customer service/other riders.

To test the impact of awareness on the ability to predict overall opinion, awareness was added to the regression model to see if this would reduce unexplained variance. Unfortunately the results were disappointing. Awareness was a statistically significant variable for only three of the six models, and did not increase the R-square in two out of the three models where it was statistically significant. Although awareness by itself does provide predictive value for overall ratings, it is apparently too closely correlated to the other variables already included in the models to significantly reduce the remaining unexplained variance. Accordingly it was not included.

Two of the indices are comprised entirely of intangible variables and one is comprised solely of tangible variables. The remaining index includes two intangibles (avoiding stress, ease of use), and one tangible variable (convenience). To try to provide a clear differentiation of impact between tangible and intangible variables, the indices were recalculated moving convenience to the single tangible variable index and the models re-run. Unfortunately, the results from this approach provided significantly lower R-squares, so this approach was abandoned.

Regression models were also run using only tangible variables. Although this provided a slightly higher R-square for the Red Line model, it was generally lower for all other modes, and thus the combined tangible and intangible variable model was retained.

5.7 Key Findings and Conclusions

- The survey results across all rider and non-rider groups show that there are significant differences in perceptions of the different transit modes. Using a scale from very poor (1) to very good (5), respondents provided a rating of their overall opinion of each service, and the results show four clear tiers of perceived service. The heavy rail Red Line receives the highest overall rating at 4.18. This is followed by the Full-Service BRT Orange Line (4.08) and light rail Gold Line (4.06) which comprise the second tier. This in

turn is followed by the Metro Rapid BRT-Lite (4.01) and light rail Blue Line (3.98), and finally by local bus service, Metro Local at 3.70[12].

- The ratings of services generally follow the investment level required to provide each service, with two exceptions. The first is the difference between the Blue Line and the Gold Line, with the Gold Line receiving a higher score than the Blue Line, even though they are both light rail. The second is the Orange Line, which outperforms its investment cost, rating as high as the light rail Gold Line.

- Although the Gold and Blue Lines represent the same mode of transit, they serve different areas. Both Lines receive similar scores on most of the tangible variables. However, the Gold Line received a higher overall rating primarily due to higher ratings for key intangible variables: safety (both at the station and onboard), and perceptions of other riders. At a lower differential, comfort was also rated higher for the Gold Line.

- When comparing the Orange Line and Metro Rapid, the differences are the result of both tangible and intangible factors. The Orange Line received higher average ratings on almost all factors with the only exceptions being travel cost and travel time. The top five differences in ratings were a combination of tangible and intangible factors with the first and fifth being intangible (station comfort – 0.25 and station safety – 0.10) and second through fourth being tangible variables (reliability – 0.15, span – 0.12, and frequency – 0.11).

- When comparing the Orange and Blue Lines, the Orange Line rated higher on both tangible and intangible variables. However, the Orange Line's higher overall rating is clearly more attributable to intangible variables. For tangible variables, the Orange line scored higher on reliability, frequency, and travel time, but the average difference was only 0.04. The Orange Line scored significantly higher for station safety, ride safety, other riders, and station comfort. For these intangible variables, the average margin was 0.12, three times the difference in ratings for tangible variables.

- The ratings of the different transit modes are generally consistent across demographic variables. The exceptions include higher ratings for Metro Local and Metro Rapid by Hispanics and African Americans than by Caucasians and Asians, and also a decrease in ratings for these two modes as income rises up to $99,999. Those with a household income of $100,000 or more then provide higher ratings than those in the next lowest income category.

- Awareness and familiarity with the different services vary significantly, with Metro Local having the highest level of awareness. This is followed by Metro Rapid and the Red Line at similar levels, and then the Orange and Blue Lines at a lower level. Awareness of the Gold Line is lower than all other modes.

