

**VARIATIONS IN THE RATES OF PASSENGER USAGE OF PORTABLE
TECHNOLOGY ON INTERCITY BUSES, TRAINS AND PLANES:
IMPLICATIONS FOR TRANSPORTATION PLANNING**



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Abstract

Over the past several years, the use of portable electronic devices by passengers on intercity transportation services has risen markedly. To support the use of such devices, carriers have installed Wi-Fi systems, power outlets, and cell-phone signal boosters for passenger use.

To fill a void in research about the effects of portable electronic technology on intercity travel behavior, this study evaluates newly collected data for 7,028 passengers on bus, train, and air trips. It explores how usage differs by mode and time of day, as well as the implications that these differences have on various sectors of the U.S. transportation system.

Field researchers conducted visual surveys to measure the use of two basic types of devices: (1) those providing *audio capability*, such as cell phones, CD players, and digital music systems, and (2) those providing *visual or audiovisual capacity*, such as laptop computers, Blackberries and other high-end smart phones, DVD players, and I-Pods with screens. The data collection involved field observations in 14 states as well as the District of Columbia.

The data suggests that the ability to use portable technology may be a driving force in the growth of “curbside” bus operators that are Wi-Fi equipped, such as Boltbus and Megabus. Twenty minutes into a trip, 38.7% of passengers are using some form of technology—twice the share of Greyhound, three percentage points more than on conventional Amtrak trains, and twenty percentage points more than airlines.

Portable technology use on weekday runs of Amtrak’s high-speed Acela Express, however, is even higher. An average, 47.8% of passengers on these trips are using technology at randomly selected points. On both Acela and conventional Amtrak trains, where the seating configuration is relatively spacious, passengers tend to use visual devices with LCD screens. On curbside bus operations, however, there is an almost equal mix of audio activities and visual/LCD-screen related activities.

Interpreted broadly, the research suggests that the ability to use portable electronics may be a factor offsetting the longer travel times associated with certain bus and train trips, and providing a new incentive for travelers to use transportation services that operate to and from the downtown areas of major cities.

I. Introduction

Over the past several decades, the manner in which passengers allocate their time while traveling on intercity train, bus, and airline trips has changed dramatically. Increasing numbers of travelers use cell phones, laptop computers, iPods, and other mobile electronic devices to maximize the value of their time en route to their destination. Many travelers attest that they perform certain tasks as efficiently on the road as they can in a traditional office setting.

Transportation companies have encouraged the use of technology through the installation of power outlets, workstations near loading areas, and signal boosters that provide greater cell-phone coverage on the tarmacs and in the terminals. Every major airline now offers wireless Internet service (Wi-Fi) or plans to offer it soon; and there is a movement underway to allow in-flight cell-phone calls as well [3]. In early 2009, several major U.S. transportation companies—Airtran Airways and Megabus—for the first time made free wireless available to passengers throughout their entire systems.

Despite this, there has been remarkably little research about the role of portable electronic devices in intercity travel. As a result, some important research questions are unanswered. Which modes of travel are amenable to the use of portable electronic devices? How do people change their use of technology over the course of a trip? What does all this mean in terms of how people choose their mode of transportation?

This study attempts to begin to fill the research gap by reviewing newly collected data about technology use among intercity travelers in the United States. It seeks to draw conclusions based on observations of 7,028 passengers traveling by bus, air, and train in the United States during late 2009 over a 14-state region.

II. Consumer Technology and the American Travel Experience

For consumers, communication systems and passenger transportation services traditionally have been mutually exclusive rather than complementary operations. People wanting to interact with someone (or a group of people) in a distant location could either travel for a face-to-face interaction or use some form of electronic or non-electronic communication to eliminate the need for a trip. There was often little opportunity to communicate *while* you were traveling, let alone sending documents, photographs, and instant messages during a trip.

The difficulty of communicating while traveling continued well into the 1980s, despite advances in technology. Although the first commercial cellular phone service in the United States was introduced in January 1969 on the Penn Central *Metroliner* trains between New York and Washington, similar innovations did not immediately follow. [5] Almost another generation would grow up before the widespread installation of pay phones (particularly the Airphone) on commercial flights in 1984. [12]

By the early 1990s, however, technological innovation had advanced to the point that travelers had many more options at their disposal. Portable devices became smaller, less expensive, and more sophisticated. Starting with laptop computers and cell phones and followed in the early 2000s by Blackberries, iPhones, notebook computers, compact memory devices, and a wide array of portable entertainment systems, consumers began performing increasingly complex tasks on the road. A 2005 study by the Wi-Fi Alliance found that 70% of mobile technology users were more likely to take their devices with them than before when traveling due to the widespread availability of wireless hotspots in airports, hotels, and restaurants. [20]

Around this period, carriers began making investments to support the use of devices carried by passengers.

