IMPROVING INTRA-CAMPUS ACCESS FOR PERSONS WITH DISABILITIES AT UMASS AMHERST

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BACKGROUND

According to the National Center for Education Statistics, one in five college students lives with the challenges of a disability [5]. With over 28,000 students enrolled at the University of Massachusetts at Amherst each year, this translates to a potential 5,800 students with disabilities at UMass Amherst who require accommodation [8]. Disabilities may impact a person's engagement and success in their respective educational endeavors, necessitating provisions of reasonable accommodations. The Accessible Van Service (AVS) is managed by staff and student workers, and regulated by the UMass Accessible Transit Office. It provides mobility services for the disabled members of the campus community. These shuttles offer transportation services for students, faculty, and visitors to navigate around the campus area ('AVS passengers'). AVS shuttles will accommodate any pickup and drop-off location on-campus, as well as any location within a three mile radius of the campus (customarily, in North Amherst or Hadley). Furthermore, the Five-Colleges Incorporated van service funds academics-related transportation between the campuses that make up the Five College network (UMass Amherst, Hampshire College, Amherst College, Mount Holyoke College, and Smith College).

These transportation services are invaluable to AVS passengers, and the efficiency of AVS service relies on clear traffic routes between destinations. On-campus traffic patterns present significant challenges to the freedom of movement for AVS passengers. One primary transportation artery through campus is North Pleasant Street, owned and regulated by the Town of Amherst. It is intersected by thirteen crosswalks and seven Pioneer Valley Transportation Authority (PVTA) bus stops. At the same time, this street is flanked by dining commons, lecture halls, social hubs, and other facilities. High rates of pedestrian and vehicular commuter traffic lead to consistent traffic impediments, and obstruct engagement opportunities for AVS passengers. This specific route is only one example of such engagement barriers on the UMass Amherst campus. This study aims to investigate how on-campus traffic patterns and transportation practices contribute to accessibility barriers faced by AVS passengers, and to provide insight into potential solutions to improve accessibility at UMass Amherst.

GUIDING QUESTIONS

This research was initiated in October 2022 by this member of the disability community, a UMass Amherst student who identified with the shared frustrations experienced by AVS passengers. This researcher recognized that the frustration of limited freedom of movement is experienced by students worldwide, as well as the reality of the belief, in some circles, that it is preferrable that individuals with disabilities be excluded from equal participation opportunities [1]. Interviews with AVS staff confirmed that students with back-to-back class schedules encounter transportation challenges, due to traffic obstructions. As students have limited options for when and where classes are offered, the limitations posed by transportation difficulties may force students to reevaluate their enrollment options, and consequently their path to graduation. These facts present significant barriers for equal participation in the campus community, and inspired questions about both their impact as well as potential solutions to improve accessibility for AVS passengers at UMass Amherst.

Initial inquiries into recordkeeping practices at AVS revealed a significant lack of data regarding AVS passenger lateness. For the purpose of this study, 'lateness' refers to instances where scheduled shuttles fail to arrive on time to pick up AVS passengers, or where passengers reach destinations after their expected drop-off time due to factors beyond the control of the shuttle. Such factors include pedestrian or vehicular traffic congestion, mechanical breakdown, and staffing shortages, among others.

Foundational interviews and written correspondence with AVS staff indicated AVS drivers are required to report lateness in real-time. To understand the impact that limited freedom of movement has on quality of life (QoL), it is essential to understand the demographic makeup of AVS passengers. By analyzing AVS transportation records, this research aimed to provide a more comprehensive insight into QoL impact.

