Blind Pedestrians' Access to Complex Intersections

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BACKGROUND

Blind Pedestrians' Street Crossing

- Earlier intersections were more accessible to blind pedestrians.
- Challenges in accessibility to modern intersections
  - Wide streets and medians
  - Channelized turn lanes
  - Large radii blended curbs

Steps in Negotiating an Intersection

- Detect the street
- Find the crosswalk location
- Aligning to cross with the correct heading
- Identifying the traffic control
- Deciding when to cross
- Maintaining a correct heading while crossing

Conceptualization of the Study

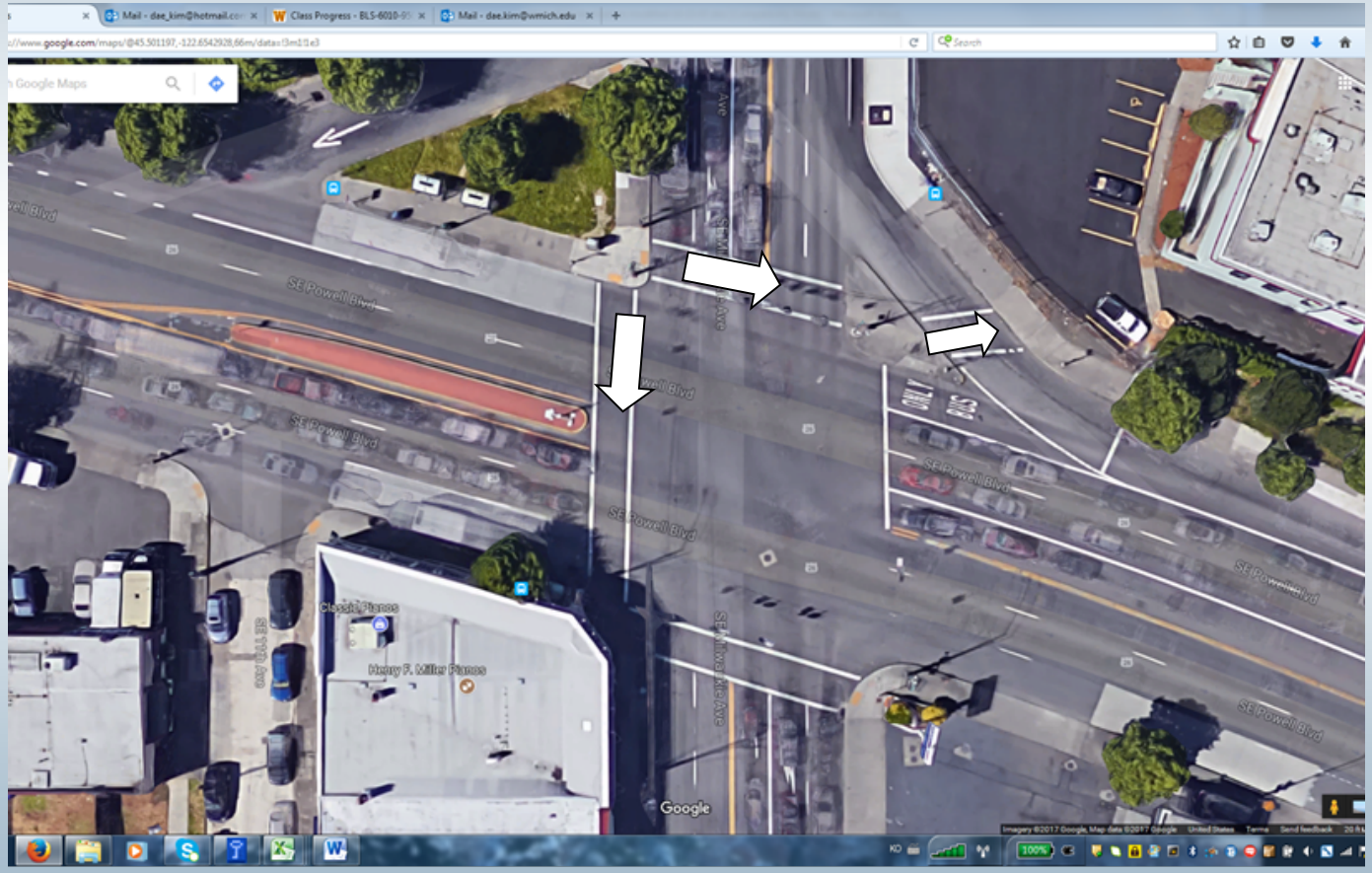
- Making information about individual intersections and crosswalks readily available to blind pedestrians, either as part of accessible GPS devices or some type of route planning program or wayfinding device
- Database was not designed to be device specific.