[12] Ideally, the goal was to assess the differences in ridership attraction. However, due to geographic positions of services and rider participants, respondents would not be able to provide ratings of likelihood to ride on an equal basis. To overcome this, rating each service from "very poor" to "very good" was used as the best substitute for ridership attraction, as riders could better assess a general opinion across the different services regardless of their location relative to the service.

- Overall opinion of the different transit services is positively correlated to familiarity with the service. As would be expected, riders for each mode rate their mode higher than the average rating for the mode.

- Also, the modes with lower awareness show greater increases in average overall ratings as familiarity increases. Metro Local, which has the highest overall level of familiarity, shows the smallest change in opinion, with average awareness increasing only 0.1 from "know, but don't use" to "use regularly." Conversely, the Orange and Gold Lines, which have the lowest level of familiarity, increase 0.43 and 0.41 respectively with increased familiarity. One exception to this rule is the Blue Line, which has an awareness rating similar to the Orange Line, but a lower increase in ratings with increased awareness (0.18). This might be attributable to a more positive experience on the Orange Line than on the Blue Line, as indicated by the overall higher ratings for the Orange Line.

- With regard to the importance of the 14 performance variables, the top four tangible variables (average importance score above 4.0) are: reliability, frequency of service, hours of service and convenience of service. For intangible variables, the top two variables with scores above 4.0 are ride safety and safety at the stop or station. "Other riders" received the lowest overall importance rating of 3.86, well below all other variables.

- "Other riders" received the lowest overall importance rating for any of the tangible or intangible performance variables. In spite of this, it explained a significant amount of the variance in the regression modeling of overall ratings. Accordingly it was included in the final regression model. The importance of other riders also varied by mode with an average importance rating above 4.0 for Metro Local riders and above 3.9 for Blue and Red Line riders.

- Assessing the impact of intangible variables, it is clear that riders and potential riders consider both tangible and intangible variables in determining their overall opinion of each transit service. However, there are differences in which variables are most important to each group. Riders put more weight than non-riders on service frequency, cost, station comfort and other riders. Conversely, non-riders put more weight on reliability, safety while riding and at stops (the most important intangible variable for non-riders), convenience, and customer service. For non-riders, safety while riding and at the stop were tied with reliability as the most important performance factor ratings.

- In line with the overall service ratings, the Red Line, which had the highest overall rating, received the highest performance ratings across 13 of the 14 performance variables. Similarly, Metro Local, which had the lowest overall rating, had the lowest scores on 13 of the 14 performance variables.

- Because of high correlations between the 14 performance factor variables, factor analysis was used to consolidate the variables into independent factors which could be used to produce regression models of overall ratings for each of the transit services. Although the factor approach provides the highest level of explained variance, it would require six different sets of factor variables, one for each mode regression model. Since the variable

loadings on the factors would not be the same, the weights on the factors could not be compared across the different models to determine their impact on predictive ability. Accordingly, a variable-index approach was employed that provided similar predictive ability while maintaining a constant use of variables across all six models. The final regression models had R-squares of between 55 and 60 percent.

- Although reliability is rated as the most important variable and has one of the highest correlations with overall service rating, it did not have as high a correlation with the first independent factor as travel time, hours of service and frequency. It also had higher correlations than these variables with the other independent factors. Since it does not explain as much variance within the context of the factor analysis, it was not included in the regression models.

- Also, although cost would appear to be a logical and independent variable when rating overall opinion of different transit modes, it did not have a statistically significant t-value in the regression models, and the adjusted R-square for the model did not decline significantly without it. Since it does not have significant predictive value for overall ratings, it was dropped from the regression model.

- The most heavily weighted performance index across all six models was "avoiding stress / convenience / ease of use." This was followed at a lower level by "travel time / span / frequency," and then "safety / comfort." The lowest weighted variable was "customer service / other riders."