The following questions were of interest to this study:

1. *How many transfer students vs. on-campus students are using the AVS system?* This quantity could be inferred in a general sense from pickup location, as transfer students would likely request pickup at parking lots rather than residence halls. The implication of pickup location distinction directly relates to retention at varying levels of enrollment, as well as passenger demographics.
2. *Do passenger lateness reports decline over the semester? At the same time, does the number of scheduled shuttles decline?* The presence of this phenomenon could indicate negative trends in student retention and engagement, as students may withdraw due to lack of access, or may be forced to find alternatives to on-campus attendance.
3. *Where is the greatest concentration of pickup or drop-off lateness? Is there a correlation between available drivers and the number of recorded lateness?* Such occurrences could indicate a need for improved funding for AVS, or an improvement in the routes or types of vehicles used by AVS.
4. *Are there records related to rides AVS was unable to accommodate? Is it possible to see if those rides were scheduled or unscheduled?* This type of observation could indicate a need for an increase in the number of AVS drivers, or further expansion of AVS services.

AVS DATA COLLECTION: RECOMMENDATION

Initially, these questions were of interest based on the description of records given by AVS staff. However, upon investigation, several challenges were discovered which prevented immediate research. First, at current the AVS office maintains hand-recorded, analog records on 17x11 ledger paper. The AVS dispatcher hand-writes the ledger sheets each day, which introduces human error to the data set. Paper records are vulnerable to loss from fire, flood, disposal, or vandalism. Data analysis, via contemporary software, is impossible with a paper record until it is digitized in a time-consuming secondary step. Before it can be digitized, the names of passengers must be manually redacted, which AVS staff may perform using an opaque correction fluid (i.e., *Wite-Out*), before it is then photo-copied. The process of defacing a hardcopy with correction fluid introduces another layer of human error and corruption into already-vulnerable data.

In addition to limitations in the AVS data, there are established standards for acceptable data collection to which the current process fails to adhere. Due to the unreliable nature of the current process for anonymizing the data, the process in its entirety is not in keeping with the Internal Review Board (IRB) accepted standards of privacy protection for AVS passengers [3]. RFC 1428 outlines a number of additional standards that are not followed in the current hand-recorded method, for instance: Consistent time and date format, consistency in naming conventions for data points, secure permissions gates, secure data backup, secure data sharing capabilities, and reduction of human error to a standard level of acceptability [6]. For improved operational efficiency within AVS office, and to better serve the UMass campus community going forward, it is imperative that the data collection process be converted to acceptable digital means as soon as possible. It is also the recommendation of this researcher that a digital literacy workshop be provided to the AVS office staff, which includes both students and non-students, to provide consistent messaging about the importance and value of digital recordkeeping, as well as the caveats and risks of the current analog method.

For ideal ease of use, this conversion to digital recordkeeping may take the form of Google Sheets, which is housed and backed up on the Google cloud

	A	B	C	D	E	F	G	H
1	Date	Time	Passenger_Name	Pickup_ID	DropOff_ID	Passenger_NoShow	Passenger_Late	Van_Late
2	02-16-2022	08:00:00		OC	WorchesterDining	No	No	No
3	02-16-2022	08:15:00		OC	WorchesterDining	No	No	No
4	02-16-2022	08:30:00		OC	LGRT	No	No	No
5	02-16-2022	10:45:00		Brett	SouthCollege	No	No	No
6	02-16-2022	11:15:00		Totman	OC	No	No	Yes
7	02-16-2022	11:30:00		Totman	OC	No	No	No
8	02-16-2022	11:45:00		Totman	OC	Yes	No	No
9	02-16-2022	12:00:00		OC	Morrill2	No	No	Yes
10	02-16-2022	12:00:00		OC	ILC	No	No	Yes
11	02-16-2022	12:00:00		Gorman	ILC	No	No	No
12	02-16-2022	12:15:00		Morrill2	UniversityDr	No	Yes	No
13	02-16-2022	13:15:00		ILC	Herter	No	No	No

Figure 1: Example data set in a standard format.

server and features an edit history and permissions settings for multiple roles. This recommendation acknowledges consistency across multiple intra-campus agencies, which also customarily make use of Google Suite. Within the Google Sheets documents, fields for date, time, passenger name, pickup location, drop-off location, and status of passenger or van lateness would provide the necessary metrics to answer the questions that concern this study (Figure 1).