Research Questions

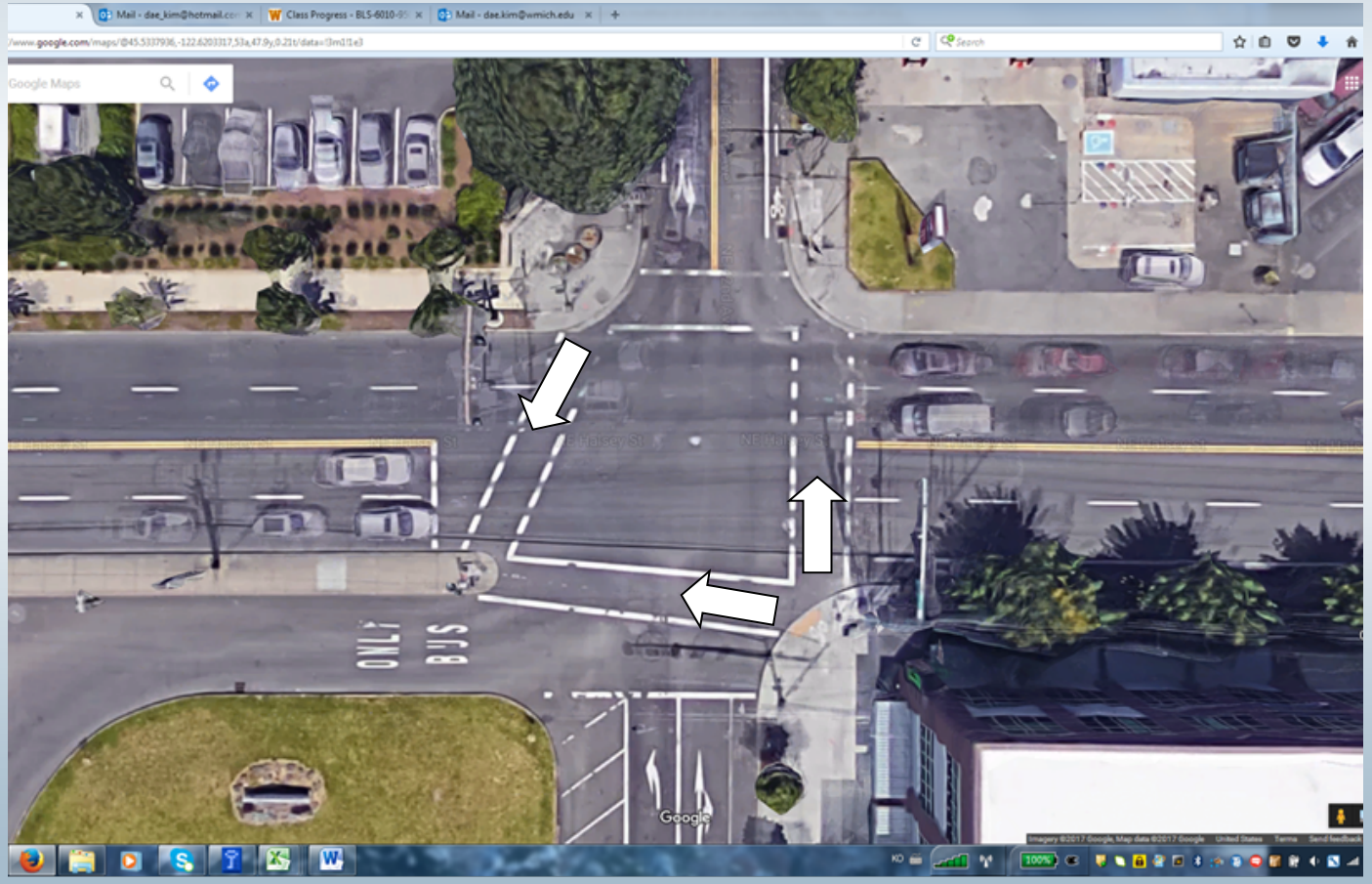
- Does availability of descriptive information about complex intersections enhance the safety and efficiency of crossing by blind pedestrians?

