Video Simulation of Roadway Bicycling

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ABSTRACT
A high-fidelity simulation methodology has been developed presenting the perspective of a bicyclist riding an arterial roadway. After researching previously used filming methods the researchers found them lacking in several respects. The researchers then developed, tested, and refined a moving camera filming platform configuration that accomplished five major goals:

- Portray the full range of roadway conditions.
- Accurately simulate a bike ride along an arterial.
- Allow extended viewing by study participants.
- Ensure the safety of the videographer/bicyclist filming the simulation.
- Ensure motorists' passing behaviors are not changed.

The Florida Department of Transportation (FDOT), a national leader in the development of non-motorized transportation planning and design tools, sponsored this research developing an arterial level of service model to rate how well arterial facilities serve bicyclists. The primary data collection method was a bike ride event with volunteer cyclists evaluating urban and suburban arterials. Because of the challenges associated with placing volunteers on high speed/conflict roadways, FDOT used video simulation to capture perceptions of busier roadways.

FDOT's research requirements created an ambitious objective for this project - to develop a video simulation methodology of such high fidelity it could be calibrated with real-time field collected data and used to expand the range of variables collected. The research team achieved this goal. Statistical analyses comparing data using the video simulation and during the field event indicated no significant difference. Therefore, researchers can present the bicyclists view of riding environments without exposing them to potentially hazardous traffic/roadway conditions.

BACKGROUND

The Florida Department of Transportation (FDOT) has been a national leader in the use of real-time field data collection events that use actual participant feedback to develop tools for evaluating user perceptions of non-motorized transportation facilities (*1,2,3,4,5*). FDOT's Ride/Walk for Science data collection events have had users score roadway segments, intersections and combinations thereof by actually bicycling and walking along the facilities and scoring roadway on how well the facilities met the users' transportation needs. In 2005, FDOT launched its most recent and ambitious effort, to develop a Level of Service model for determining how well urban and suburban arterial roadway facilities (including combinations of roadway segments and signalized intersections) meet the needs of bicyclists (*6*).

This data collection event posed challenges not previously faced in this type of research. A bicycling course of arterial roadways had to be developed which exposed participant bicyclists to a wide range of geometric and traffic conditions within a course length that could be ridden by typical bicyclists. The volumes and speeds of motor vehicles on urban arterials can be such that the research sponsors are not comfortable asking typical cyclists to ride on those roadways. The same is true of arterial roadways with high truck traffic volumes, and those with high volume driveway movements. The event must be held on a Saturday to ensure an adequate number of volunteer bicyclists will participate; however, roadway and driveway traffic volumes on a Saturday may not completely represent typical weekday conditions.

To address some of the challenges associated with this research effort, the researchers decided to supplement the real-time field data collection event using a video simulation of the arterial roadways. A video simulation would allow us to expose event participant bicyclists to arterials that could not be worked into a course of reasonable typical cyclists.

While simulation studies can provide a wealth of information, they do have limitations. They do not expose the participants to all of the stimuli associated with the real bicycling environment; some factors may be under-represented and others may be over-represented in a video simulation. For example, the impacts on personal safety from wind blast effects of motor vehicles or trucks are not experienced. The bicyclist's field of vision is not completely captured on video. The impact of delay upon the participants' perceptions of the intersections is also likely to be skewed by the simulation format, partly because they are not exposed to the environmental elements waiting for a signal to change. Additionally, scores may be skewed by the fact that there is no trip associated with the simulation methodology.

However, because of the potential-long term benefits of video simulation, the researchers and FDOT studied and evaluated the best method available for producing a high fidelity simulation from the perspective of a bicyclist riding along an arterial roadway. The resulting combined real-time field data collection and video simulation event would allow for determining the fidelity of a selected video simulation methodology. It would also enable future researchers to collect viable data without putting bicyclists on busy roadways in real traffic.