Additionally, the AVS office currently only records the lateness of van pickups, with no recording of lateness for drop-offs, or the passenger experience beyond the point of drop-off. These limitations in data collection have significant implications for research, as they prevent comprehensive understanding of the impact of lateness on campus access for AVS passengers. The missing information is critical to the research in question, and as a result, one goal of this study became the creation of a QoL impact survey for AVS passengers (See section: Survey).

At the close of the Spring 2023 semester, this researcher provided a presentation to the AVS office student workers and staff, with the recommendations indicated here. As a result of the absence of usable AVS data, the research study was redirected to focus on PVTA buses at UMass Amherst (See section: PVTA Data Set). Although this was not the original intended focus of the study, it was hypothesized that it could be possible to model the student experience where other campus transportation methods, such as buses, are concerned.

SURVEY

Given the absence of recorded data on passenger experience, a QoL impact survey was created to gauge the effect of traffic congestion on the timeliness of AVS shuttles. The anonymous survey accepts unlimited submissions, is intended to provide more data and insight into AVS passenger QoL experience, and accepts the following data points:

- Date of ride
- Type of ride[1]
- Pickup and drop-off locations[2]
- On time or late for the obligation that the ride was used for (binary input)
- Reason for lateness:
    - Motor vehicle traffic/vehicles blocking van movement.
    - Bicyclists, skateboarders, or similar non-vehicle transportation impeding traffic.
    - Pedestrian traffic in crosswalks
    - Crowd congestion on sidewalks
    - Weather hazard
    - Miscommunication with dispatch or unable to locate van.
    - Distance from shuttle drop-off to destination was challenging to traverse.[3]
    - Other or Unknown (text input)
- How QoL was impacted due to this ride[4]:
    - Increased stress, discomfort, and/or irritation
    - Loss of lecture/lab time, or loss of study time
    - Loss of opportunity to set up learning area before a class began.

[1] A prescheduled, permanent ride is a ride that is scheduled by the individual before the semester begins and recurs each week at the same time and location. Van availability for permanent rides is guaranteed. On-demand rides are impromptu and scheduled as needs arise. There is no explicit guarantee that a van will be available for an on-demand ride. This distinction is important, when gauging passenger satisfaction, as on-demand rides may be late due to allocation of infrastructural resources.

[2] Due to the number of variables exceeding the selection limit in Google Forms, the pickup and drop-off locations will be manually entered by the user, alongside the following request: "Building or location name, ex. Franklin Dining Hall, Parking Lot 13. If off-campus, simply state 'Off-Campus'." This survey does not request the name of off-campus locations due to concern for privacy of the passenger, as well as consideration that UMass Amherst has little control over traffic patterns that occur off-campus.

[3] The phenomenon of distance from transportation shuttle drop-off to real passenger destination is known as the last-mile challenge [2]. When a person with a disability uses a transportation system, the transport is often able to help them traverse a large distance; however, the location where the individual is dropped off is actually not their desired endpoint. The individual must still travel from the shuttle's drop-off point to their real destination, which may incur further travel time, depending on the circumstances. Such circumstances may include crowd congestion, damaged sidewalks or other hardscape barriers, weather hazards, and logistics of maneuvering mobility aids, among others.

[4] QoL is a comprehensive measure of an individual's wellbeing, and is comprised of personal physical, mental, and spiritual health, as well as educational status, work environment, social standing and belonging, personal security and safety, freedom, and autonomy in decision-making [7]. Inability to equally participate on campus due to limited mobility or missed engagement opportunities may negatively impact an individual's QoL by causing them to feel they are experiencing discrimination or are otherwise disadvantaged as compared to others. To understand the impact of traffic hindrance on AVS service, and its effect on reliant passenger QoL, obtaining first-hand impact statements is crucial. These statements will lend insight into how transportation barriers the on-campus experience, and identify potential solutions for improving accessibility.

- Loss of opportunity to socialize (late to extracurricular activity, including spending time with friends)
- Loss of time for meals, rest, or other form of essential recuperation
- Late to a timed event (i.e., test or exam)
- Other (text input)

- A text input for anything else the passenger would like to add, such as additional thoughts or concerns.