Methods

Intersection One



Intersection Two



Participants

- 22 totally blind adults
- Received formal orientation and mobility training
- Experienced travelers who generally feel confident crossing unfamiliar signalized intersections

Intersection Database

Category	Sample of Included Information
Intersection shape and size	• Lanes • Legs • [Right angle/Skewed] intersection • Channelized right turn lane • Two-stage crossing • Median
Crosswalks and curb ramps	• [Diagonal/Separate] ramp • Crosswalk [parallel to a street/perpendicular to a street/skewed] • Detectable warnings

Intersection Database

Category	Sample of Included Information
Traffic signals and control	• Actuated signal • Split phase signalization • [Protected/permissive] left turns • Pushbutton
Accessible pedestrian signals	• Locator tone • Tactile arrow • Audible beaconing

Example of Information Provided to Participants

General Description: "Halsey, east/west, 4 lanes; 42nd, north/south, 2 lanes. Right angle, 4 legs. Actuated. Split phasing on 42nd. Some detectable warnings, pushbuttons, and APS. South leg 42nd transit station driveway, buses travel counterclockwise loop."

Specific example for Crossing 42nd, on the south crosswalk (traveling from southeast to southwest corners) : "Diagonal ramp. Detectable warnings. No pushbutton. No APS. 3 lanes. Crosswalk ends on sidewalk between Halsey and pavement of bus turnaround loop."

Experiment Procedure

- Participants were informed that they would be crossing at three of the intersection's crosswalks, starting at random distances between 25 and 50 feet from the crosswalk.
- A participant's task was to cross as if you were unaccompanied and on your way to an appointment.
- The relevant general intersection and crossing information was played twice on the BrailleNote and participants were allowed to ask for definitions of terms as needed.
- Participants were asked to take as much time as they wished to find the crosswalk and to cross.

Outcome Measures

- Finding an appropriate start location
- Aligning to cross with the correct heading
- Finding and using the pedestrian pushbutton when one was available
- Starting to cross at an appropriate time
- Traveling in an appropriate direction
- Traveling within the crosswalk
- Completing the crossing within the crosswalk
- Completing the crossing before Don’t Walk

Predictor Variables

- Whether the intersection database information was provided or not
- Whether APS was present or absent for a given crossing
- Whether there were separate ramps or a single diagonal ramp