To appreciate the transformative effects of portable electronic devices on travel over the past 25 years, consider some milestones reached by motor coach, rail and air carriers.

- Intercity Bus Operators. For decades, the onboard product delivered to intercity bus travelers was largely unchanged. Over the past three years, however, bus companies—particularly “curbside” operators that do not operate from conventional bus stations and typically sell tickets only over the Internet—have pushed themselves to the forefront of the wireless Internet movement.

In the summer of 2007, DC2NY Bus, a curbside operator, launched service between Washington, D.C., and New York, becoming the first U.S. carrier on a major intercity route to offer free Wi-Fi. The carrier also pioneered the availability of power outlets on buses. These features became more prevalent when Boltbus, a joint venture of Greyhound and Peter Pan Bus Lines, launched services between New York, Boston, Philadelphia, and Washington, D.C., in April 2008. [21]

Megabus quickly followed, offering wireless Internet service on all its routes, first in the Northeast and then in the Midwest. Wi-Fi gradually became the accepted standard for curbside operators, so much so that passengers felt slighted when it was not available. [21] Various “Chinatown” carriers (bus operators linking the Chinatown districts of major cities, typically operated by Chinese-owned businesses), attempted to forestall their loss in market share by spending an estimated \$5,000 per vehicle to equip their buses with Wi-Fi. [21] Greyhound is on the tail end of the trend. In late 2009, it introduced buses with wireless service and power outlets serving the major Northeastern corridors as well as the New York–Montreal route. Now, it anticipates having its entire system equipped with wireless within the next several years. [10]

- Amtrak. Despite the fact that commuter railroads in the metropolitan Boston and San Francisco areas installed wireless Internet service in 2007, making them the first U.S. rail-passenger carriers to offer this feature, Amtrak has been slow to match their achievement. [6] Although Amtrak succeeded in installing electric outlets on its trains in many corridors, it ran into difficulties with wireless Internet due to the prevalence of tunnels and the length and capacity of its trains, both of which make installation difficult.

In 2009, however, Amtrak has made notable progress. The carrier has begun installing free wireless service on Acela Express routes and hired a private contractor to begin installing it

on its Capitol Corridor trains in California. [1] Amtrak also rents portable DVD players and sells batteries on board its trains, catering to the increasingly technology adapt ridership.

Power outlets are now widely available on heavily traveled corridors. For the foreseeable future, however, wireless will likely be available only on a small portion of its trains. There are no constraints on the use of cellular phones, although coverage is inconsistent on some routes, with “dead spots” occurring, particularly on routes outside of the Northeast corridors.

- Commercial Airlines. There are notable constraints on the use of technology by airline travelers. Passengers, of course, must deactivate portable electronic devices after the planes leave the gate and keep them off for an extended period, leaving travelers on short flights with only a short time to use them. Moreover, the design features of commercial airplanes make power outlets impractical to install.

Due to gradual reductions in seat pitch, escalating load factors, and the “hassle factor” of airport security in the post-9/11 environment (requiring travelers to complete a series of tasks before boarding the plane and taking their seat), many travelers opt to bring only the smallest devices, such as cell phones and iPods, with them. Others aggressively use their frequent flyer status to upgrade to business or first class cabins where seating is more spacious and conducive to working on laptops or other electronic devices. Another problem, of course, is the lack of wireless Internet and cell-phone connectivity. Although the push to provide wireless Internet on commercial flights gathered momentum in 2004, it was not until 2008 that Wi-Fi became available on an appreciable share of domestic flights—generally at a considerable price. [21] Since then, most airports have also installed wireless Internet systems and invested in making their gate areas and tarmacs “hot spots” for cell-phone users. Airtran now offers free wireless, and in early 2010, Delta expects to have Wi-Fi available for a fee on all its domestic flights. [14] Just how quickly airlines find a way to allow in-flight cell phone service remains to be seen. [5]

Previous research offers a useful framework for understanding the effects of the differing rates of technological adoption by various passenger groups but is relatively silent on how travelers use portable devices after embarking on intercity trips. There is considerable research, for example, on varying access to cellular phones and the Internet, and how this affects the

propensity to travel [9]. A branch of this research focuses on the persistent “digital divide” and its implications for mobility and career opportunities. There is also extensive research on travel and technology in an international setting, particularly Europe.