- Overall the model showed general consistency in the weights attached to the index variables across the different transit modes. The key exceptions are: 1) the model for Metro Local has a constant near zero and the tangible index-variable, "travel time/span/frequency", accounts for a higher proportion of the index-variable weights than for other modes, and 2) safety/comfort accounts for a higher proportion of the index-variable weights for the rail models than for the models for bus transit modes.

- In summary, there are significant differences in overall opinions of different transit services and these are influenced by both tangible and intangible variables. The models provide a clearer understanding of the development of opinions about transit, but still only explain approximately 60 percent of the variance in the evaluation process. This is likely a combination of two factors; first, the inability to provide completely logical assessments of modes that cannot be feasibly used due to geographic or other availability considerations, and second, the potential for some other variable or variables in the evaluation process that are still not being measured. Additional research starting with a qualitative study reviewing survey results with respondents might provide insights into this issue.

6. Conclusions

The overall project conclusions section has been structured around the core research questions defined upon completion of the literature review.

6.1 Do people perceive alternative rapid transit modes differently?

In short, yes. It was concluded that statistically significant differences existed in the overall ratings achieved by the alternative transit modes, which they separated into four different tiers:

- Tier 1: Rated lowest was the local bus service
- Tier 2: BRT-Lite and the Blue Line LRT
- Tier 3: High level BRT and the Gold Line
- Tier 4: Rated highest was the Red Line HRT

Redhill Group concluded that the overall service ratings of each mode generally followed the relative level of investment required to provide each service. This issue has been investigated further, by considering the actual level of investment associated with each mode (defined here in terms of capital cost per mile[13] in 2005 dollars), as extracted from Table 2.1 (Chapter 2). Figure 6.1 on the next page compares each mode in terms of capital cost per mile and overall rating, and also shows the position of the four tiers defined above.

Figure 6.1 illustrates the large disparity in investment level, with the Red Line costing approximately one thousand times the capital cost per mile of the local bus service and Metro Rapid. While local bus and Red Line represent the lower and upper extremes of the variation in investment level and overall rating, the remaining modes are all "bunched" in the same area of the figure. Focusing on the Tier 2 services, it can be seen that the Metro Rapid achieves a slightly higher rating than the Blue Line (in statistical terms these two are considered to have the same rating) for a fraction of the investment cost per mile ($0.355M versus $59.1M). Given that the investment level associated with the Metro Rapid is much closer to that of the local bus than it is to any of the other modes under consideration, it must be concluded that the Metro Rapid performs remarkably well in terms of overall rating achieved per dollar of investment, and therefore represents a very cost effective form of BRT. Considering the Tier 3 services, it can be seen that the Orange Line achieves a slightly higher rating than the Gold Line (though again, in statistical terms these two are rated at the same level) for approximately one third of the investment cost per mile. This indicates that the

[13] It should be noted that capital cost per mile has been used to represent investment level due to the absence of lifecycle cost data. Such data would include capital costs plus a summation of operating costs over the lifetime of the project. One further caveat regarding capital costs relates to the issue of urban context. Issues such as land costs associated with right-of-way acquisition, and whether expensive tunneling is required, play a significant role in determining overall capital costs. This makes it difficult to make accurate universal inferences by comparing the cost of rapid transit projects in different locations, even within the same city. In summary, an accurate cost comparison of different rapid transit modes would ideally be based on the assessment of each mode's lifecycle costs within the same corridor, and within a similar timeframe. Thus, the information provided in Figure 6.1 must be considered with this caveat in mind.

Orange Line also performs well in terms of overall rating achieved per dollar of investment, though not to the dramatic level associated with the Metro Rapid. Overall, the figure shows that BRT (even in its lower investment forms) can compete with rail-based transit (at least in the perception of the general public) in return for lower capital cost investments. The question of whether these perceptions translate into similar levels of ridership attraction is a topic for further research.