STUDY OBJECTIVE

The purpose of this simulation effort was to test three primary hypotheses. First, that there is a method to accurately represent the viewpoint of a bicyclist riding in a roadway environment by simulating the geometric and operational conditions experienced by the bicyclist. Second, that data collected using this methodology would correlate closely with data collected using a real-time field data collection effort. Third, that some form of calibration equation could be developed that would correct any discrepancy between data collected using the simulation and field collected data, as was recently created for the pedestrian mode (*7*). The research effort and our findings with regard to these hypotheses are discussed below.

SELECTING THE VIDEO SIMULATION METHODOLOGY

The first step in developing a simulation was to determine the methodology for video taping the roadway arterial from a bicyclist's viewpoint. There were three main objectives for the video simulation:

1. It must portray the full range of geometric and operational conditions:
    - Traffic volumes
    - Total number of through lanes
    - Percent heavy vehicles
    - Traffic speeds
    - Width of the travel lanes
    - Pavement condition
    - Crossing width at intersections
    - Turning conflicts at intersections
    - Driveway conflicts
2. It must simulate a bike ride along arterial roadways with the highest practical fidelity. It was important to capture the above listed characteristics and the bicyclist's interaction therewith, with the highest fidelity practical. To this end, extensive testing for the most appropriate camera platform and filming protocol was very important.
3. It must be viewable by participants for an adequate duration to allow simulation of a number of arterials with a variety of conditions.

In addition to the video simulation objectives, the researchers had two additional objectives:

4. The methodology must provide for the safety of the cyclist/videographer.
5. The method should ensure that the behavior of motor vehicle drivers overtaking the filming platform is similar with those of motorists passing regular bicyclists.

With these objectives in mind the project team researched potential video simulation methodologies.

Previously Used Video Simulation Methodologies

The researchers performed a literature search to determine what other methods had been used to simulate riding in the roadway environment. The advantages of each method were then evaluated to determine if it would be appropriate for application in this research effort. Three of those efforts are discussed below.

Fixed Camera Mounted Roadside

Harkey *et al.* used video clips from a stationary camera to develop the Bicycle Compatibility Index (*8*). The video clips reflected a variety of characteristics including a range of curb lane widths, motor vehicle speeds, traffic volumes, and bicycle/paved shoulder widths.

Participants were asked to rate their comfort level based on a six-point scale in the following categories: volume of traffic, speed of traffic, width or space available for bicyclists, and overall rating. In the end, eight variables were found to be significant in the BCI regression model:

- Number of lanes and direction of travel

- Curb lane, bicycle lane, paved shoulder, parking lane, and gutter pan widths
- Traffic volume
- Speed limit and 85 percentile speed
- Median type (including two-way left turn lane)
- Driveway density
- Presence of sidewalks
- Type of roadside development

Since this research was done in a video laboratory setting, the subjects could not take into account the comfort effects of pavement condition or crosswinds and suction effects caused by high-speed trucks and buses. These factors consequently are either absent or show up to a minimal extent in the BCI model.

Moving Motor Vehicle Mounted Camera

Jones and Carlson developed a rural bicycle compatibility index (*9*) using a moving camera methodology. They employed a web-based survey consisting of questions and thirty-two 30-second video clips. The 30-second video clips were edited from 15-minute videos shot with image stabilization from a car moving 10 mph at a height 4.5 feet above the ground. According to the researchers, since overtaking motor vehicle traffic tended to give wide clearance to the slow moving car on the shoulder, the video clips tended to show over-taking vehicles giving bicyclists more clearance than they would in reality.

The rural bicycle compatibility index in this model is a function of two factors: shoulder width, and the volume of heavy vehicles traveling in the same direction as the bicyclist. The authors intentionally excluded pavement condition from the survey due to various data difficulties (including the difficulty of representing rough pavement in a video shot from a camera mounted on a car). All sites had relatively level grades, only two traffic lanes and speed limits in excess of 50 mph.

Bicycle Helmet Mounted Camera

Hummer *et al.* (including one of the authors of this paper) used a helmet mounted camera to produce a video to obtain user bicyclists' feedback and develop a level of service estimation method for shared use paths (*10*). Thirty-six 60-second video clips were used in this research effort. The video clips were in black and white and had no audio. The video was then digitized; the quality of the digitized video was considered good to marginal. However, the researchers described some camera angles as marginal and noted the quality was also impacted by level of brightness and contrast control of the equipment used. The images were considered 'good enough' and presented for periods of sufficient time to give respondents a realistic view of operations on the trail.