Several researchers explore whether Information and Communication Technology (ICT) has supplanted the need for travel [8, 17]. Sasaki and Nishii (2009) examine how technology affects the need for people to travel for non-business reasons, focusing particularly on consumer behavior and online shopping. [18]. Kim, Park and Morrison (2009) examine how people use technology differently to plan for personal and business travel. [11]. Although these and other studies explore how advances in technology influence travel decisions, none offer data about the use of portable devices by passengers on intercity trips, which is the primary focus of this study.

V. Measuring the Use of Portable Electronic Devices

To understand the patterns of consumer use of portable electronic devices, field observations were made on common carriers between October and December 2009, primarily on intercity buses and Amtrak trains but also encompassing airline flights and commuter trains (see Table 1 on the next page).

Field researchers conducted visual surveys to measure the use of two basic features of electronic devices: (1) those using *audio features* of devices, such as cell phones, CD players, or other devices that can be used with earphones or headsets, and (2) those using *visual or audiovisual features*, such as the LCD screens of laptop computers, Blackberries and other smart phones, DVD players, and iPods (essentially, any travelers looking at a screen for the purpose of engaging in an activity more substantial than placing a phone call or changing a music selection fell into this category). These activities typically involve the observance of images or information on LCD screens (Table 2).

TABLE 1:
CORRIDORS AND ROUTES SURVEYED

Amtrak (6,001 observations on 27 departures, including Acela Express)

Northeast Corridor (New York – Washington, New York – Boston)
Keystone Corridor (Harrisburg – Philadelphia)
East Coast Service (Washington, D.C. – Jacksonville)
Wolverine Corridor (Chicago – Detroit)
Hiawatha Corridor (Chicago – Milwaukee)
Lincoln Service (Chicago – St. Louis)
Illini Corridor (Chicago – Carbondale)

Megabus/Boltbus routes (1,716 observations on 19 departures)

Baltimore – New York route
Boston – New York route
Chicago – Milwaukee/Twin Cities route
Chicago – Indianapolis route
Cincinnati - Indianapolis route
New York – Philadelphia route
New York – Washington route

Greyhound routes (355 observations on 10 departures)

Baltimore – New York route
Chicago – Champaign, Ill. route
Chicago – Milwaukee route
Chicago – Madison route
Chicago – Indianapolis route
Chicago - Quad Cities route
Philadelphia – Baltimore route

Commercial Flights (652 observations on 10 departures)

Atlanta - Chicago (Air Tran)
Indianapolis – Chicago (American)
Indianapolis – New York (Continental)
Chicago – New York (Southwest)
Chicago – Newark (Continental)
Chicago – Washington (United)
New York – Atlanta (Air Tran)
New York – Chicago (Southwest)
Washington – Chicago (United)
Washington – New York (United)

Commuter Railroads (1,381 observations on 16 departures)

Various routes on Metra and South Shore Lines in metropolitan Chicago and Caltrain in metropolitan San Francisco. Data from Caltrain were not ready for inclusion in this analysis and will instead be evaluated in future publications.

Our survey involved observations of 7,028 unique passengers on 82 different transportation departures to and from major cities (Table 3). The sample was limited to daytime services in corridors with multiple trains and buses per day rather than on long- distance runs with a single daily departure. On longer trips, passengers were surveyed multiple times, bringing the total number of passenger observations to 10,105. The data were collected in 14 states as well as the District of Columbia.

TABLE 2

CLASSIFICATION OF ACTIVITIES INVOLVING PORTABLE DEVICES

Notable Examples

Visual and Audio-Visual Activities

- Laptop, notebook, and “netbook” computers with active LCD screens
- DVD players, and portable television sets
- Screen-based functions of
 - iPods and iPhones
 - Blackberries
 - Smart phones and similar devices.
- Electronic calculators
- GPS devices

Audio Activities

- Cell phones, Blue-Tooth headsets, and related communication devices
- Voice recording devices
- Pocket radios and scanners
- Audio/telephone features of
 - iPods and MP3 players
 - Blackberries
 - iPhones, smart phones and similar devices.

