

CONFLICTS AND ACCIDENTS AT MULTILANE ROUNDABOUTS IN WASHINGTON – what can we learn?



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OVERVIEW

- What can we do to improve safety at multilane roundabouts?
- Hypothesis:- The multilane roundabout places demands on the driver that has limitations, and these demands are related to geometric design
- Exploratory & Ongoing Process



METHOD

- Accident Data Analysis: 2001 – 2003
- Redefine Accident Types
- Roundabouts, focus multi-lanes, with accident history
- Create Design Feature Scoring System
- Exploratory Analysis
 - Relationships between accidents and design features

DATA

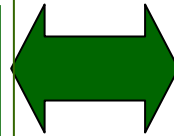
- 36 roundabouts in Washington State
 - focus on 11 multilane roundabouts installed prior to '04
- Single Lanes
 - Reported Crashes: 69 accidents over 3 years
 - Transformed: 28.3 accidents per year
- Multi Lanes
 - Reported Crashes: 132 accidents over 3 years
 - Transformed: 66 accidents per year

METHOD

Primary Focus: Multilane Facilities

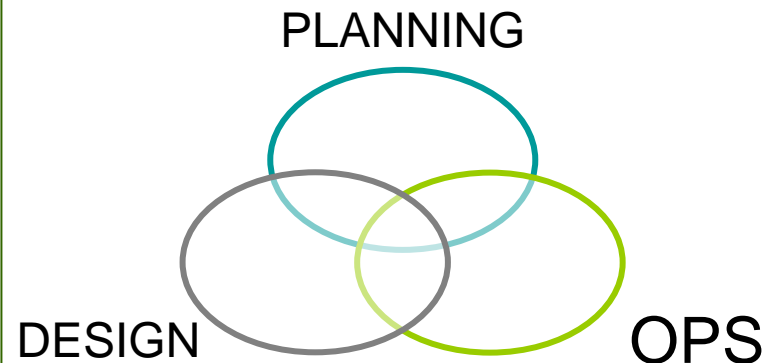
ACCIDENTS

- 2001 – 2003
 - WSDOT accident database
 - Supplemented by crashes not included in database
- Implementation Dates Differ
- Transform to annual accident frequency
- Create accident indicators



ROUNDABOUT FEATURES

- Develop Design Feature Scoring System



ASSUMPTIONS/LIMITATIONS

- Accident frequencies only
- Transform reported crashes to annual frequencies – random fluctuations unaccounted for
- Unreported Crashes not included

ACCIDENT CATEGORIES

- **Entry Crash:**
 - Rear-end at entry: 2 vehicles involved, vehicle in front stops at yield line and then proceeds, following vehicle hits front vehicle
 - Failure to yield right of way
 - Other
- **Circulatory Crash:**
 - Crash related to lane changes inside roundabout
 - Fixed object – hit curb
 - Other
- **Exiting Crash**
 - Driver remains in outside lane (illegally) and vehicle on inside lane (legally) exists
 - Fixed object – hit curb
 - Other

DESIGN FEATURE SCORING SYSTEM

“Geometrics” Score

1	Very Good: Fully developed entry curves that align entering vehicle with circulating roadway to minimize steering adjustments; Exits that unhindered by roundabout features and have appropriate sight distance; Length and area of splitter islands is appropriately sized with consideration for inscribed diameter dimension.
2	Good: Entry curves that provide good driver guidance while some steering adjustments may necessary; exit speeds are not noticeably affected by exit curb placement.
3	Fair: Geometrics may have minor limitations; limitations are offset by the presence of a well designed splitter island and other appropriately designed features such as truck apron, crosswalk location and a central island that provides deflection.
4	Marginal: Painted splitter islands or the attempt to use lots of paint to affect vehicle path; overly small inscribed diameter; design vehicle strikes curb.
5	Questionable: Primary movements with significant path overlap leading to braking or stopping in the circulating roadway in order to exit the roundabout; no deflection at entry; lack of raised curbing in key areas.

“Geometrics” Score



“Low Degree of Path Overlap” Score

National Roundabout Conference 2005 DRAFT

1	Very Good: designed entries and exits to eliminate path overlap
2	Good: design reflects an understanding of operations and has minimized path overlap
3	Fair: design is requiring driver to stay in their own lane and steer to avoid conflict on entering
4	Marginal: design do not consider operations and unwittingly put vehicles in conflict in the circulating roadway
5	Questionable: design do not reflect an understanding of path overlap

“Low Degree of Path Overlap” Score



“Available Gaps Accepted” Score

1	Very Good: Vehicles see gaps prior to reaching yield line and don't break unnecessarily. Design assists movement by being consistent with flow paths through the roundabout. Gaps predominately are identified prior and taken safely.
2	Good: Vehicles see gaps prior to reaching yield line. Design may not allow entry into roundabout without steering inputs to maintain optimal path. Most available gaps are taken by driver and movement is predictable
3	Fair: Drivers miss some available entry gaps. Design does not optimize movement into the circulating roadway. Vehicles delay despite adequate gaps in traffic flow. Splitter island size can give the impression exiting cars are actually continuing around the roundabout causing entering cars to hesitate
4	Marginal: Cars miss available gaps routinely due to entry and exit geometry
5	Questionable: Cars stop routinely before entering roundabout. Entering curve is non-existent and causes what looks like a right turn into the roundabout.