Additional Video the Simulation Methodology Testing

Based upon a review of the literature, the FDOT and the researchers determined the first two methods discussed above would not meet the needs of this project. The stationary and motor vehicle mounted cameras did not capture the full range of variables expected to be significant in an arterial setting for bicyclists. Additionally, the position of the passing motorists represented in the video would not accurately represent that experienced by actual cyclists.

The helmet cam used in Hummer's study was still considered a viable option but was seen as needing further refinement. The quality of the video would have to be improved and sound would need to be included to accurate represent the roadway environment. Also, it was reported that some participants viewing the video experience nausea and/or headaches because of the camera's movement.

The researchers decided to experiment with numerous different moving camera video platforms and evaluate them to determine which would be the best to use in the arterial roadway environment. Videos were shot using six different camera/bicycle configurations. These configurations included a mountain bike with the rider wearing a helmet cam; a frame mounted camera on a fully suspended mountain bike; a tandem bicycle with front suspension and the stoker operating a stabilized camera; a two person adult tricycle with the videographer in the left front seat; and, a Viewpoint bicycle with the front rider (stoker) operating a hand held camera.

These were first evaluated by the project team viewing sample video filmed with the various configurations. Subsequently a group of 44 individuals viewed the video clips in a controlled environment. They provided comments on an evaluation form as they watched video footage shot with the various filming platforms. Each individual was interviewed after watching the videos to obtain any additional insights s/he might have had. Summaries of their observations and the researchers' conclusions regarding each of the moving camera video platforms are presented below:

Bike with Rider Wearing Helmet Cam

The first configuration tested was a helmet cam mounted on the helmet of a cyclist riding a mountain bike. With respect to the objectives we found the following:

1. Most of the variables could be represented using this configuration. However, pavement roughness was not well represented on the video; evidently the cyclist's body acted to dampen vibrations due to roadway surface irregularities.
2. The mountain bike/helmet cam met the second criterion very well. It is absolutely clear from the video that one is getting a cyclist's eye view of the roadway.
3. The video <u>did not meet</u> the third criterion of being viewable by participants for an adequate duration. Every movement of the rider's head was reflected on the video tape. Additionally, the scanning movements of the bicyclist (required to maintain an awareness of traffic) occurred much too fast on video. The constant motion was found to make several viewers nauseous after only a few minutes.
4. This configuration requires the cyclist to both operate the bicycle (in heavy traffic) and act as the videographer. To provide consistent video representations of each facility, it is necessary to "script" the cyclist's speed and any camera movements to eliminate unintended biases. For instance, on a busier highway, a cyclist might look over his shoulder more frequently than on a quiet residential street. This could cause the video to over-represent the effect of some of the variables.
5. If the video unit and batteries are placed within a trunk bag or saddle bags, the impact of this device on motorists' behavior is minimal.

While the method may have been adequate for a shared use path environment, the project team decided that the mountain bike/helmet cam configuration would not adequately meet the objectives of this video simulation project for this arterial roadway project. The nausea caused by the video made viewing the tape for more than just a few minutes impractical. In addition, the expert advisory committee had concerns about the safety of the cyclist acting as both the driver of the bike and the videographer.

Suspended Mountain Bike with Frame Mounted Camera
This configuration is a mini camera mounted on a tripod attached to the top tube of a suspended mountain bike.

1. Many of the expected variables could be represented quite well using this configuration. However, because this method eliminates the opportunity for scanning, the impact of side streets or multiple lanes may be under-represented in viewers' responses.
2. This configuration met the second criterion quite well. It is absolutely clear from the video that the video was taken from a bicycle.
3. The video did not meet the third criterion of being viewable by participants for an adequate duration. Because a bicycle is constantly swerving (albeit ever so slightly), the video had a back and forth sway throughout its length. Additionally, even though the bike was equipped with both front and rear suspension, surface irregularities caused a near constant and very severe vibration to the picture. The constant motion was found to make several viewers nauseous after only a few minutes.
4. This configuration does not require the cyclist to act as a videographer and is therefore acceptable from a safety standpoint.
5. Based upon the passing position of the motor vehicles in the video, this arrangement appears to have minimal impact on the behaviors of motorists passing the bicycle.