TABLE 3:
SAMPLE SIZE BY MODE OF TRANSPORT

<u>Mode</u>	<u>Carriers</u>	<u>Departures Surveyed</u>	<u>Unique Passengers Observed</u>	<u>Total Observations</u>
Train—Conventional	Amtrak	21	3,179	5,133
Train—High speed	Acela Express	6	868	868
Commuter train	Metra	16	1,381	1,381
	South Shore Line			
Bus—Curbside	Megabus, Boltbus	19	697	1,716
Bus—Conventional	Greyhound	10	251	355
Commercial flight	AirTran, Southwest	10	652	652
	United, Continental, American			
Total		82	7,028	10,105

VI. Principal Findings

Our review allowed us to make six principal conclusions that show how technology use differs across travel modes and circumstances.

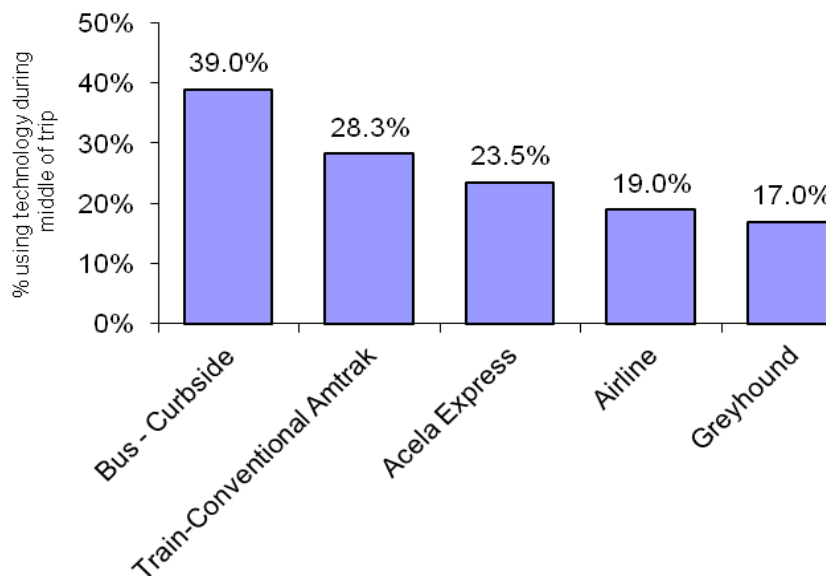
Finding 1: On weekends and weekdays after 7 p.m., technology use is higher on curbside buses than on any other mode. Nearly 40 percent of passengers are engaged with portable devices at any given point. Cumulatively, with all time periods combined, curbside bus use trails only the business-oriented Acela Express in technology usage.

Our observations involving curbside bus passengers during weekends/weekdays after 7 p.m. are limited primarily to the Midwest. We hope to build a more comprehensive national sample involving off-peak trips from other regions in the months ahead. In our sample, however, the differences between modes appear to be dramatic (Figure 1).

The use of technology on curbside buses during weekends/late evenings exceeds that of all other modes by an appreciable margin. Usage rates (39%) are far ahead of conventional Amtrak train's 30 percent, Acela Express' 23.5 percent, and airline's 19.5 percent. Moreover,

unlike on trains, technology use on curbside buses is almost the same on weekdays before 7 p.m. and at other times.

