RESEARCH ON WAYFINDING SYSTEMS FOR PEDESTRIANS WHO ARE BLIND

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Do pedestrians who are blind have difficulty when they approach streets via curb ramps?

- Participants who were totally blind were asked to stop before stepping into the street
  - Stepped into the street before stopping on approximately 39% of trials
  - On approximately 60% of those trials where participants stepped into the street, there were vehicles either moving or idling on the street in front of them
Stopping, before stepping into the street, was highly correlated with ramp slope

- Steeper slopes were more detectable
- When ramp slope was 1/12 (8.3%) or less, participants failed to stop on approximately 50% of trials
Results replicated

- Research sponsored by Access Board confirmed the direction of these results.
- In addition, results documented that pedestrians who are blind are more likely to veer out of the crosswalk where curb ramps were at the apex.
- Results also documented
  - some participants with mobility impairments experienced some level of decrease in ease of negotiation
  - majority found ramps having truncated dome detectable warnings to be safer, more slip resistant, more stable, and to require less effort to negotiate than concrete curb ramps
Detectable warnings—Tactile ground surface indicators (TGSIs)

- Research to identify a surface texture that is highly detectable by pedestrians who are blind both under foot and by use of a long cane, U.S. 1979—1992.
  - Numerous projects funded by various Federal agencies.
  - Goal was to identify a surface that could be used both on transit platforms and on curb ramps

- Most surfaces that “look like” they would be detectable aren’t.

- 90% of participants who were totally blind detected and stopped within 24” on truncated dome surfaces.
Not detectable

Grooves in concrete

Bricks, grids or textured pavements
Warning and guiding surfaces used in Japan since 1967

Emerging concerns

- Dimensions and locations for dot and bar tiles not based on research. No standard.
- Sometimes pedestrians who are blind can’t discriminate between dot and bar tiles, confusing one with the other.
- In the last 10 years Japanese researchers have carried out extensive research to standardize dimensions.
- Standard is most like U.S. smaller domes spaced somewhat close together.
French research on guidance surfaces
U.K. Extensive program of research to identify surfaces that are discriminable from one another and that are "memorable"

- Pedestrian crossing points where the sidewalk is flush with the street
- Hazards including stairs, level crossings and the approach to light rapid transit platforms
- The edge of off-street rail platforms
- The edge of on-street rail platforms
- A shared cycle track/footway surface and central delineator strip
- Guidance along a route where traditional cues such as property lines or curbs are not available
Other research on TGSIs

**Countries**
- Denmark
- Sweden
- Netherlands
- Probably others

**Goals**
- Identify warning and guidance surfaces that were detectable and discriminable
- Identify guidance surfaces that were easy to follow
Salience and preference, by persons with low vision, for detectable warnings of different hues, having different amounts of contrast.

- Safety yellow was preferred over other hues.
- Safety yellow was considered more salient with contrast as low as 40%, that other hues having as much as 80% contrast.
No systematic research to determine whether pedestrians who are blind can accurately align on the basis of either the orientation of truncated domes or by following directional surfaces.
Do pedestrians who are blind have difficulty crossing at signalized intersections?

Surveys of visually impaired pedestrians and orientation and mobility specialists confirmed the following problems:

- Identifying the onset of the walk interval
- Aligning and traveling in the crosswalk direction
- Knowing whether they needed to push a button to actuate a pedestrian timing
- Locating the pushbutton
- Others
Do accessible signals help?