INTERNAL REVIEW BOARD PROCESS

As indicated by the UMass Amherst IRB, administration of this survey qualifies as a human subject research experiment. Consultation with UMass IRB analysts resulted in an expedited review of this survey. As a component of the IRB requirements, this researcher fulfilled the IRB Collaborative Institutional Training Initiative (CITI) training through the Kuali system. This rigorous and comprehensive 10-day training process covered twelve modules of text documents, culminating in a certification test. A post-hoc intensive scrutiny of the survey content was performed by IRB analysts, ultimately resulting in a full protocol review and approval. Due to this process, the survey contents cannot be altered without additional or further review from the IRB; consequently, the survey will be administered as-is, beginning from the Fall 2023 semester until the conclusion of the Spring 2024 semester, barring any significant impediments.

PVTA DATA SET ANALYSIS

PVTA provides service to the entire Pioneer Valley, including the UMass Amherst campus. The PVTA data set is freely available for download from the Massachusetts Transportation Authority (MTA) website [4]. Using the Python data analysis library, the PVTA bus routes can be inspected and analyzed. This data is contained within eleven tables, out of which four were chiefly relevant to the research: '*stop_times'*, '*stops'*, '*trips'*, and '*routes'*. Each of the tables required cleaning to some extent, as they contained some columns that were not relevant to this study, including color codes, URLs, descriptions, and zone IDs, among others. After pruning the tables of interest, they were merged on their foreign keys to create one data frame ('*pvta_campus_routes*') containing relevant information columns. This data frame contains 14644 observations over fourteen columns.

From studying this refined data frame, the following can be observed: Out of fifty-one individual PVTA bus routes, twelve operate on the UMass Amherst campus, including routes 30, 31, 33-36, 38, 45, 46, 943, B43, and R29. Using this information, the routes map presented in Figure 2 was created. From this data it can be observed that the routes appear to be largely disjoint and present significant last-mile challenges. The bus routes do not universally or cleanly overlap; a mobility-impaired passenger beginning at Route B43 would be unlikely to arrive at a destination on Route 36 within the same timeframe as a passenger who is not mobility-

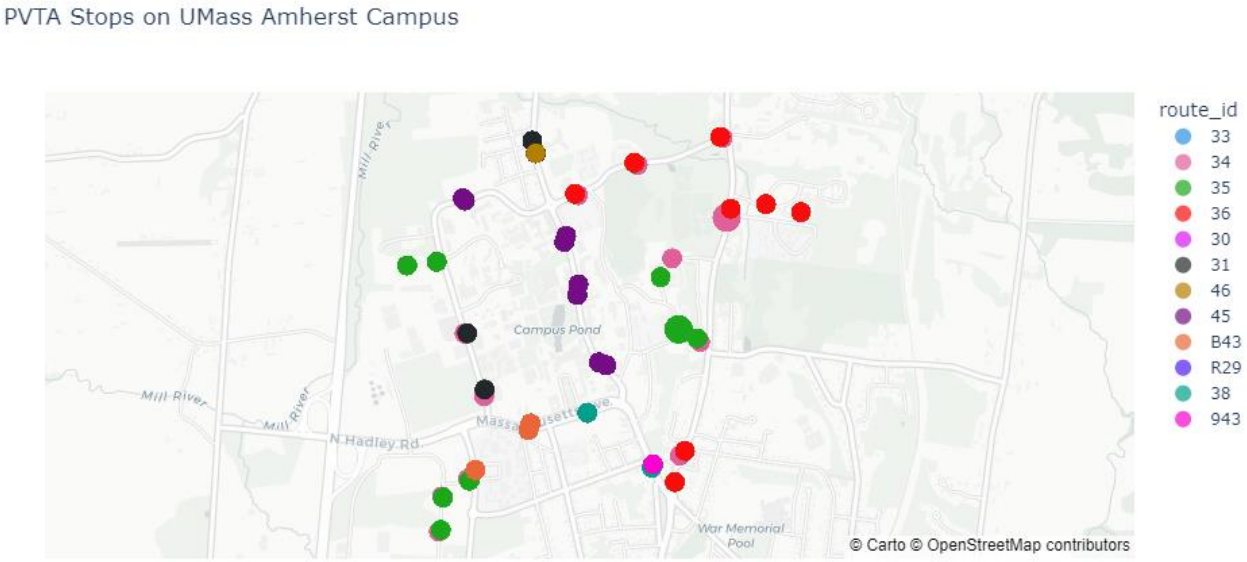

Figure 2: A map of twelve on-campus PVTA routes.