The project team decided the camera mounted to the top tube of a fully suspended mountain bike would not adequately meet the objectives of this video simulation project. The nausea caused by the video made viewing the tape for more than just a few minutes impractical. In addition, the advisory committee decided that because the opportunity to pan the camera is eliminated, some variables of the urban arterial environment would not be adequately represented in the video.

Front Suspended Tandem Bicycle with Rear Rider (Stoker) Operating a Camera Mounted on a Glidecam™ Stabilization System
The Glidecam™ Stabilization System stabilizes the camera to eliminate unwanted roll, pitch and yaw in a video.

1. Many of the expected variables could be represented quite well using this configuration. The long wheelbase of the tandem bicycle and the shock absorber on the Glidecam™ dampened the effect of surface irregularities on the video. However, because this method eliminates the opportunity for scanning to the right, the impact of side streets may be under-represented in subsequent viewers' responses.
2. This configuration met the second criterion quite well. It is absolutely clear from the video that the video was taken from a bicycle. The front cyclist was in the picture for most of the video. There was some discussion as to whether having the cyclist in the frame would create a scoring bias.
3. The video obtained using this method provided excellent picture stability and quality. No one watching the video complained of any discomfort or nausea.
4. This configuration does not require the cyclist to act as a videographer and is therefore acceptable from a safety standpoint.

5. The test configuration involved using a large body mounted Glidecam™ arrangement. Consequently, the obvious presence of the camera and videographer on the back of the tandem may have influenced motorists' overtaking behaviors. However, it is felt that with modifications – using a smaller camera configuration – this effect could be minimized.

This platform and camera combination provided stable, clear video. However, the advisory committee decided that because the opportunity to pan the camera is eliminated, some variables, such as interactions with motorists at intersections and driveways, would not be adequately represented in the video.

Two-person Adult Tricycle with the Videographer in the Left Side Seat
This configuration had the videographer sitting to the left of the individual who actually drove the bicycle.

1. Many of the expected variables could be represented quite well using this configuration. However, surface irregularities were not well represented by this methodology.
2. This configuration resulted in a travel speed too low to represent realistic bicycle speeds on busy roadways.
3. The video obtained using this method provided excellent picture stability and quality. No one watching the video complained of any discomfort or nausea.
4. This configuration does not require the cyclist to act as a videographer and is therefore acceptable from a safety standpoint.
5. Because of the additional width of the tricycle, motor vehicle drivers gave additional space to the tricycle, as evidenced in the test video clips.

Because of the potential (lack of) speed and the influence of the tricycle's design on motorists, the advisory committee found this option to be unacceptable for this project.

Viewpoint Bicycle with Front Rider (Stoker) Operating a Hand Held Camera
A Bilenky Viewpoint bicycle is a tandem bicycle on which the captain, the one who steers the bicycle, sits in the back on a regular upright frame. The stoker (and cameraman) sits in the front on a recumbent style seat. The videographer's arm was braced on part of the bicycle to aid in steadying the camera.

1. Many of the expected variables could be represented quite well using this configuration. The videographer's arm provided some dampening effect on the effect of roadway irregularities. Intersection, driveway and lane number effects can be captured because scanning can be readily executed by the videographer.
2. This configuration met the second criterion quite well. It is absolutely clear from the video that the perspective is that of a bicyclist.
3. The video obtained using this method provided excellent picture stability and quality. No one watching the video complained of any discomfort.
4. This configuration does not require the cyclist to act as a videographer and is therefore acceptable from a safety standpoint.
5. The effect of the Viewpoint bicycle on passing traffic appears to be minimal; motorists appear to overtake and pass the bicycle as they would a regular bicycle (Figure 1). This

may be because the motorists' view of the bicycle is similar to that of a regular bicycle as the front cyclist (cameraman) is relatively hidden from the motorist until the overtaking is completed.