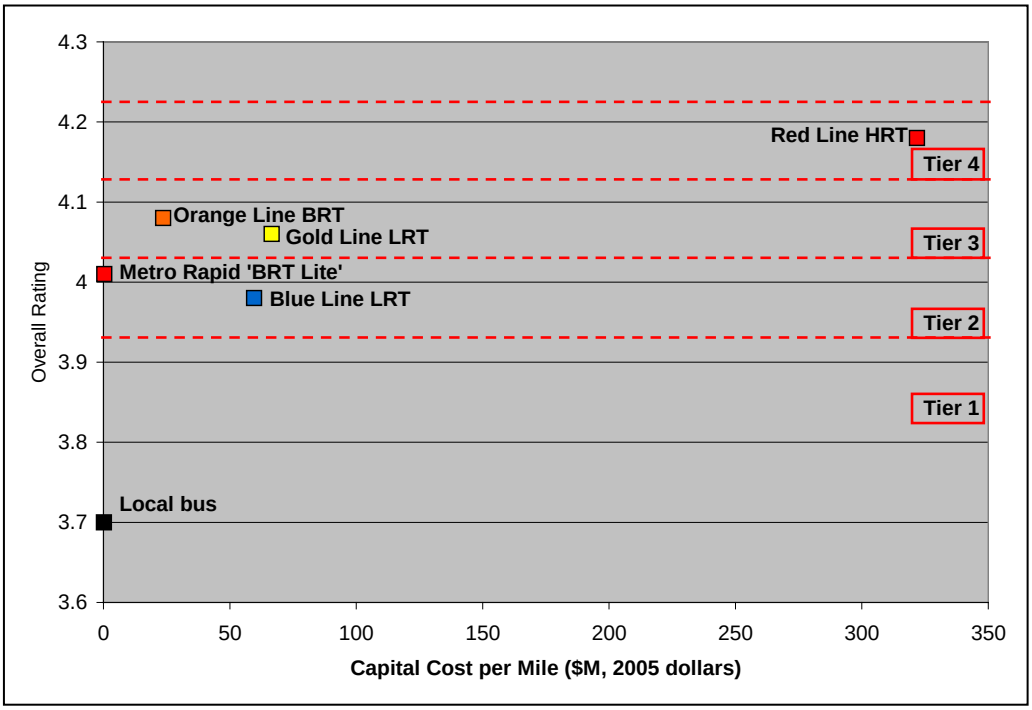


FIGURE 6.1 – Four Tiers of Overall Rating of Alternative Modes

6.2 If modal differences exist, where do they originate?

Why do the statistically significant differences described above exist? Redhill Group observed that level of investment played a role, with local bus having the lowest investment level and the lowest rating, and the Red Line having the highest investment and the highest rating. However, besides these two obvious extremes, the ratings achieved by the remaining modes were clearly not simply proportional to respective level of investment. This section discusses why this was the case, by assessing the influence of the different tangible and intangible attribute ratings on the overall ratings of each mode.

The first issue to consider is why the Blue and Gold Lines were rated differently, even though they are essentially the same mode at approximately the same level of investment. Further investigation showed that the higher overall rating achieved by the Gold Line can be attributed primarily to higher ratings for key intangible variables: safety (both at the station and onboard), and to perceptions of other riders. Qualitative research performed within this study suggests that this finding speaks to the wider issue of urban context – the hypothesis

being that the urban context through which a transit mode runs exerts a significant impact on the relative attractiveness of that mode. Given that the Blue Line runs through some of the most economically deprived areas of the city, while the Gold Line serves relatively affluent areas, it seems reasonable to hypothesize that the difference in overall rating between these two light rail lines originates in the respective differences in urban context.