Analyses

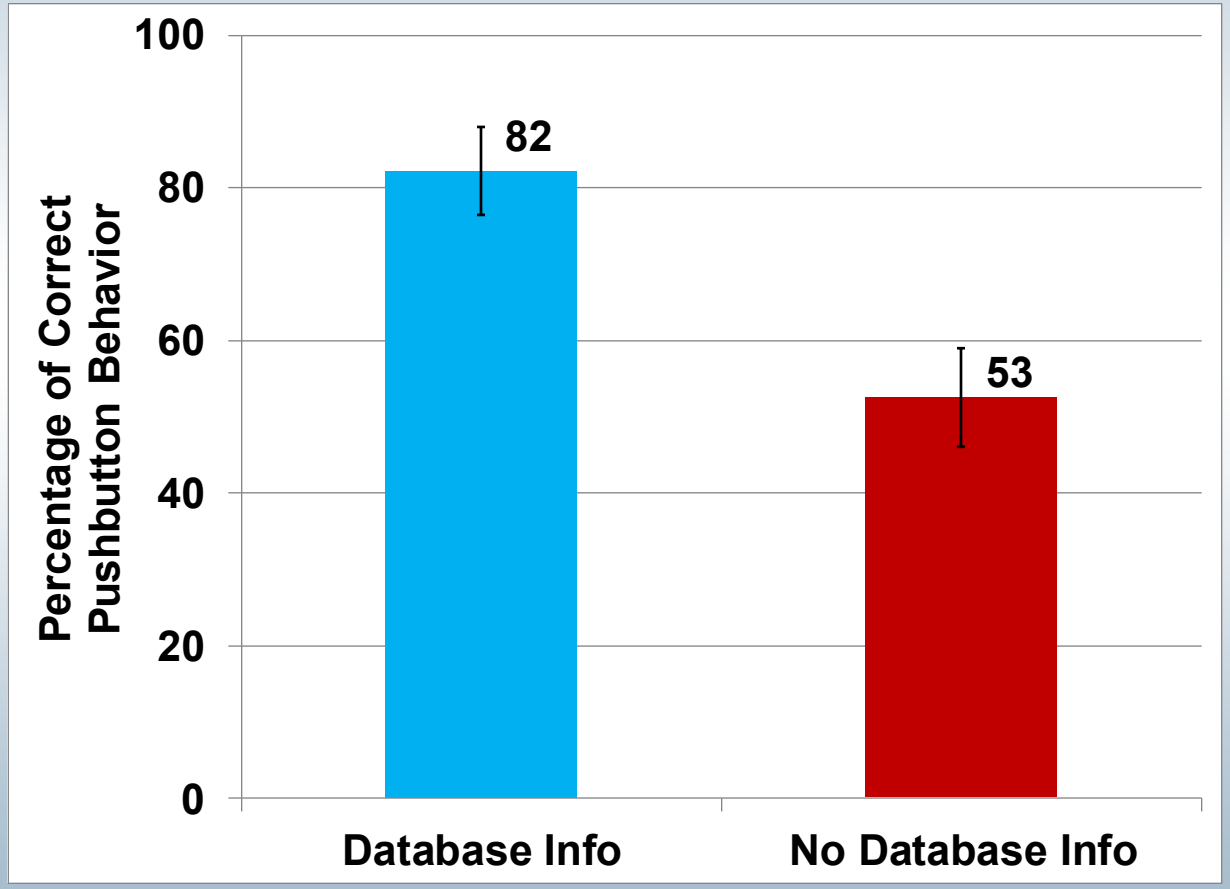
- Generalized Estimating Equation (GEE) procedure was used to test our hypotheses (Hanley, Negassa, Edwardes, & Forrester, 2003; Hubbard et al., 2010).
- A significance level of .05 was used for all statistical tests.
- All statistical analyses were conducted with SPSS version 25 and *R*.