The project team found that this configuration provided the best overall potential for high quality, consistent video representation of arterial roadways.

Final Video Platform

The final video platform was a Viewpoint bicycle with Glidecam™ placed on a vertical mast added to the bike's forward boom (Figure 2). The handle of the Glidecam™ slipped over the vertical mast and rested on foam shock absorbing material. This modification had several advantages over a hand held camera. The mast made it easier for the videographer to stabilize the camera, particularly through curves. It also helped the videographer execute camera panning maneuvers along the roadways and at intersections. The shock absorption material was chosen to dampen, but not eliminate, the vibration experienced by cyclists on rougher roads. The final length of the camera mast was chosen to approximate the height of an average bicyclist's eye (*11*). A digital mini-cam with an external microphone was used to provide high quality image and sound with a less conspicuous and cumbersome camera setup (Figure 3).

A final filming technique modification was an increase in speed over that used in the preliminary testing. The video clips shot for the initial test were filmed at approximately the fiftieth percentile for bicyclists' speeds (*11*), about 17 kilometers per hour (10 – 11 miles per hour) when traveling at speed. This speed was chosen because it was anticipated that the average cyclist would perceive this as a "normal" speed for bicycling. Responses from the testing revealed those viewing the video felt the speed was too low. Consequently, the speed was raised to 22 kilometers per hour (13 - 14 mph) to represent approximately the eighty-fifth percentile speed for bicyclists.

VIDEO SIMULATION

As stated previously, the video simulation in conjunction with the real-time field data collection event had two primary purposes: to expand the range of bicycling conditions beyond what the course provided and to calibrate the video simulation to physical reality. To accomplish this, a number of arterials from the *Ride for Science* course were videotaped during weekday rush hour conditions. Additionally, sections of arterial roadways with on-street parking and sections with heavy truck volumes were videotaped and included in the study. Through the use of video simulation, participants would be able to view and rate complex roadways with high traffic volumes and numerous conflicts that would have possessed a higher degree of risk for participants than what they experienced on the riding course. To calibrate the video simulation to reality, some of the roadway sections shown in the video coincided with those on the *Ride for Science* course itself.

Creation of the Video

Videotaping was performed with the camera configuration described above several weeks in advance of the actual event. To ensure consistent filming which reflects typical bicyclists' scanning behavior, a protocol was developed, tested, and employed by the researchers and videographer. The camera was panned at intersections and intermittently along the midblock sections of roadway. When not panning, the video shot was directed at the roadway ahead in the right-center of the frame to focus on the roadway and capture driveway conditions while not focusing on objects outside the right of way.

All traffic laws were obeyed during the filming of the roadway sections. The researchers considered this important as the intent of this project was to obtain cyclists' feedback on the roadway when used as intended. This meant the bicycle was ridden near the right side of the roadway, and positioned in the proper lane at intersections. The cyclist obeyed all traffic signals to ensure any impact from signal delay would be captured in the video.

The resulting video used during the event contained eleven (11) arterial roadway sections, with a running time of approximately forty-seven (47) minutes. The arrival at all videoed intersections was random relative to the traffic signal to ensure that the associated delay was also random.

Video simulation transitions were carefully designed to allow participants to finish their assessment of the arterial segment and circle a grade on a score card before focusing their attention on the subsequent video clip.

Because the video simulation was intended to both accurately reflect in-street riding conditions as closely as possible and to be used in other studies throughout the United States, the sound level of the video simulation was indexed to the physical environment. The week of the event, decibel readings were recorded along several arterials. Minimum and maximum values were taken in the field, as well as an average reading during which the parallel roadway traffic was moving. Maximum sound, usually representing a closely passing tractor trailer, was generally associated with a decibel level in the low 80s, with minimum levels in the high 50s and average levels in the high 60s. During the video simulation event, the audio levels were set to these measurements by adjusting the volume on the speakers.