**Figure 1:
Technology Use by Mode of Travel
Weekends and Weekdays after 7 p.m.**

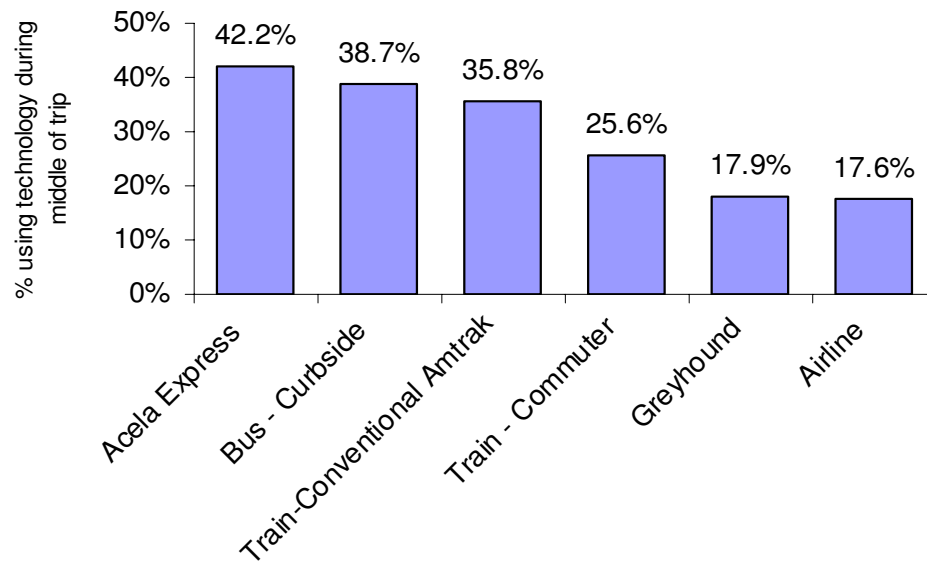


When both weekday and weekend data is combined, the *cumulative* average rate of technology use on the Acela Express is highest at 42.2%, followed by curbside bus (38.7%) and conventional Amtrak trains (35.8%). On average, each of these modes experience technology usage at more than twice the rate of commercial flights and Greyhound.

We discuss the extensive usage on the Acela Express below in Finding 2.

On curbside buses, the intensity of technology use appears to be partially attributable to the young and upwardly mobile demographic of customers served. These passengers appear quite savvy about technology, making Wi-Fi an important amenity. (Nearly all passengers purchase tickets online and a significant share of them display their electronic receipt on a smart phone to board the bus.) Unlike trains, which typically have lengthy “dead spots” in terminal areas and rural environments curbside-bus operations typically benefit from virtually uninterrupted cell-

**Figure 2:
Technology Use by Mode of Travel
Cumulative**



phone signals. In fact, cell phone towers are often along Interstate highways that these buses use.

The informal nature of the boarding process may also be significant. Whereas passengers on planes and trains typically turn off portable devices before boarding (in some cases due to boarding procedures that include the presentation of identification and finding assigned seats in crowded environments) curbside bus passengers need only allow a few seconds to find a seat. Some simply display their ticketless confirmation on an LCD screen when boarding and then continue to use the device for other purposes.

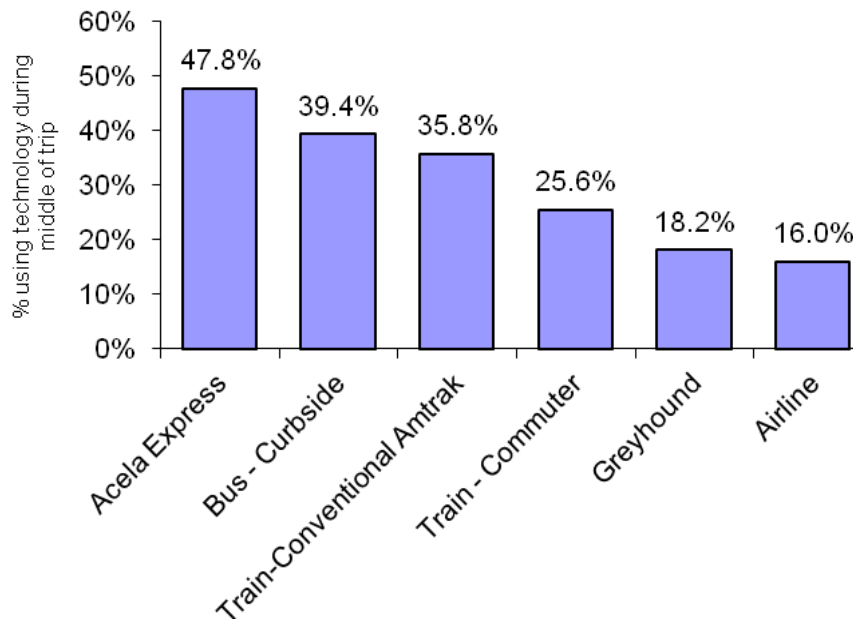
Another factor may be that there are fewer intermediate stops on curbside bus operations than on many Amtrak and Greyhound trips, thus minimizing disruptions and allowing passengers to more easily use technology as a means of insulating themselves from the surrounding

environment. Although the seating density is high, load factors are often low, allowing passengers to spread out.