Results

Finding the Crosswalk (Correct Start Location)

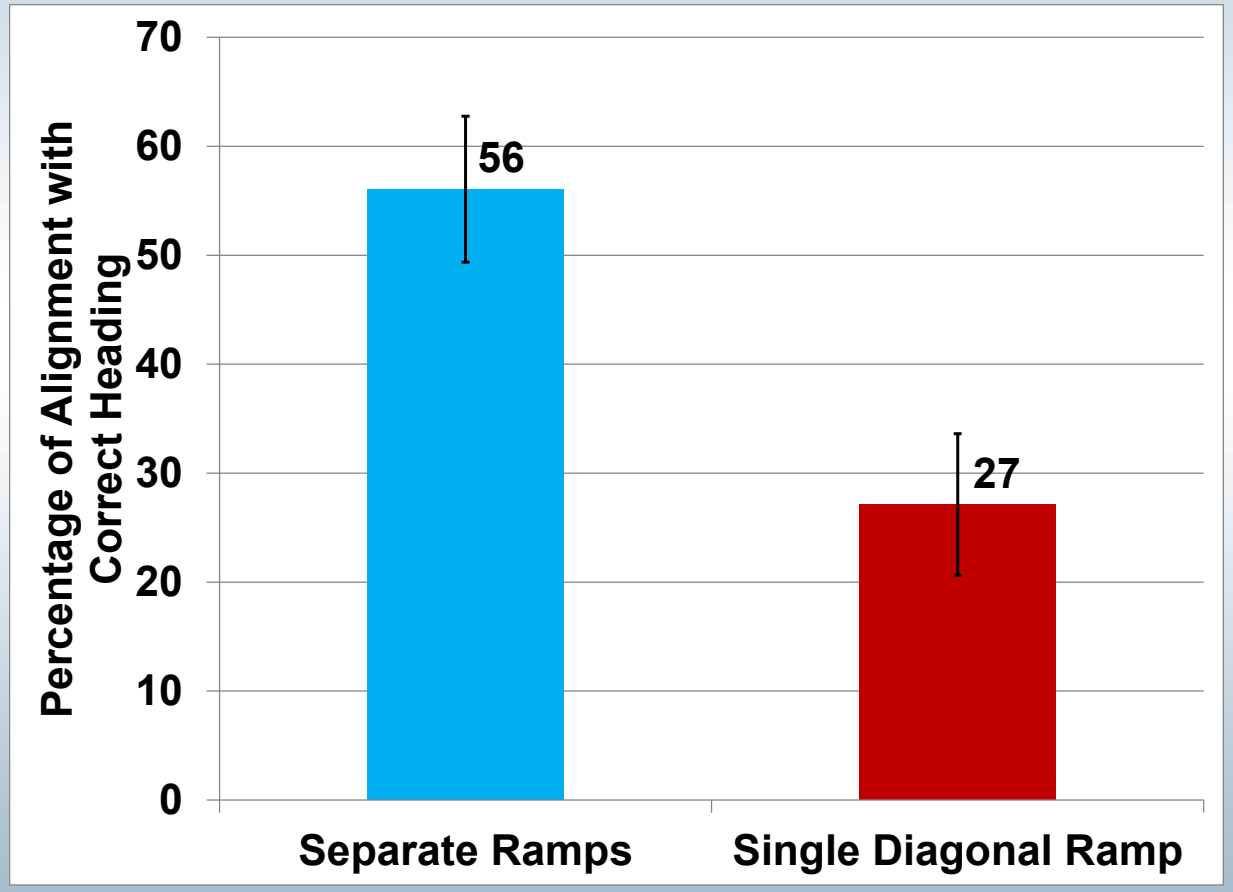
- Predictor variables:
  1) Database Information
  2) APS
- Neither database information ($p = .589$) nor APS ($p = .635$) had a significant effect on the percentage of successfully finding the correct start location.