“Entry lane utilization” Score

1	Very Good: Vehicles see gaps prior to reaching yield line and don't break unnecessarily. Design assists movement by being consistent with flow paths through the roundabout. Gaps predominately are identified prior and taken safely.
2	Good: Vehicles see gaps prior to reaching yield line. Design may not allow entry into roundabout without steering inputs to maintain optimal path. Most available gaps are taken by driver and movement is predictable
3	Fair: Drivers miss some available entry gaps. Design does not optimize movement into the circulating roadway. Vehicles delay despite adequate gaps in traffic flow. Splitter island size can give the impression exiting cars are actually continuing around the roundabout causing entering cars to hesitate
4	Marginal: Cars miss available gaps routinely due to entry and exit geometry
5	Questionable: Cars stop routinely before entering roundabout. Entering curve is non-existent and causes what looks like a right turn into the roundabout.

“Entry lane utilization” Score



“Degree of Ped/Bike Provision” Score

<p>1</p>	<p>Very Good: Pedestrian and Bike features are incorporated into the design. Shared sidewalk systems, proper bike lane markings before and after roundabout. Sufficiently wide sidewalks and crossings are installed to accommodate both user groups. Truncated Domes are installed. Buffer between sidewalk and travel way is provided.</p>
<p>2</p>	<p>Good: Presence of bike and pedestrian features. Sidewalks are adequate, separated from travel way</p>
<p>3</p>	<p>Fair: Sidewalks and crossings are installed. No buffer between sidewalk and travel way</p>
<p>4</p>	<p>Marginal: Pedestrian crossing provided, with sidewalks installation.</p>
<p>5</p>	<p>Questionable: Bike or pedestrian features not evident in design</p>

“Degree of Ped/Bike Provision” Score

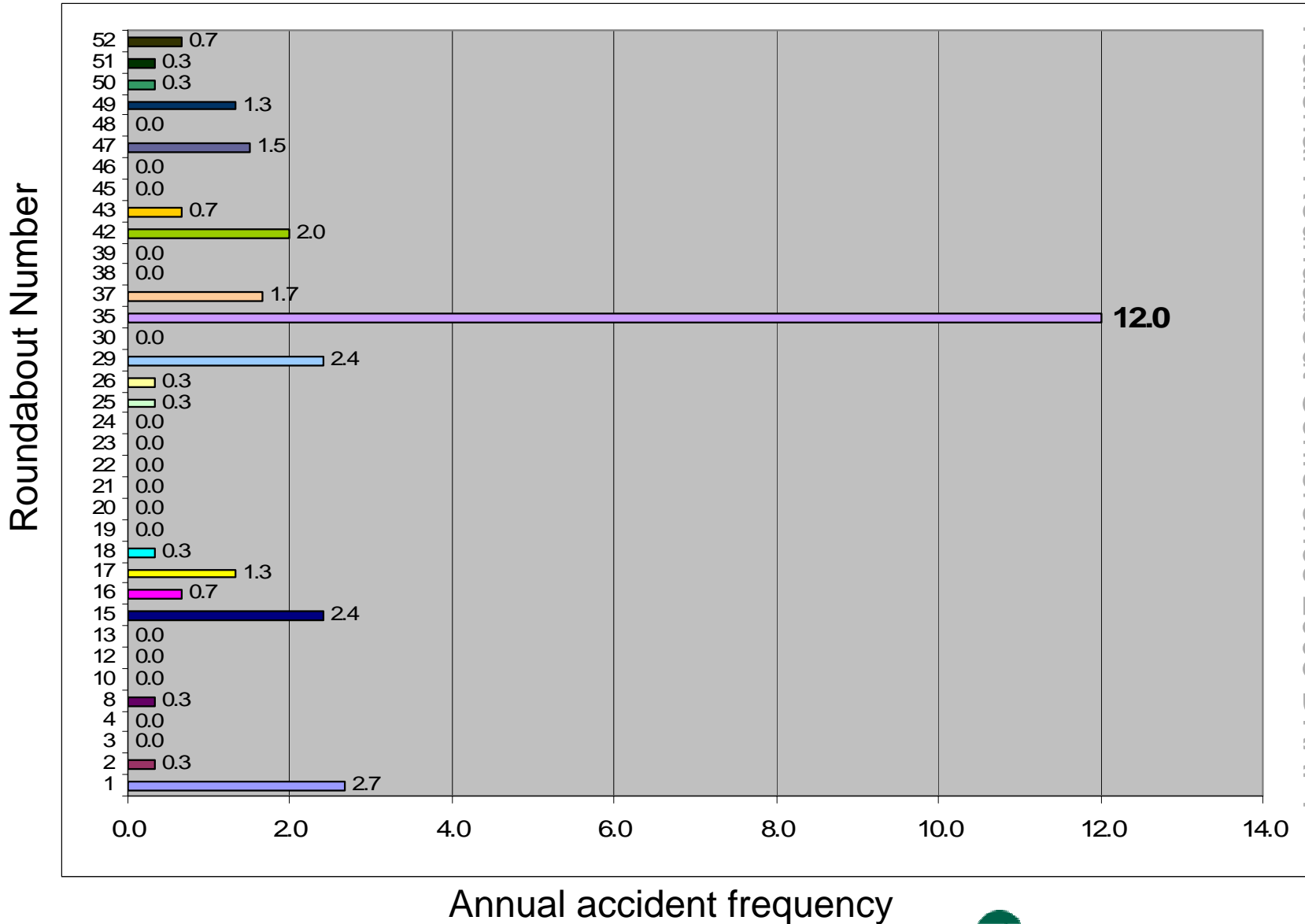


2/2/2005

SINGLE LANES: Preliminary Findings

- Fairly low annual accident frequencies for all roundabouts.. Except ONE!
- No reported ped/bike accidents