RIDE FOR SCIENCE 2005

The *Ride for Science 2005* field data collection event was held in Tampa, Florida on Saturday, November 12, 2005. The Event captured to what extent roadway facilities accommodated bicyclists, eliciting their perceived level of safety, comfort, and travel efficiency (*i.e.*, delay) provided in the various bicycling environments. During the Event, participants completed two primary activities: they viewed a video simulation and rode a marked course through the surrounding urbanized area. In the process, individuals rated the varying geometric and operational environments on a pseudo-academic ("A" to "F," representing "best" to "worst") scale.

The researchers had most of the participants view the video before riding the course. This was because of the anticipation that when simulations are used in future research, no actual field event would be taking place. Consequently, it was important to know how people who were only able to view a video would perceive the roadway in the simulation environment. The balance of the participants was sent to the field course prior to watching the video to facilitate additional future hypothesis testing.

Participants

The study team recruited volunteer participants through broad media outreach. The participant registration forms included questions the participants' age, gender, years living in Tampa, and miles ridden per week for various purposes.

An important characteristic of the participants for this video simulation study is that they (generally) represented individuals who <u>would</u> ride a roadway course. This is not to say that they were all high end or commuter cyclists; in fact, nearly a third of the participants reported riding an average of less than 10 kilometers (6 miles) each week. However, most came to the event expecting to ride bikes on urban roadways.

The Roadway Course

The *Ride for Science 2005* course included a broad spectrum of arterial- and collector-type roadways typically found in U.S. metropolitan areas. Held in the areas around the University of South Florida and Busch Gardens, the course wound through a wide variety of urban and suburban land use types. The course included roadways with two to six lanes; with and without bike lanes or shoulders; and with varying traffic speeds, vehicle types, driveway densities, and pavement conditions. The course was designed to allow participants to experience a variety of roadway facility configurations and traffic conditions. Approximately 20 miles (32 kilometers) long, the course included twelve roadway sections. The data collection procedures, event logistics, and course data are described in more detail in another paper (*6*).

Video Room Setup and Equipment

A room was set up to exact standards to ensure a consistent video simulation environment for all participants and to allow future accurate calibration of the video simulation data to bicycling course data. Participants, seated in four rows of chairs, watched the video as it was projected onto a screen from a projector situated on a table. High quality computer speakers and sub-woofers were used to provide sound. Two video projection setups were used simultaneously. Each of the projections were of the same size, 64 inches (1.6 m) measured diagonally, and were projected using similar projectors.

Given the length of the video (47 minutes) and the maximum number of participants expected in one hour (36), it was determined that two setups, each with sixteen chairs arranged into four rows, would allow for sufficient capacity. Within the rows, the chairs were arranged so that all viewers could see the screen without any obstructions from other seated participants. Participants were instructed not to move chairs, and proctors were available to restore chairs to their original positions when necessary.

Viewing Procedure

Participants were briefed by a proctor stationed outside the building regarding the viewing procedure, assessment of arterials, and the corresponding grading. They were handed their scorecards showing a number for each video simulation segment and the letters “A” through “F” for them to circle after viewing each segment. Each scorecard contained a written summary of the instructions on the back in addition to the grading form on the front. To ensure that everyone was fully briefed, individuals arriving in the middle of a briefing were instructed to wait for the next one.

After being briefed, participants were directed to the video viewing room, where they were met by a room proctor. Because the video was constantly running (a second rewound tape was always available to replace the running one), the first facility section viewed and graded by a given individual was random. To allow testing for any potential scoring fatigue bias (grading differently later toward the end of the video than at the beginning) based on point of arrival, participants were asked to circle the number of their first viewed section. After they had graded each section, participants checked out with the room proctor, who collected their scorecards and directed them to the bicycling course briefing station to complete the remainder of the event.

DATA ANALYSIS

Participant Demographics

The seventy-five (75) video participants provided demographic data including age, gender, years living in Tampa, bicycling trip purposes (work, shopping, school, etc.), and riding experience (*i.e.*, miles ridden per week). The participants in the video simulation study represented a good cross section of age, gender, and geographic origin. Participants ranged in age from 17 to 71; although minors were prohibited from riding the course, one 17-year-old watched and graded the video. The gender split of the study was 47 percent females and 53 percent males. Most (63 percent) participants had lived in areas other than the Tampa region for the majority of their lives.