Using Correct Pushbutton



$p = .005$ (odds ratio = 5.73)

Alignment with Correct Heading

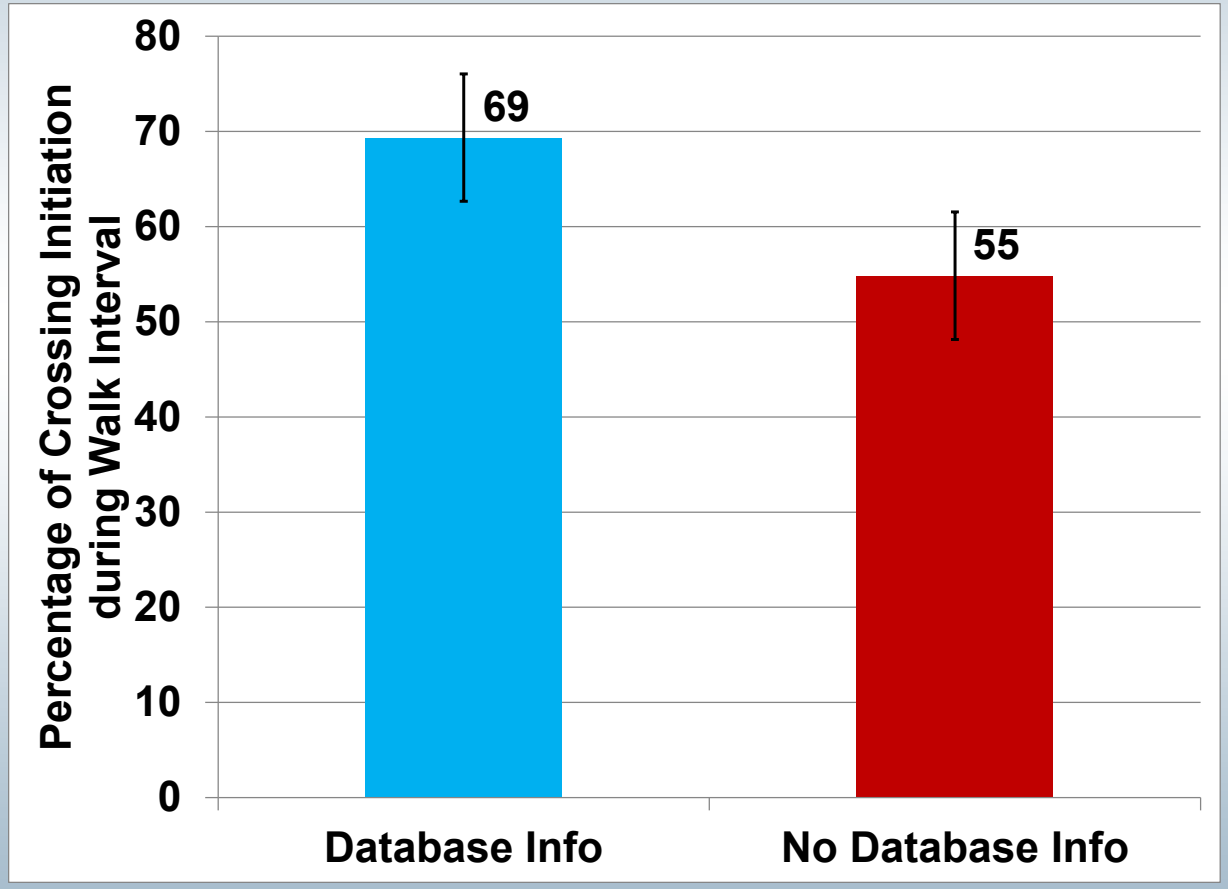


$p = 0.012$ (odds ratio = 3.29)

Initiating within Crosswalk Lines

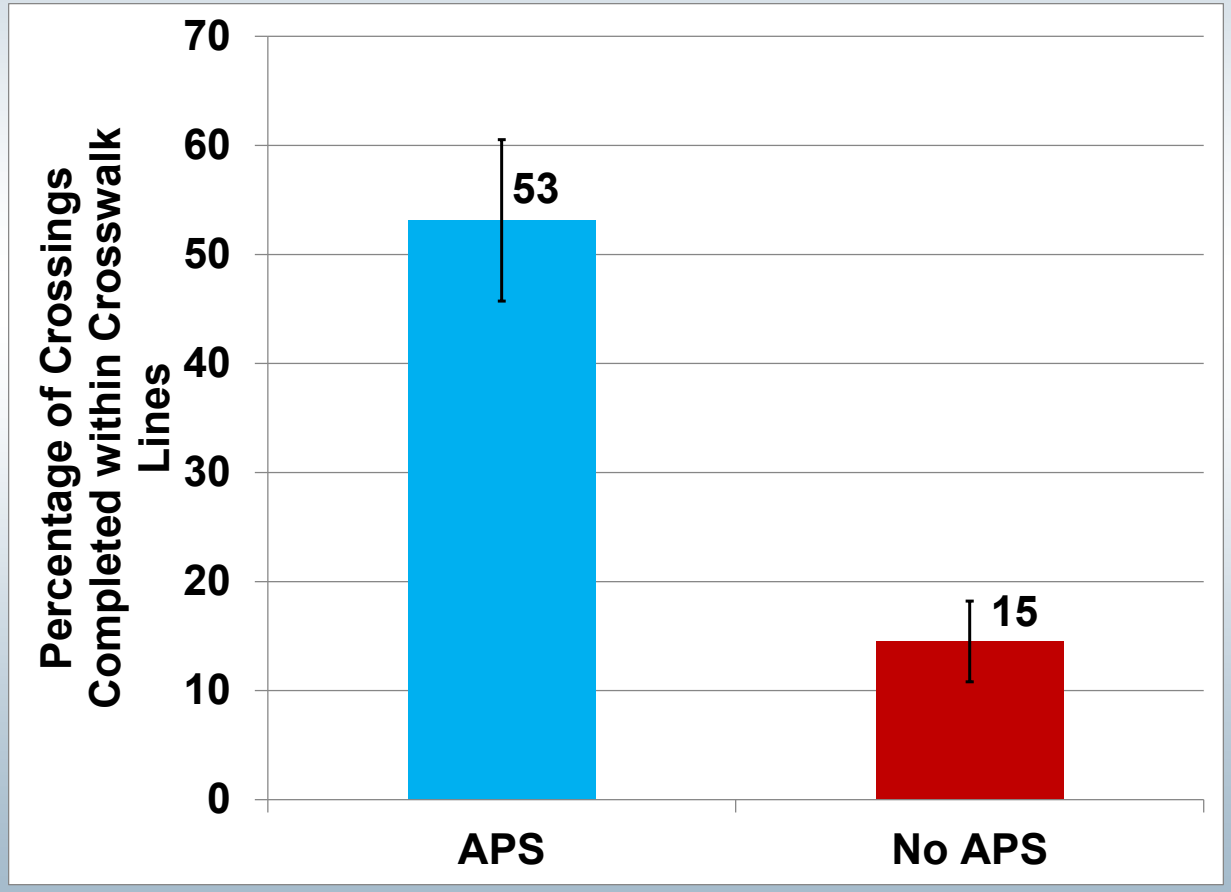
- Predictor variables:
  1) Database Information
  2) Type of ramp (separate vs. single diagonal)
- Neither database information ($p = .928$) nor ramp type ($p = .207$) had a significant effect on the percentage of crossing initiation within crosswalk lines.