In research using remote infrared audible signs (Talking Signs®), comparing crossing at intersections with RIAS with crossing at those same intersections with no APS, 19/20 participants performed better with RIAS on the following measures:

- finding the crosswalk,
- aligning to cross,
- starting during the walk interval, and
- ending the crossing within the crosswalk.
Japanese have used audible signals since the 1960’s
Some concerns

- Directional information was not very usable---same sound came from both ends of crosswalks.
- Research in Japan and Canada has supported the use of a signal that alternates from one end of the crosswalk to the other, as providing better directionality.
- Audible signals have been quite loud, so they could be heard throughout the intersection. Consequently they have disturbed neighbors and most are now turned off at 8:00 pm.
Ordinary ATS System
“Simultaneous” “same sound”

Japan
ATS System (1997)
“Alternate”
“same sound”
“Two-speaker-system”
New ATS System (1998)
“Alternate”
“different sounds”
“Two-speaker-system”
Japan—Remote infrared audible sign
A different accessible signal developed in Europe and Australia

- APS incorporated into pedestrian pushbuttons
- Provided a quiet, slowly repeating, locator tone or tick, indicating the location of the pushbutton and its associated crosswalk.
- A tone or tick having a faster repetition rate was used as the WALK signal indication. In some locations, the WALK signal was indicated by a knurled knob at the bottom of the pushbutton housing, which rotated during the walk interval.
- Some APS products included an arrow that vibrated during the walk interval.
Swedish APS
U.S. research on locator tone repetition rate

Found that pedestrians who were blind located a pushbutton more quickly and easily when the tone repeated at once/second than either faster or slower.

MUTCD says where there is a locator tone, it shall repeat at once/second.
Rapidly repeating percussive signals were more detectable than others, in the presence of recorded traffic sound.

- Multiple sharp onsets
- Mixed frequencies

“Chirp” was not very detectable.

“Cuckoo” was a little better.

Speech was about as good as cuckoo.
The tone doesn’t matter as much as source of the signal.

Simultaneous sounds from both ends of the crosswalk are not very localizable.

Alternating sounds were not better.

Far-side only signals were much better.

The presence of a locator tone during the clearance interval, audible from the middle of the intersection, greatly facilitated crossing accuracy.
Location of APS influences correct judgment of which crosswalk has the walk interval

Laboratory research (ITE Journal, Sept.)

- Two pedhead-mounted APS about 10’ apart, close to the curb line, resulted in most accurate judgment regarding which crosswalk had the WALK signal
Field research on pushbutton location and WALK signal

- Portland, Oregon
- Pushbuttons arranged differently on each of four corners at a busy intersection
- To determine which arrangement and signals resulted in greatest accuracy in determining which crosswalk had the WALK signal
- Compared single rapid tone with two different tones
- Compared two tones with speech message
Two Poles Near the Curb
Two Tones or Same Tone
Single Pole Far from the Curb
Two Tones or Speech Messages
Field research results

Pushbuttons on two poles on one corner, separated by 10’, and placed about 3’ from the curb resulted in good accuracy in determining which crosswalk had the WALK signal.

Where both APS had a rapid percussive sound, responses were more accurate than where APS had two different sounds.
More results

Where two pushbuttons were on one pole, regardless of distance from the curb, speech messages resulted in greater accuracy than two tones.
Content and structure of speech messages

Model pushbutton information message—
- “Wait, to cross Howard at Grand.”
- May include information on unusual signalization and/or geometry

Model WALK message message—
- “Howard. Walk sign is on to cross Howard.”
Topics of current U.S. research

- Yielding behavior of drivers for pedestrians who are blind at different types of crosswalks, approaching with various degrees of assertiveness

- Ability of pedestrians who are blind to detect yielding vehicles using information provided by
  - noise generating strips, or by
  - prototype yield detection system using loop detectors that actuate a speech message indicating that a vehicle has yielded
More ongoing research

- Determine whether people who use wheelchairs are able to and will align their chairs to minimize effects of detectable warnings on slopes.
- Determine the ability of pedestrians who are blind to align for crossing using detectable warnings and using guiding surfaces.
More ongoing research

- Comparison of APS features based on objective and subjective data
- Comparison of crossing safety, accuracy, and independence at complex signalized intersections with and without APS
  - Pushbutton-integrated, with and without beaconing by a louder WALK signal and subsequent locator tone, actuated by an extended button press
  - More conventional APS having a pushbutton-actuated orienting tone during flashing or steady DON’T WALK