Video Simulation Grades

The video simulation participants collectively graded a total of 817 arterial sections. For analysis purposes, the letter grades were converted to numerical scores: A = 1, B = 2, C = 3, D = 4, E = 5, and F = 6. Figure 4 shows the average grade for each section.

At the 0.05 significance level, females (N=35) graded worse (more severely) overall than males (N=39) (4.27 vs. 4.02, $p=0.021$). Participants who were 40 years or older (N=41) graded worse than younger participants (N=27) (4.26 vs. 3.84, $p<0.001$). There was not a significant difference in grading between those who had lived in Tampa for less than 5 years (N=14) and those who had lived in Tampa for 5 years or longer (N=53) (4.01 vs. 4.11, $p>0.05$).

Among the 75 participants in the video simulation, there were 59 “course and video” participants, *i.e.*, they watched the video and rode the course. The remaining sixteen participants were “video only” – they did not ride the course. “Video only” participants graded the arterial roadway sections less favorably than “course and video” participants (4.33 vs. 4.07, $p=0.034$).

Of the sixteen “video only” participants, thirteen volunteered to watch and grade the video (“volunteer video” participants). The other three had signed up to ride the course but then decided, on the day of the event, not to ride the course (“refused to ride” participants). “Refused to ride” participants graded the video simulation segments less favorably overall than “volunteer video” participants (5.03 vs. 4.17, $p=0.003$). It is important to remember that this comparison involves a small sample size (of three).

Comparison of Video and Course Grades

Of the eleven sections shown in the video simulation, six represented facilities that were also graded as part of the riding course. They were filmed under similar traffic conditions as those experienced by the Ride for Science 2005 participants. To test the hypothesis that people grade differently in a video simulation setting than they do within the riding environment, results for these six facilities were compared. The scores for both the video and course facilities were reduced. Based on a total of 615 observations (some of the potential responses from the 59 “video and course” participants were not included because of non-response), the video scores were not statistically significantly different from the course scores ($t=1.39$, not significant at the 0.05 level). Specifically, participants graded the common facilities nearly the same in the video simulation environment (mean=4.05) as they did on the course (mean=4.24). As a consequence, no calibration type equation to correlate the video grades to those obtained during the real-time field was needed.

FINDINGS

The researchers hypothesized that there was a method to accurately represent the viewpoint of a bicyclist riding in a roadway environment while simulating the geometric and operational conditions experienced by the bicyclist. They found numerous methods that had been used in prior research, each having some advantages and disadvantages in terms their representation of roadway variables, fidelity to the roadway environment, comfort of those viewing the video, and the safety of those shooting the video. Taking the lessons learned from each of the methods used in previous research and feedback from a study group and an expert panel, the researchers developed and refined a method for video taping roadways to accurately simulate the roadway environment.

The researchers expected that data collected using this methodology would correlate closely with data collected using a real-time field data collection effort. In this respect the results exceeded our expectation. Based upon our statistical analyses, we found no significant difference between the data collected during the real-time, actual bike ride portion of the data collection event and the data collected from the video.

The high correlation between video and field data collection made the final hypothesis moot. No calibration equation was needed to correct the data collected using video to data collected to the real-time field data.

APPLICATIONS

The simulation video platform and protocol developed during this effort appears to have wide potential for professionals in the bicycle engineering, planning, and educational fields. Because of its high fidelity to the roadway environment and the portability of the project, this simulation methodology can be used to evaluate any number of roadway/path cross sections and traffic conditions to determine their effect on the perceptions and safety of bicyclists. Using this methodology it is possible to represent roadway conditions without putting subjects into actual traffic.