How was the Orange Line able to achieve an overall rating level that was equivalent to the Gold Line and significantly higher than the Blue Line for approximately one-third the capital investment level? A comparison of the Orange and Blue Lines showed that these two services achieved comparable tangible attribute ratings, and that the primary differences lay in significantly lower ratings for the Blue Line on the intangible attributes of ride safety, station safety, and other riders. Given that these are the same three factors responsible for the disparity between the Gold Line and the Blue Line, it is hypothesized that urban context also plays a role here. It appears that the influence of the urban area through which a rapid transit service runs has a larger impact on overall perceptions than whether it is based on bus or rail technology[14]. Given that the Orange Line achieved similar ratings to the Gold Line in terms of both tangible and intangible attributes, it can be concluded that "Full Service" BRT is capable of replicating both the functionality standards (tangible attributes) and image qualities (intangible attributes) normally associated with light-rail transit, at least in the perception of the general public. In the words of one focus group participant: "*It's not a bus, it's a train-bus!*"

It was important to understand how the two different forms of BRT, representing opposite ends of the BRT investment spectrum, are viewed by the public. It was found that the Orange Line's significantly higher overall rating originated in higher ratings on both the tangible and intangible attributes, though by far the largest single difference was in relation to station comfort. This implies that the Orange Line is superior in the eyes of the public both in terms of tangible service attributes like span, frequency and reliability, and also on intangibles like comfort and safety, and is thus more likely to succeed in attracting the coveted 'potential rider' market segment. However, while the Orange Line is perceived as superior, it should be noted that the Metro Rapid achieved an overall rating that was only slightly lower, while costing around 100 times less to provide.

Finally, it was important to understand why BRT-Lite systems like the Metro Rapid achieve significantly higher ratings than the local bus system, given that both make use of the same mixed traffic runningway type. The most significant differences in attribute ratings were found in relation to travel time, followed by frequency and reliability. So while the Metro Rapid also achieved higher ratings on important intangible attributes like safety and comfort, it appears that the attraction of "BRT-Lite" over the local bus service relates to a perception of higher levels of functional service performance. This finding was also corroborated in the focus groups, where BRT-Lite was typically perceived as the high-performance version of the regular bus network.

[14] As with capital costs (see Footnote 13), an accurate comparison of perceptual differences across different transit modes would ideally be conducted within the same urban context or corridor.

6.3 Can Ridership Attraction be linked to specific Tangible and Intangible Factors?

While the ultimate goal was to assess modal differences in ridership attraction potential, respondents residing in different parts of Los Angeles would not be in a position to provide useful information on their likelihood of riding the different geographically dispersed transit services (except perhaps for the more ubiquitous local bus and Metro Rapid networks). To overcome this, rating each service from "very poor" to "very good" was used as the best substitute for ridership attraction, as riders could better assess a general opinion across the different services regardless of their location relative to the service. Thus, "overall rating" was used as a proxy for "ridership attraction potential," though we acknowledge that these are considerably different. A more extensive rapid transit ridership forecasting study (37) is currently underway that aims to look in more detail at the issue.

While accepting the caveat described above, some progress was made in understanding the influence of different tangible and intangible factors on modal perceptions. In terms of overall importance, the tangible attributes of reliability and service frequency received the highest overall ratings, along with the intangible attribute of ride safety. These were closely followed by the tangible attribute of service span and the intangible attribute of station safety. Thus, it is clear that the public consider both tangible and intangible factors in determining their overall opinion of alternative transit services, and that reliability is the most important tangible factor and safety is the most important intangible factor. Interestingly, modal perceptions of reliability also tended to increase roughly in line with relative investment level, with local bus rated lowest, followed by Metro Rapid, followed by the Orange Line and the two light rail lines at the same level, with the Red Line achieving the highest perceived reliability. Given the importance of safety, it is also worth noting that local bus and Blue Line received much lower ratings for ride safety and station safety compared to the other modes.