impaired. Other similar scenarios are also possible to imagine. For instance, a mobility-impaired passenger may begin on one route, yet due to the route infrastructure may overshoot their destination point by perhaps a quarter mile, necessitating enormous exertion of doubling back. For AVS passengers, the difficult coordination of traveling the PVTA routes underscores the importance and profound value of the AVS system. For many such passengers, AVS is likely the only viable option for approaching equal participation and engagement on campus.

Curiosity surrounding the theory of mobility-impaired passengers relying on the PVTA routes led to expansion of the analysis. It seemed probable, using this data, to create hypothetical passenger routes for traversal of the entirety of the campus and examine the average duration for a given route cycle. Upon inspection, PVTA operates on an employee shift cycle that customarily ends at 3:00 AM. For this reason, the data contained non-standard time stamps, including hours such as 24, 25, 26, and 27. These are not considered valid Pandas timedelta objects, and although these hour designations could be converted to valid timedeltas (for instance, 24 becomes 00), doing so resulted in negative route durations. Therefore, observations with irregular time stamps were omitted from the data frame. The omission of these 227 rows was deemed acceptable as these observations were limited to the hours of midnight and three in the morning, which are outside the typical campus hours of operation.

The remaining 14417 observations were sorted on three dimensions (route, trip, and arrival time) to calculate travel time between stops. During this process, it was discovered that there were many repetitions of a given bus route, due to the action of the bus looping on their route throughout the day. From this it can be observed that nearly all the route “loops” are designated with the same durations. For instance, a trip from the UMass Visitors Center to Fearing Street (Out) lasts 90 seconds, regardless of time of day. Whether this is an accurate measurement or merely an imputed estimate cannot be determined from this data. Due to this interesting phenomenon, a new data frame was created (*‘first_trip’*), displaying only the first time a given route is completed and its duration. The *first_trip* frame contains sixty-two observations and three columns (*trip_name*, *trip_time*, and *trip_time_in_seconds*). The final column can be used to calculate durations, if desired. However, it is quickly evident that such calculations would be merely ‘best case scenario’ inferences and therefore unreliable for forming any definitive conclusions; due to the aforementioned last-mile challenges, passenger compensatory travel between route stops cannot be calculated or inferred. Ultimately, one conclusion that may be drawn is that the use of buses for timely traversal of the UMass Amherst campus is unrealistic, as well as unreasonable, for members of the campus community who also live with the challenges of disabilities.

CONCLUSION

After conducting the investigation and research into the viability of campus transportation systems for the disability community at UMass Amherst, it is clear that there remain significant barriers to conclusive research at this time. The current, limited data practices of AVS, combined with elevated levels of traffic congestion and lack of passenger QoL perspectives, impede the progress of UMass Amherst to continually meet the needs of the disability community. These barriers to research also compound the significant barriers to mobility and access for passengers who rely on the AVS service. Several key areas for improvements have been identified in this research. By adopting best practices outlined in RFC 1428 for data collection and recordkeeping, AVS management can provide improved tracking of usage patterns, while promoting greater transparency and accountability within the system. Additionally, a survey of student voices holds the potential to highlight the need for more comprehensive accessibility solutions across UMass Amherst. Finally, the analysis of PVTA data emphasizes the inadequacy of current bus services for meeting the realistic needs of AVS passengers. To address these issues effectively requires a more serious look at the community experience, to better promote equal access to the full campus for the community of people with disabilities at UMass Amherst.

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