The portability of the simulation methodology means that study subjects from across the United States can be exposed to identical roadway conditions. It has already been used to provide simulation video for the current NCHRP Project 3-70 Level of Service for Arterial Roadways project. During this project, the study participants will need to be carefully screened to ensure those participants evaluating the roadway arterials represent a cohort which would actually ride a bicycle on-road. If this is not done, some correlation may have to be developed to calibrate the overall population (using the video only data set) to those who would actually ride.

The researchers found the simulation methodology to be an excellent method for documenting motorist/bicyclist conflicts on roadways and sidewalks. Because of its low impact on motorists' behaviors we were able to film conflicts and riding conditions that occur for cyclists riding with traffic on the roadway and for those riding against traffic on sidewalks.

The FDOT and the University of Florida have used this methodology to evaluate bicycle facilities in construction zones and the simulations filmed in that project have been shown to engineers and to students to show them the impacts of design on bicyclists.

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LIST OF FIGURES

Figure 1 Rear view of the Viewpoint tandem

Figure 2 Final video taping platform

Figure 3 Video taping facilities

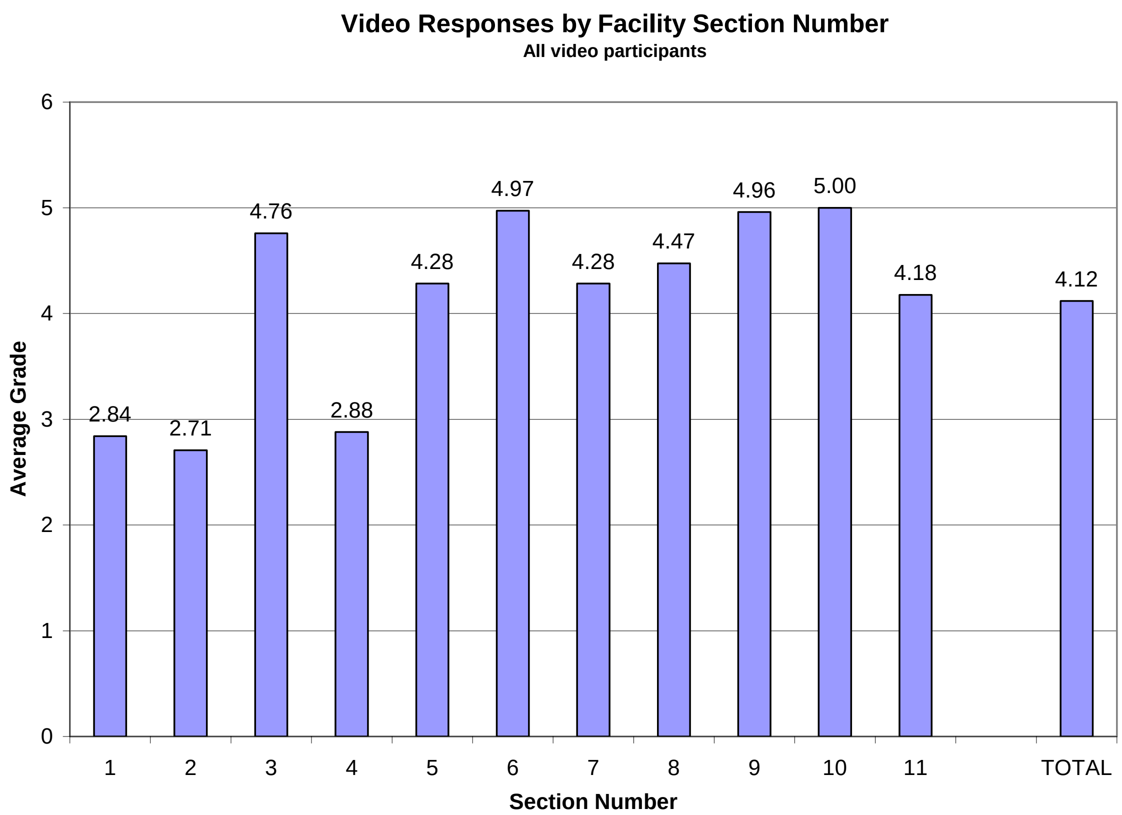

Figure 4 Average video grades by facility section number