Crossing Initiation during "Walk"



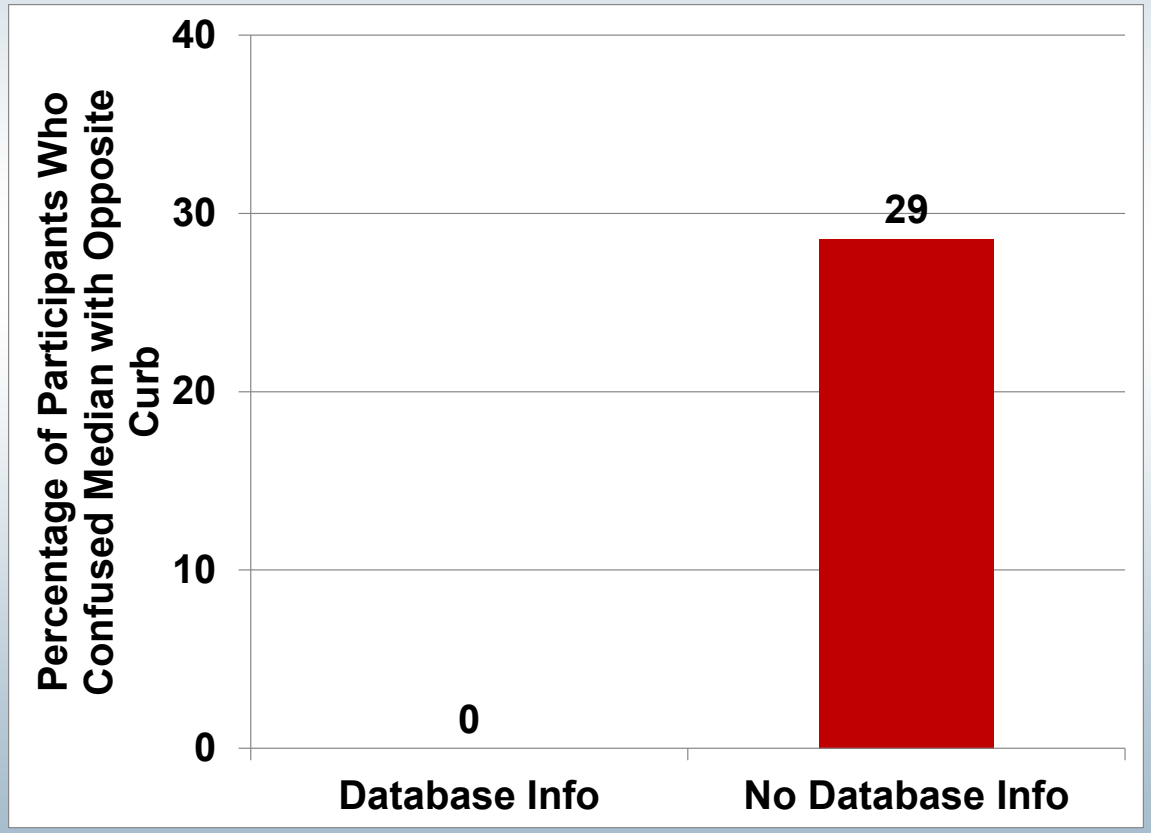
p = .025 (odds ratio = 3.16)

Completing within Crosswalk Lines



p = .003 (odds ratio = 8.83)

Confusing Median for Opposite Curb



$N = 14$

DISCUSSION

Discussion

- Key findings
  - Provision of database information helped the participants use the pushbutton, initiate crossing during the Walk interval, and avoid confusing a median as the opposite curb.
  - Separate ramps help blind pedestrians align themselves with correct heading and the presence of APS helps them complete the crossing within crosswalk lines.

Practical Implications

- Use of accessibility features
- Initiate crossing without delay
- Avoid confusion when there are unusual features such as a median
- Physical features help aligning with the correct heading and completing crossing within crosswalk lines.

Acknowledgement

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