Finding 2: During peak periods—on weekdays between 6 a.m. and 7 p.m.—the use of portable technology on Amtrak’s Acela Express greatly surpasses usage on all other modes. An estimated 48 percent of passengers are using portable technology at any given point—more than two-and-a-half times the rate observed among airline passengers. Approximately 85 percent of these technology users are engaged in the use of visually oriented electronic devices.

The differences between Acela Express service and other modes of intercity travel are striking. On weekdays prior to 7 p.m., 47.8 percent of passengers are using some form of technology, more than eight percentage points higher than conventional Amtrak runs (39.4 percent) and curbside bus operations (38.5 percent). It was not uncommon for Acela passengers to be engaged in multiple technology activities; many were talking on the phone or listening to music while working on laptop computers, apparently linked to the Internet. A summary of these differences appears in Figure 3.

**Figure 3:
Technology Use by Mode of Travel
Weekdays before 7 p.m.**



None of the weekday Acela trips had fewer than four in ten passengers using technology at any time we conducted the survey. The lowest had a 41 percent usage rate, which was nearly double the highest technology usage observed on an airline trip (22 percent). On commercial flights, conversely, less than 18 percent of passengers were engaged in the use of technology.

Our data does not allow us to sort passengers on the basis of the purpose of their trip, which is likely an important explanatory variable. When looking at all passengers together, however, the gap between Acela trains and commercial flights may be even greater than these numbers suggest. Acela service competes predominantly with short-distance flights by airlines, on which technology use is obviously limited by the need to keep devices deactivated during a higher proportion of the trip than on long-distance flights. For example, on New York – Washington trips, passengers are generally able to use technology for less than 25 minutes.

An overwhelming share of Acela Express passengers use devices for their visual capability (mostly laptop and notebook computers), an observation we discuss further in Finding 4 on the next page. On weekends, however, overall technology usage on Acela trains is far less intensive. In our sample of 240 passengers, only about 24 percent were using technology at various points. There appears to be a far greater tendency for passengers to travel in groups on the weekend, making reading and conversation more dominant uses of time.

Finding 3: Greyhound has only about half the technology use as curbside bus operators. This is apparently due to both the demographic segment it attracts and the types of routes it services. The lack of Wi-Fi service on the majority of Greyhound's routes appears to be only a secondary factor in explaining the low rates of technology use.

Technology use on conventional Greyhound trips averages just 17.9 percent. A mere 8 percent of passengers use devices strictly for their audio capacity (which generally don't require access to the Internet), the lowest of any mode observed in our sample except airlines. The fact that audio devices are so sparsely used suggests that there is an additional factor, other than the absence of Wi-Fi that limits technology use on Greyhound.

One such factor may be the clientele that Greyhound serves, which appears less affluent and less apt to use technology. Moreover, an appreciable share of travelers are in the midst of

long journeys, even transcontinental trips. Driver announcements may also play a role. On two trips, for example, the bus drivers asked passengers after dark to be as quiet as possible and to put cell phones on “silent mode;” one driver even threatened to stop the bus if this rule was violated.

The uneven quality of Greyhound stations—some are located in high-crime areas—and the onboard atmosphere may also be factors. Similarly, there is a greater propensity for Greyhound buses to make intermediate stops than curbside bus operators, causing more potential disruptions to thru passengers as others exit and enter throughout the duration of their trip.

In the future, we plan to expand our data beyond the current sample of ten Greyhound departures. The consistency of technology use across our sample, however, suggests that there is high product differentiation in the intercity bus sector, between traditional and newer curbside operators.

Finding 4: Technology users on curbside bus carriers divide their time almost equally between using audio features and visual features. On Amtrak trains, however, the use of visual features outnumbers the use of audio devices by a two-to-one margin.

On both curbside bus operators and Greyhound, passengers divide their time almost equally between audio and visual technologies. On curbside bus operations, for example, the use of audio and visual devices is split 20 percent and 19 percent, respectively. Conversely, on conventional Amtrak trains, visual technology use exceeds audio use by a margin of two to one. On Acela Express, the ratio is six to one, as the dominant technologies are laptops and notebook computers. Some of the differences are summarized in Table 4.

Demographics and environmental factors are also relevant. In comparison to other modes of travel, only a small proportion of curbside bus travelers are traveling for purely business purposes. These passengers appear more apt to use music players and cell phones than DVD players and laptop computers. Concerns over privacy may also contribute to the relative dearth of visual-technology use not only on buses, but on commuter trains and flights as well.