Annual Accident Frequencies

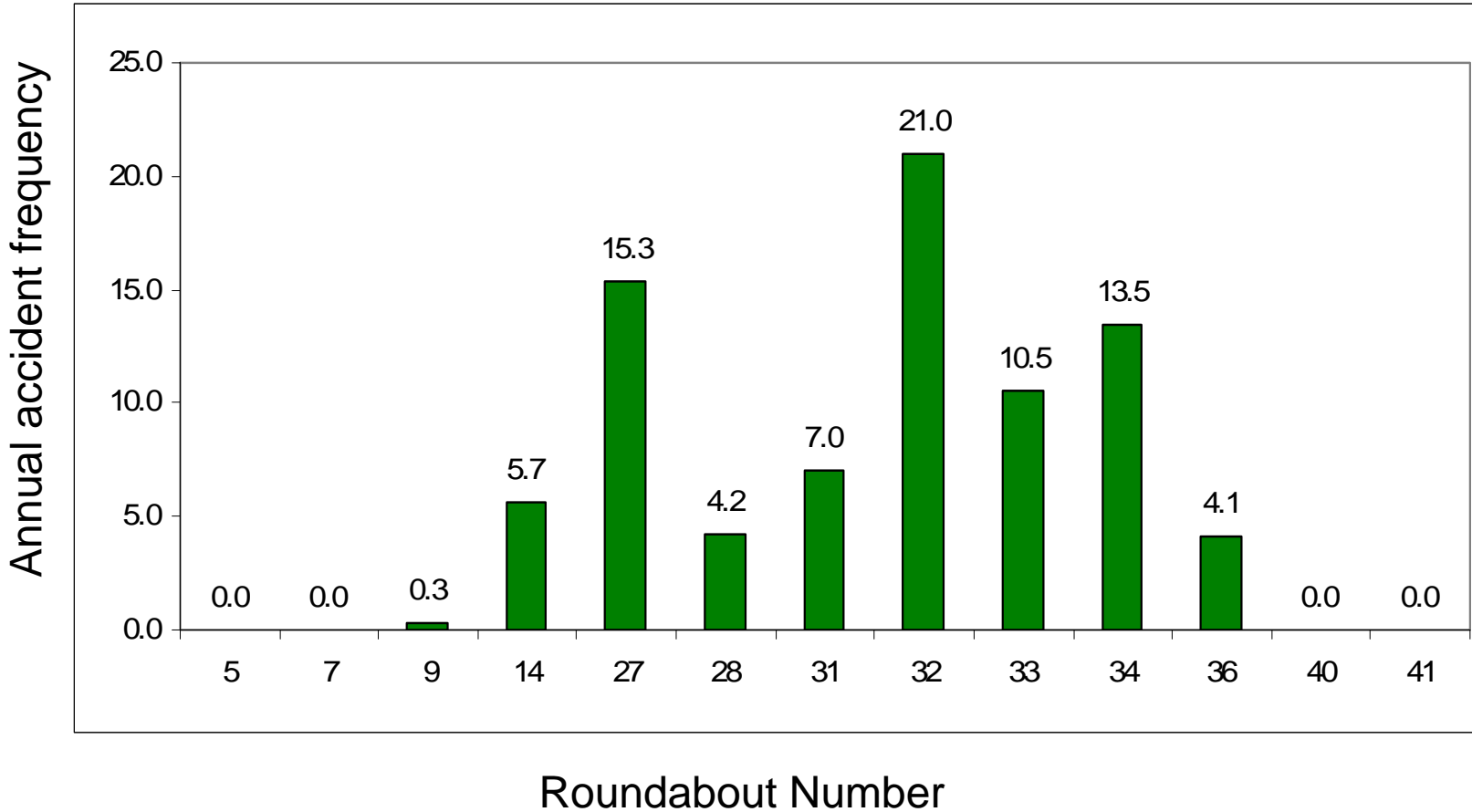


ROUNDAABOUT 35



MULTI-LANE ROUNDABOUTS: Preliminary Findings

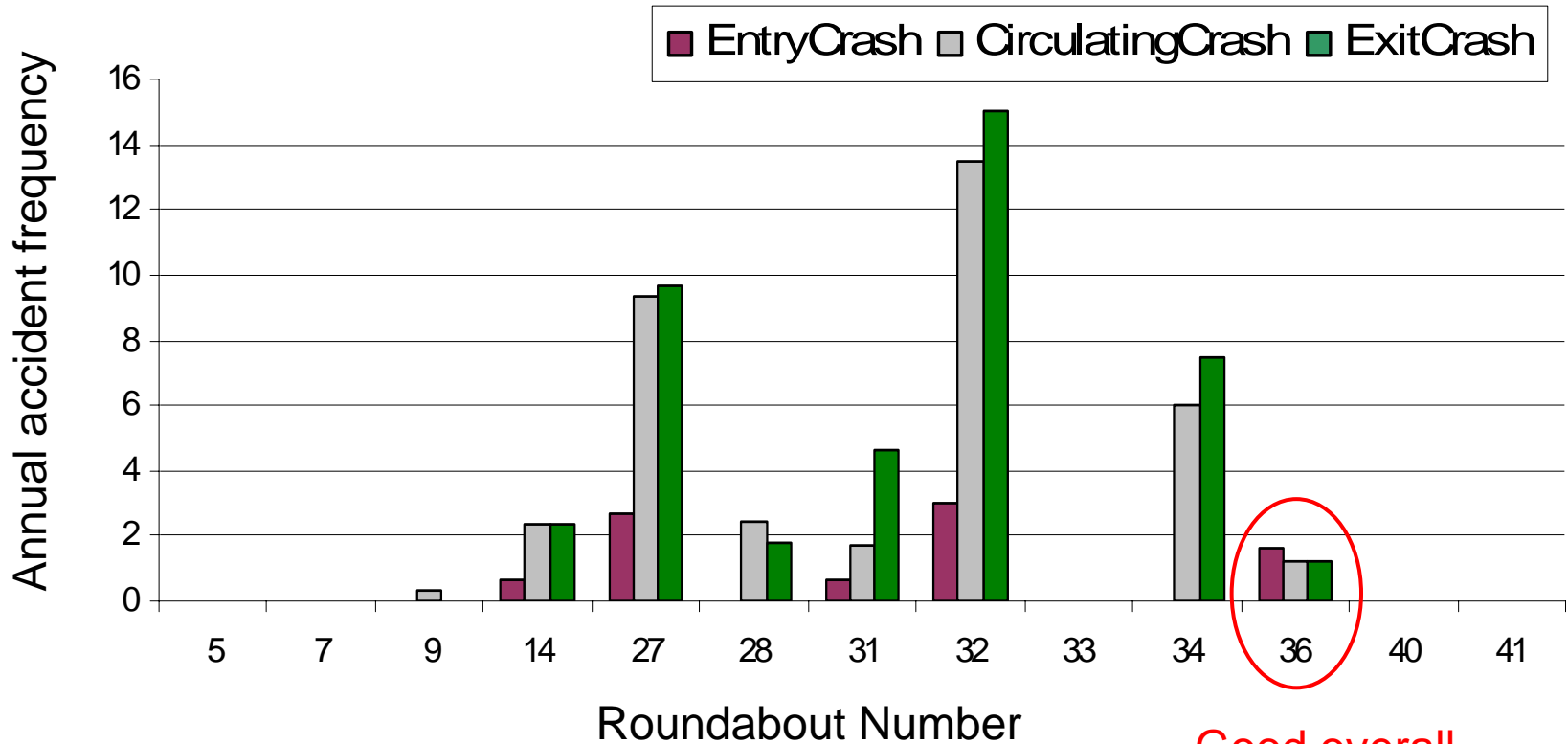
Annual Accident Frequencies



Preliminary findings

- No reported pedestrian & bicyclist accidents
- We know about accidents that we don't have reports for
- Generally PDO accidents – only limited injury accidents, mostly “possible” injury type
- Volumes expected to show large variations: essential to include in future analysis