High correlations between tangible and intangible attributes made it impossible to isolate the contribution of individual attributes to overall modal ratings, so an index regression model was developed to investigate the explanatory power of different factor groups. In general, the model reinforced the hypothesis that a mix of tangible and intangible attributes combine to determine ridership attraction potential. Interestingly, reliability was not included in the model despite being rated the most important tangible attribute, and neither was cost. The factor weightings were relatively consistent across the different modes, suggesting that the relative explanatory power of the different tangible and intangible attributes are not mode specific. However, ratings for the local bus were found to be more heavily influenced by the tangible attribute group that included travel time, service span and service frequency, while the rail modes were more heavily influenced by the intangible safety/comfort factor group. Further research could test the hypothesis that functionality is more of a determinant for the attractiveness of lower-investment bus-based services, which tend to focus on 'no-frills' provision of basic mobility, while intangible aspects like safety and comfort are more influential in determining the attractiveness of higher investment BRT and rail-based modes. It is conceivable that once basic mobility needs have been met, riders then turn their attention to intangible aspects like safety and comfort. Such behavior would be consistent with Maslow's famous Hierarchy of Needs theory (38), in which basic human physiological needs are required to be met before other higher-level needs such as self-esteem can be considered. Perhaps the same is true of mobility.

6.4 What variations exist with regard to socio-economic/geographic factors?

The overall ratings for the different transit modes were generally consistent across demographic variables. The exceptions included higher ratings for Metro Local and Metro Rapid by Hispanics and African Americans than by Caucasians and Asians, and also a decrease in ratings for these two modes as income rose up to $99,999. However, these relationships could exist at least in part to higher levels of familiarly among the demographic groups in question.

The sample was divided into four transit market segments: transit captive, transit choice, auto potential and auto captive. The only observed statistically significant difference in overall ratings was that transit captives rated the Metro Rapid higher than the transit choice. With the exception of the Red Line, auto users (captive and potential) rated the Orange Line and the two light rail lines higher than did transit users (captive and choice), though it should be noted that these differences were not statistically significant.

Overall opinion of the different transit services was positively correlated to familiarity with the service. In each case, riders rated their current transit mode higher than those who didn't ride it, which is clearly due to self-selection bias. Also expected was the observation that transit captives were more familiar with all the transit modes compared to the other groups, and that auto users were less familiar with the transit modes compared to transit users.

Similar to the overall ratings section, service familiarity was higher for Hispanics and African Americans than Asians or Caucasians for Metro Local and Metro Rapid. Age was also correlated with familiarity for these two services, decreasing as age increased.

The importance of the different tangible and intangible attributes were cross tabulated across the various demographic variables and due to the large sample size, most of them produced statistically significant differences, though they did not provide any actionable insights. For example, women rated safety while riding and at the stop, and "other riders" at a higher importance level than men. However, they also rated every other performance factor higher in importance as well. Cost was rated more important by transit captives than by the other three market segments, and this difference was statistically significant. For transit choice riders, travel time was rated higher than for the other groups, and this difference was also statistically significant. It is conceivable that cost would be more of an issue for transit captives, who tend to have lower-incomes, while travel time would be more of an issue for transit choice riders, who have the option of traveling by private auto.

Riders put more weight than non-riders on service frequency, cost, station comfort and other riders. Conversely, non-riders put more weight on reliability, safety while riding and at stops (the most important intangible variable for non-riders), convenience, and customer service. For non-riders, safety while riding and safety at the stop were tied with reliability for the most important performance factor rating.

In summary, there were significant differences in overall opinions of different transit services, which were influenced by both tangible and intangible variables. The models provided a clearer understanding of the development of opinions about transit, but still only explained approximately 60 percent of the variance in the evaluation process. This was likely due to a combination of two factors; first, the inability to provide completely logical assessments of modes that cannot be feasibly used due to geographic or other availability considerations, and second, the potential for some other variable or variables in the evaluation process that are still not being measured. Additional research starting with a qualitative study reviewing survey results with respondents might provide insights into this issue.

One final point to note is that these findings were obtained in just one U.S. urban area. Thus, they must be regarded as context-specific and cannot be generalized to other urban areas until further research has been conducted.