TABLE 4:
USE OF TECHNOLOGY BY MODE OF TRANSPORTATION

	<i>Percentage of Passengers Using Technology (Middle of Trip)</i>		
	<u>Visual</u>	<u>Audio</u>	<u>Approx. Ratio Visual to Audio</u>
Train—High speed	36%	6%	6:1
Bus—Curbside	19%	20%	1:1
Train—Conventional Amtrak	24%	12%	2:1
Commuter Train	17%	8%	2:1
Commercial Flight	8%	9%	1:1
Bus—Greyhound	10%	8%	5:4

Sample size: 7,028

The emphasis on visual technology use on Amtrak is also noteworthy. Amtrak's generous seat pitch and fold-down tray tables make it more conducive to laptop computer use. Visual technology is most common on weekday trains, when 28 percent of passengers are using it at any given point, well above that of curbside buses (20 percent), commuter trains (17 percent) and airlines (6 percent).

Finding 5. On the average commercial flight, only 17.6 percent of passengers are using technology at any given point. The low usage does not appear to be a lack of interest in technology, but some other factor, such as the in-flight environment, the lack of wireless connectivity, or the short duration of many trips. In fact, the use of technology, particularly laptop computers, is much higher in terminal waiting areas than while in flight.

The density of seating as well as restrictions on the use of electronics at takeoff and landing create strong incentives for passengers to either avoid using technology or to limit use to devices that can be easily kept in their pocket. The start and end of trips appear to be critical times for the use of devices, particularly communication systems, thus putting airlines at a notable disadvantage. Once devices are turned off, many customers apparently do not turn them back on until they disembark.

Our sample is not large enough to allow for definitive conclusions about how the time-of-day and availability of airline in-flight entertainment systems affects portable technology use on

commercial flights. Preliminary analysis, however, suggests that weekend usage appears almost the same (at about 19 percent) as weekday usage. In terminal waiting areas, conversely, we estimate that technology use exceeds 30 percent.

The survey also provides evidence to suggest that the use of portable technology may not be appreciably different between flights with in-flight entertainment systems and those without it, averaging between 17 and 18 percent in both cases. It does *not* appear that many people are leaving portable technology devices off due to the availability of centralized entertainment systems.

Finding 6. The types of portable technology devices that bus and train travelers use are remarkably consistent during different phases of their trip. There is a slight tendency for curbside-bus travelers to shift away from using devices for their audio capacity in favor of visually oriented activities further into the trip.

Among all types of passengers, there is great consistency in the use of technology over the course of a trip. In the period between about 20 minutes into the trip and one hour into a trip, however, the share of curbside bus passengers using audio technology drops from 21.2 percent to 19.7 percent while the share of visual-technology users increases from 17.8 percent to 18.9 percent. Although this change is slight, it suggests that more passengers use audio devices before transitioning to more intensive visual technology than the other way around.

VII. Implications and Conclusions

The above findings suggest that the growing prevalence and sophistication of portable electronic technology may be diminishing the perceived cost of time spent on buses and trains for many travelers. As a greater share of communication is handled through text messages and emails as well as through social-interaction sites such as Facebook, it appears likely that many consumers place a premium on the ability to use portable devices when traveling. The rapid expansion of 3-G and 4-G wireless networks makes travel on buses and trains more attractive.

Our future research will include the development of a predictive model to explain the varying use of technology among travelers in different types of markets as well as variations

between different types of passengers. Although we have not yet found a mechanism to collect disaggregated data, we believe that there is more to learn about variations in technology use by controlling for the differing characters of trips, such as the length-of-haul, the time of day, and the geographic qualities of the markets served. Among our priorities is to better understand regional differences (which will require expanding the sample) and to differentiate between the types of “products” available (e.g., first and business class, Amtrak Custom Class, etc.).

Moreover, we plan to further explore the link between the “technological friendliness” of various transportation modes and their rate of growth. Although the ability to use portable technology may be only a secondary factor in explaining the growth of bus travel—low fares are likely the principle reason for the sector’s growth—the evidence suggests that it may be important to explaining the industry’s continued growth in the midst of difficult economic circumstances. (More than 90% of the growth in bus service is attributable to curbside bus operators with free Wi-Fi). [19] Meanwhile, the technological frontier will continue to push outward, raising new questions on the role of technology in consumer travel decisions.

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