Distribution: Entry, Circulatory, Exit Crash Types



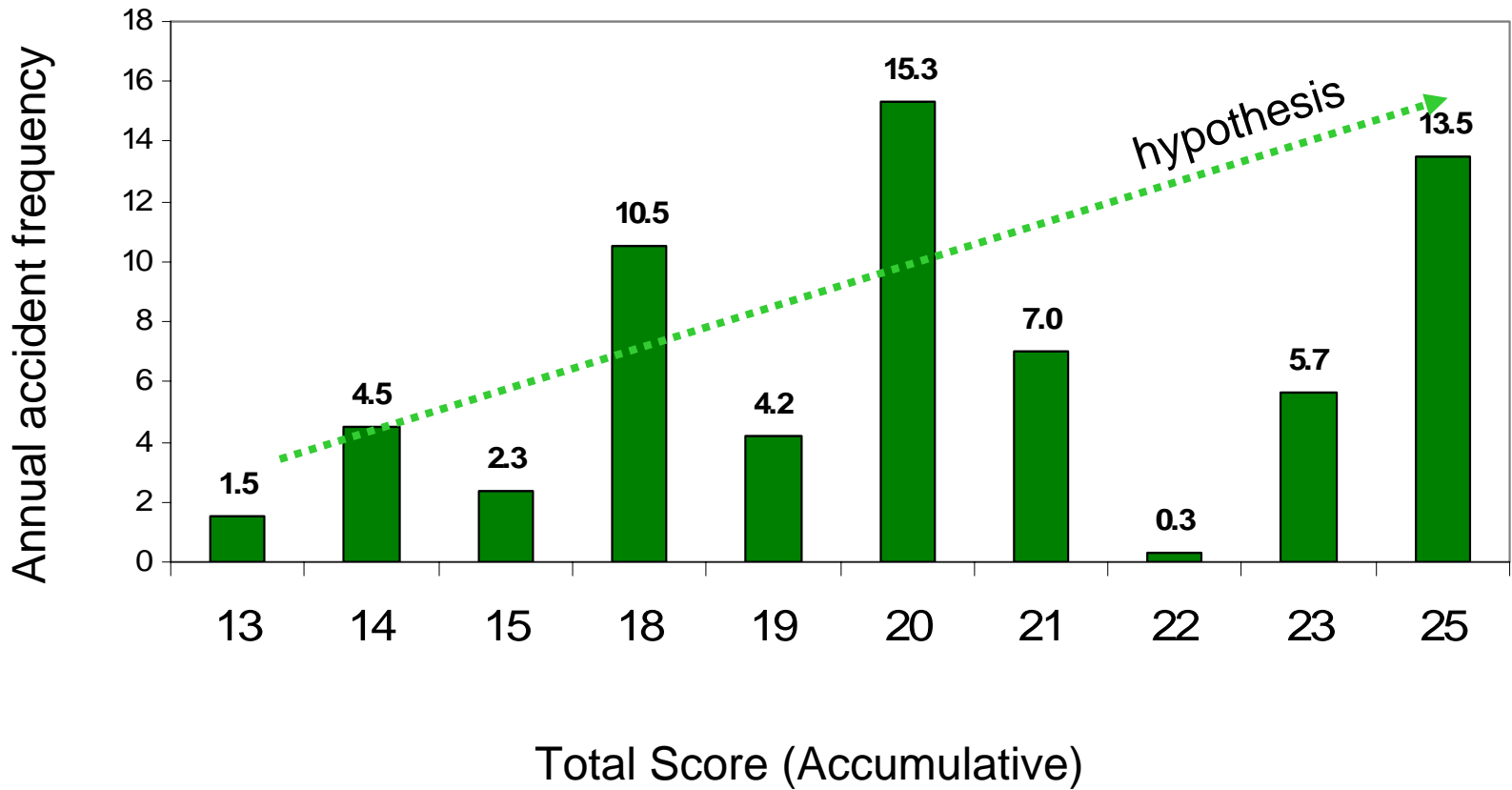
Good overall performance