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Appendix I – Focus Group Topic Guide

BRT IMAGE AND PERCEPTION RESEARCH PROJECT

- FOCUS GROUP TOPIC GUIDE

This topic guide provides a general overview of the discussion topics to be covered in the focus group sessions. The topic guide will be used by the focus group moderators to ensure that the structure of the session is maintained, and that the time is used effectively. It should be noted that free discussion is encouraged in the sessions and that the moderator will permit digression onto related topics if they feel they are of importance to the main topic area.

Introductory Statement from Focus Group Moderator: **2** ***mins***

"Hello everyone and thanks for coming along today / tonight. My name is 'xxxxxxx' and I am helping conduct a research project for the University of South Florida on transportation issues. Today we will be talking about your views on the different options you have for getting around. This is intended to be an informal discussion group, so please feel free to give your views on what we are discussing as we go along. Remember, there are no right or wrong answers, and the main thing is to be honest about your view on each topic of discussion. As you can see, I will be recording the discussion."

[points to audio recorder / microphone]

"This is so that I will have an accurate record of what was said. Please try to ignore the recorder, everything discussed today / tonight is completely confidential. Please try to speak one at a time and try not to interrupt anyone else while they are talking. The discussion will last for approximately one hour. If anyone needs to make any calls or go to the bathroom, could they do so now before we get started. Are there any questions before we get started?"

[answer any questions / switch on recorder]

Introductions / Current Travel Behavior ***10 mins***

⇒ Moderator asks each group member to state their first name, age, the area where they live, and to provide some details on their travel behavior, including the following aspects:
- Modes of transport used for travel (car driver, car passenger, school bus, service bus, train, walk, cycle, etc)
- Different trip purposes
- Main destinations
- Time of day of travel

⇒ Moderator to determine whether each participant is a "choice" transit riders or "captive" transit rider.

Attitudes towards travel in Los Angeles **20 *mins***

⇒ Views on different aspects of travel:
- Is travel relatively easy or difficult?
- How have things changed over the years – better or worse?
- Comparing car travel with public transport

⇒ Any specific problems associated with car travel?
- ***Congestion? If so, where, when, and how severe? PROBE***
- Parking
- Fuel prices
- Disruption due to construction
- Other?

Perceptions of Public Transport: **30 *mins***

⇒ Focus discussion on the different local transit modes. Red Line, Gold Line, Orange Line, Metro Rapid, regular bus.

⇒ Moderator asks if anyone has heard of BRT. After observing response, moderator to briefly describe the concept and focus discussion on participant views of the concept and LA based examples like the Orange Line and the Metro Rapid. Some images may be circulated at this point.
- How does BRT compare to Light Rail?
- How does the Metro Rapid compare to the Orange Line?
- How could the BRT services be improved?

⇒ (To choice riders): Is it possible to use public transport instead of a car for certain trips? If yes, why is it not used? If no, why not?

⇒ (To captive riders): What is it like to use public transport – easy / hard, cheap / expensive?

⇒ (To car users): What would have to change for you to consider using transit? Are some transit modes more feasible than others?

⇒ Perceptions of different modes – how to they differ / why? PROBE Attempt to separate tangible factors from intangible factors and identify the different factors that influence mode choice decisions in each case.

Future Travel Behavior / Improvements **20 *mins***

⇒ Is car travel adequate in the city?
⇒ Is public transit adequate in the city?
⇒ What should be done to improve transport in and around the city?
⇒ If these improvements were made, would your travel behavior change? If so, how?

⇒ Moderator probes on whether participants expect travel behavior to change over time
- To Captive Riders - Will they get their own car?
- To Choice Riders - will they continue to use public transit?
- To car users – will they consider using transit? What would have to change to them to start using transit? Are some modes preferable over others?