ROUNDAABOUT 36

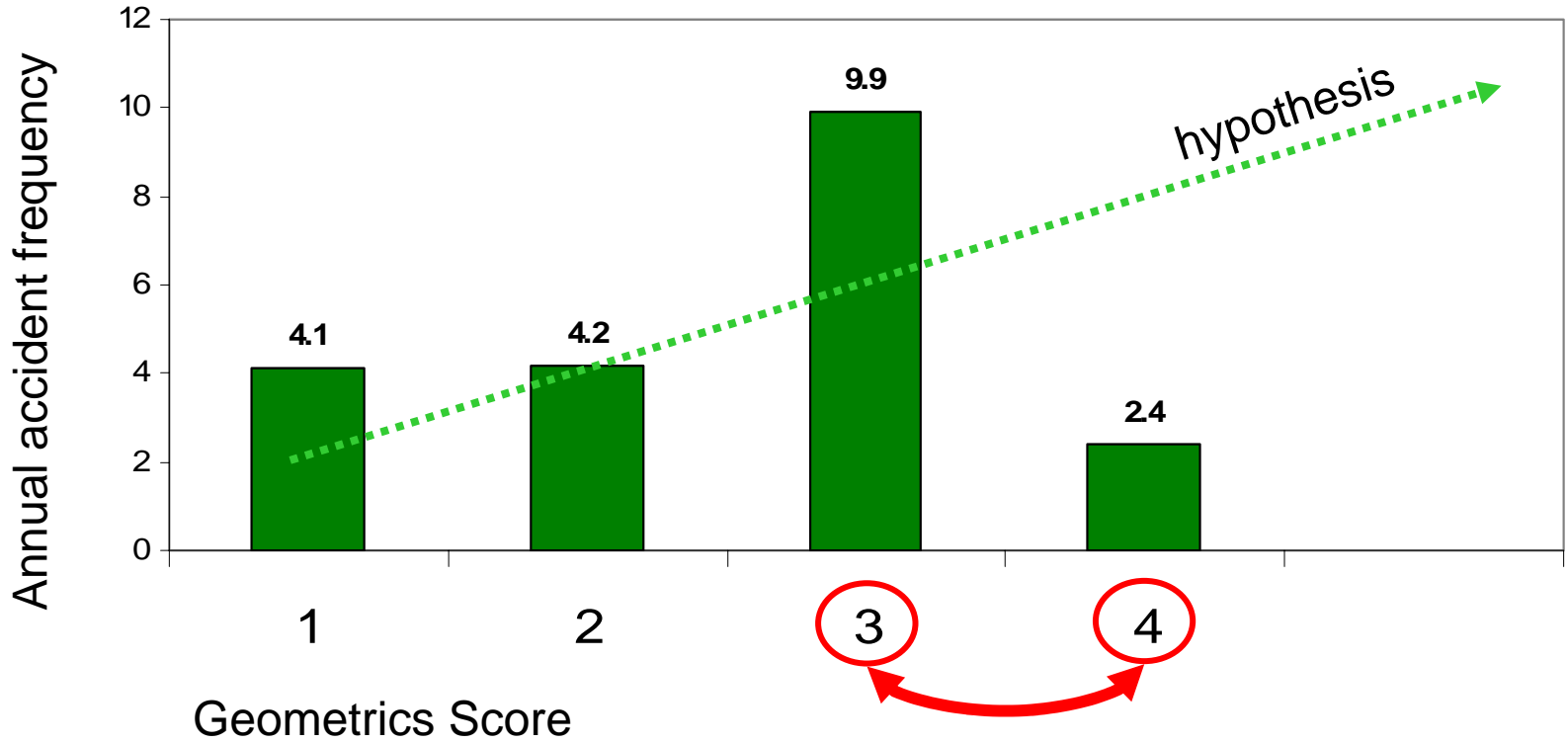


SCORING ANALYSIS

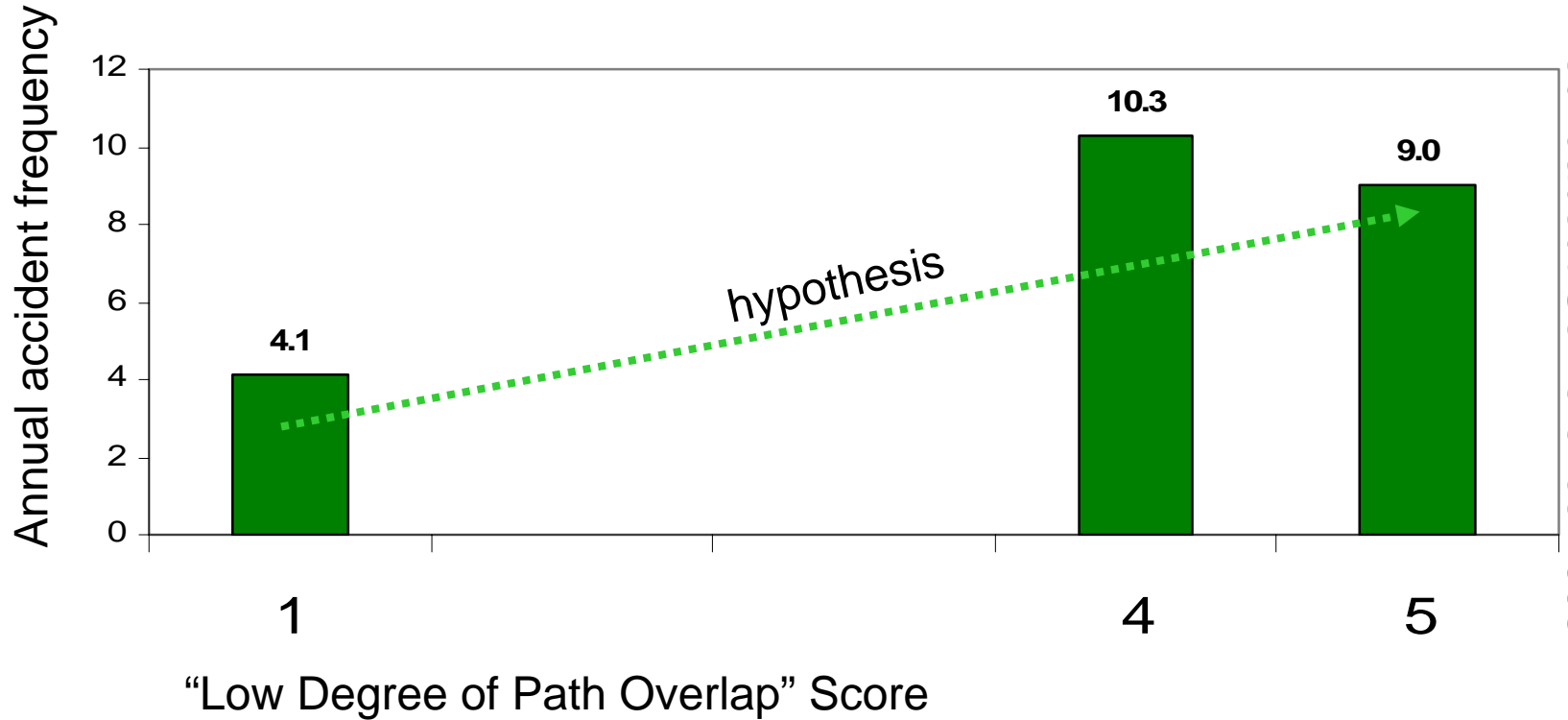
Total Score



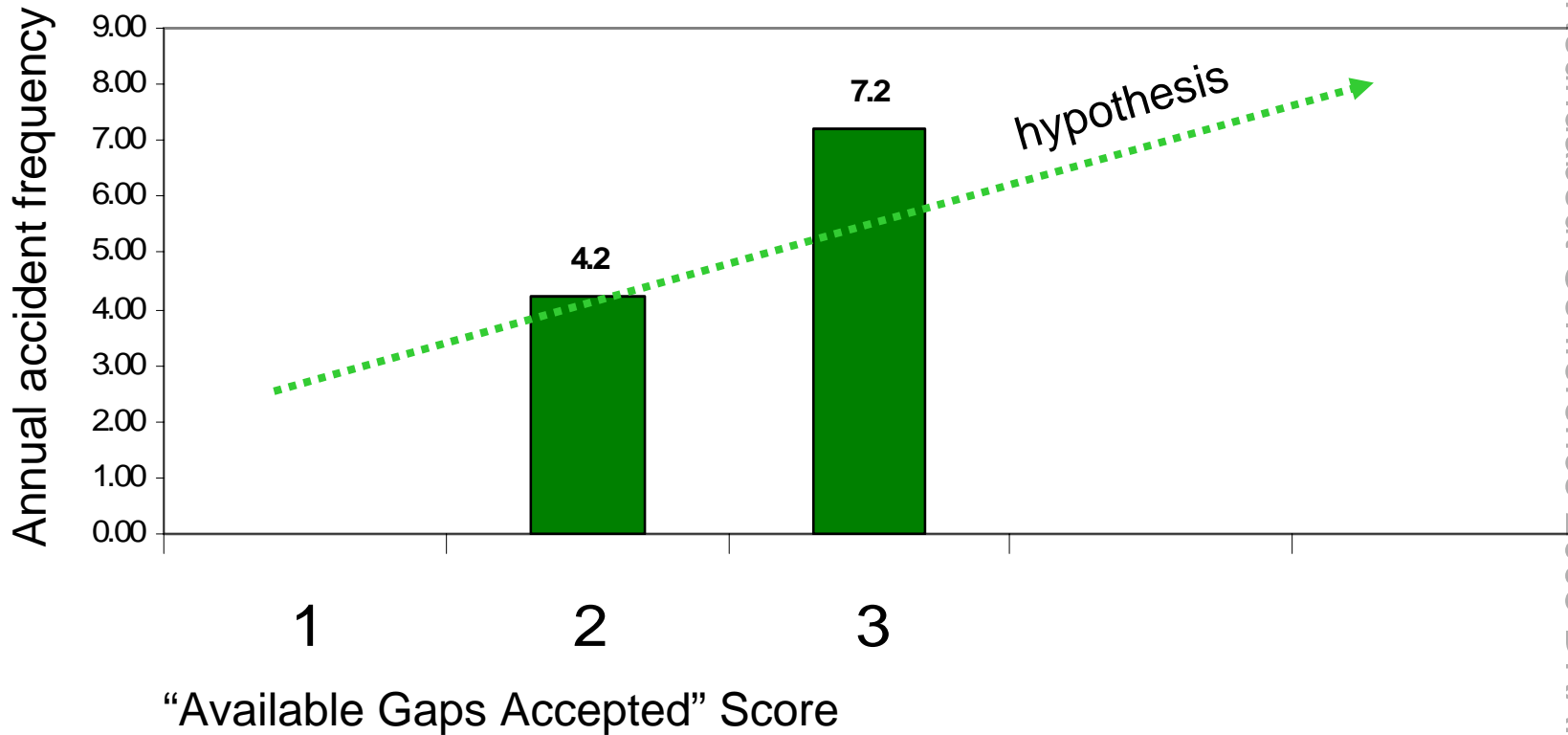
Geometrics Score



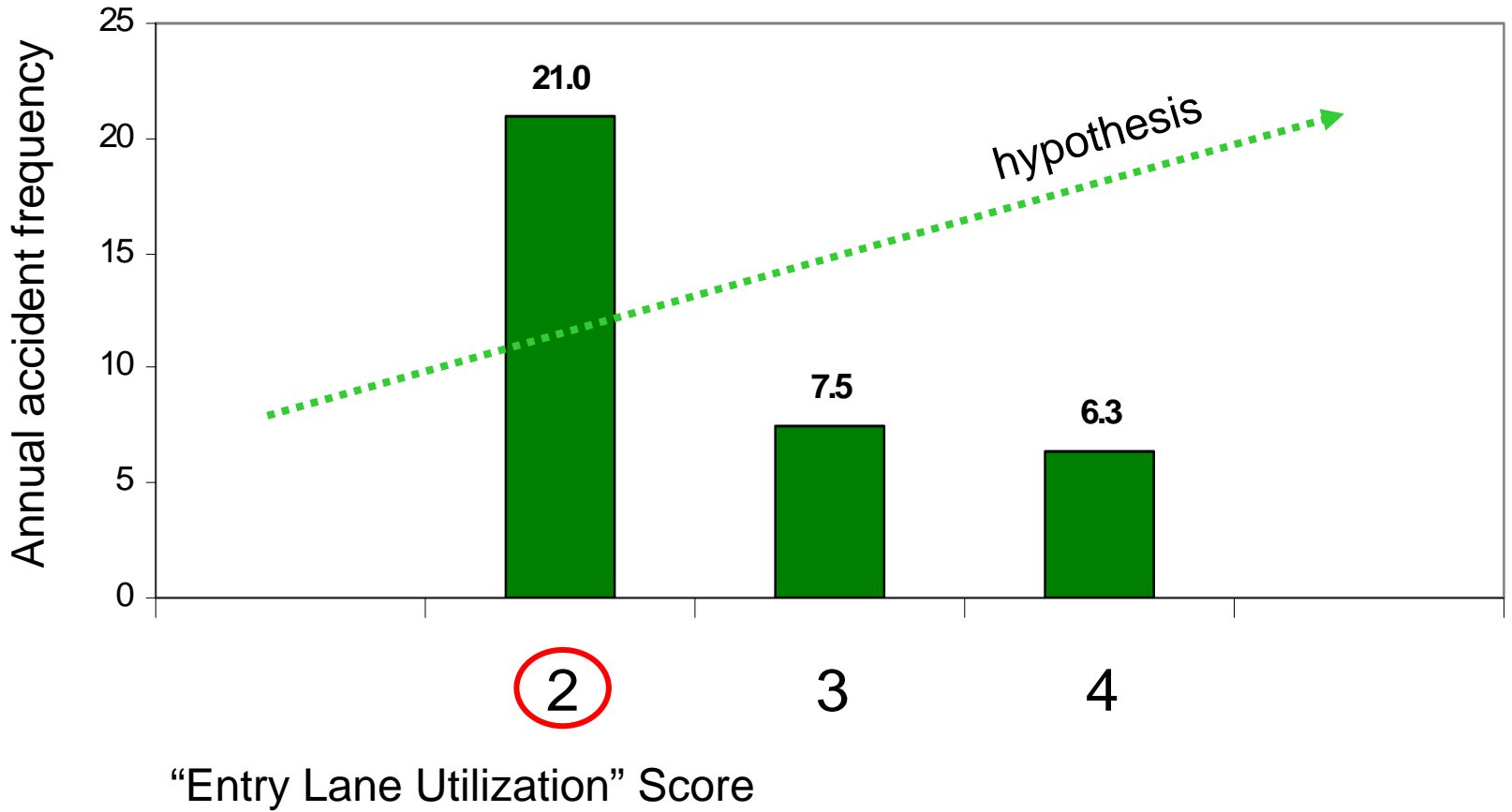
“Low Degree of Path Overlap” Score