Closing Statement from Moderator ***2 mins***

*"Well, we are just coming to the end of our time here. Thanks everyone for sharing your views with us. Your input ha been very useful and will be taken into account when we report the research findings. Before we finish, are there a*ny *other comments or issues that anyone would like to raise?*

[answer any questions / switch off recorder]

THANK AND CLOSE

Appendix II – Survey Instrument

TRANSIT SERVICE EVALUATION SURVEY (la version en Español al dorso)

1. What is your level of awareness/use of the following Los Angeles County transit services?
(*please check one box in each row*)

	Have not heard of it	Know it but don't use it	Used at least once	Use regularly
Regular bus				
Metro Rapid (network of red bus routes throughout city)				
Orange Line (Canoga Park to/from North Hollywood)				
Gold Line (Pasadena to/from Union Station)				
Blue Line (Long Beach to/from Downtown)				
Red Line (North Hollywood to/from Union Station)				

2. How important are each of the following factors in determining whether or not you use transit?
(*please circle one number in each row; 1 =not at all important, 5=extremely important*)

Door to door travel time	1	2	3	4	5
Safety while at station/stop (safety from accidents and/or crime)	1	2	3	4	5
Safety while riding the service (safety from accidents and/or crime)	1	2	3	4	5
Travel cost (transit fares, plus related costs like parking)	1	2	3	4	5
Frequency of service (how often service runs)	1	2	3	4	5
Comfort while waiting at station/stop (shelter from weather, amenities, etc)	1	2	3	4	5
Other riders (feeling secure/ at ease/compatible with others using the service)	1	2	3	4	5
Convenience of service (goes where you need to go/parking availability)	1	2	3	4	5
Customer service (provided by drivers and other transit service staff)	1	2	3	4	5
Reliability of service (does the service run on time?)	1	2	3	4	5
Ease of service use (clear service info, routes easy to figure out, etc)	1	2	3	4	5
Hours of service (how early or late service runs, and/or weekend hours)	1	2	3	4	5
Comfort while riding (seats available, temperature, smooth ride, cleanliness, etc)	1	2	3	4	5
Avoid stress/cost of car use (traffic, parking, accidents, tickets, etc)	1	2	3	4	5

3. Do you own or lease a car? 1____ Yes 2____No

4. Do you have a vehicle available to make **this trip** if you didn't use transit 1____ Yes 2____No

5. Are you female or male? 1____ Female 2____Male

6. How old are you? _____ (years old)

7. Are you Hispanic/Latino? 1____ Yes 2____ No

8. Are you...
1____ African American/Black
2____ Asian / Pacific Islander
3____ White / Caucasian
4____ Other (specify: _____)

9. What is your household's approximate total annual income?
1 ___ Less than $20,000 2 ___ $20,000 to $34,999 3 ___ $35,000 to $49,999
4 ___ $50,000 to $74,999 5 ___ $75,000 to $99,999 6 ___ $100,000 or more

10. What is your typical **door-to-door** travel time for this trip? _____ (minutes)

Please rate **ALL** of the following transit services in terms of the different service attributes presented below.
We want your impressions **even if you have not used this service before.**

1=Very Poor 2=Poor 3=Fair 4=Good 5=Very Good

11. Door-to-door travel time

	☹				☺
Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

12. Safety while at station/stop

	☹				☺
Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

13. Safety while riding the service

	☹				☺
Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

14. Travel cost

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

15. Frequency of service

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

16. Comfort while riding

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

17. Hours of service

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

18. Comfort while waiting at station/stop

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

19. Convenience of service

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

20. Customer service

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

21. Reliability of service

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

22. Ease of service use

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

23. Other riders

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

24. Avoid stress/cost of car use

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

25. Your overall opinion of each service?

Regular bus	1	2	3	4	5
Metro Rapid	1	2	3	4	5
Orange Line	1	2	3	4	5
Gold Line	1	2	3	4	5
Blue Line	1	2	3	4	5
Red Line	1	2	3	4	5

Other comments? _____

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