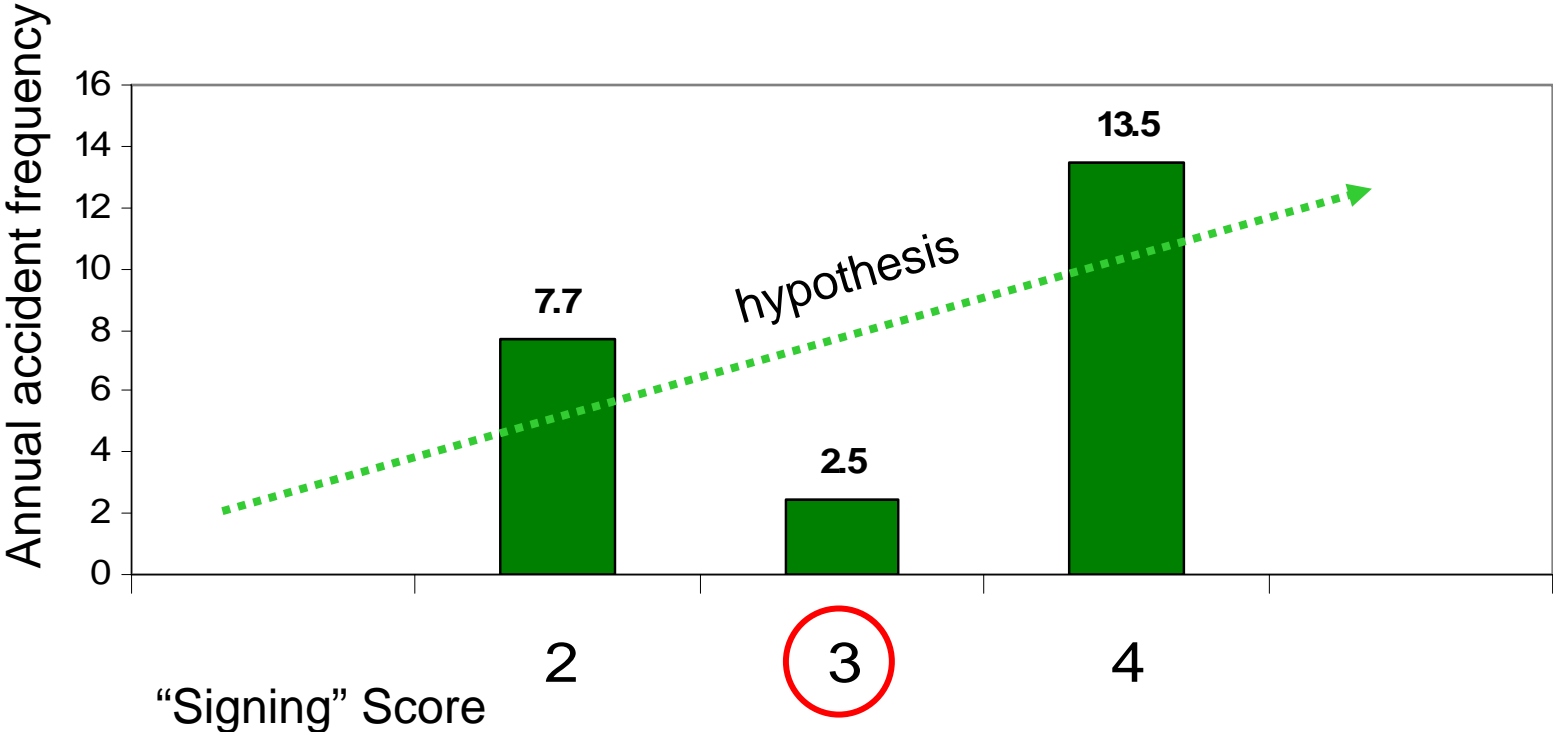
“Available Gaps Accepted” Score



“Entry Lane Utilization” Score

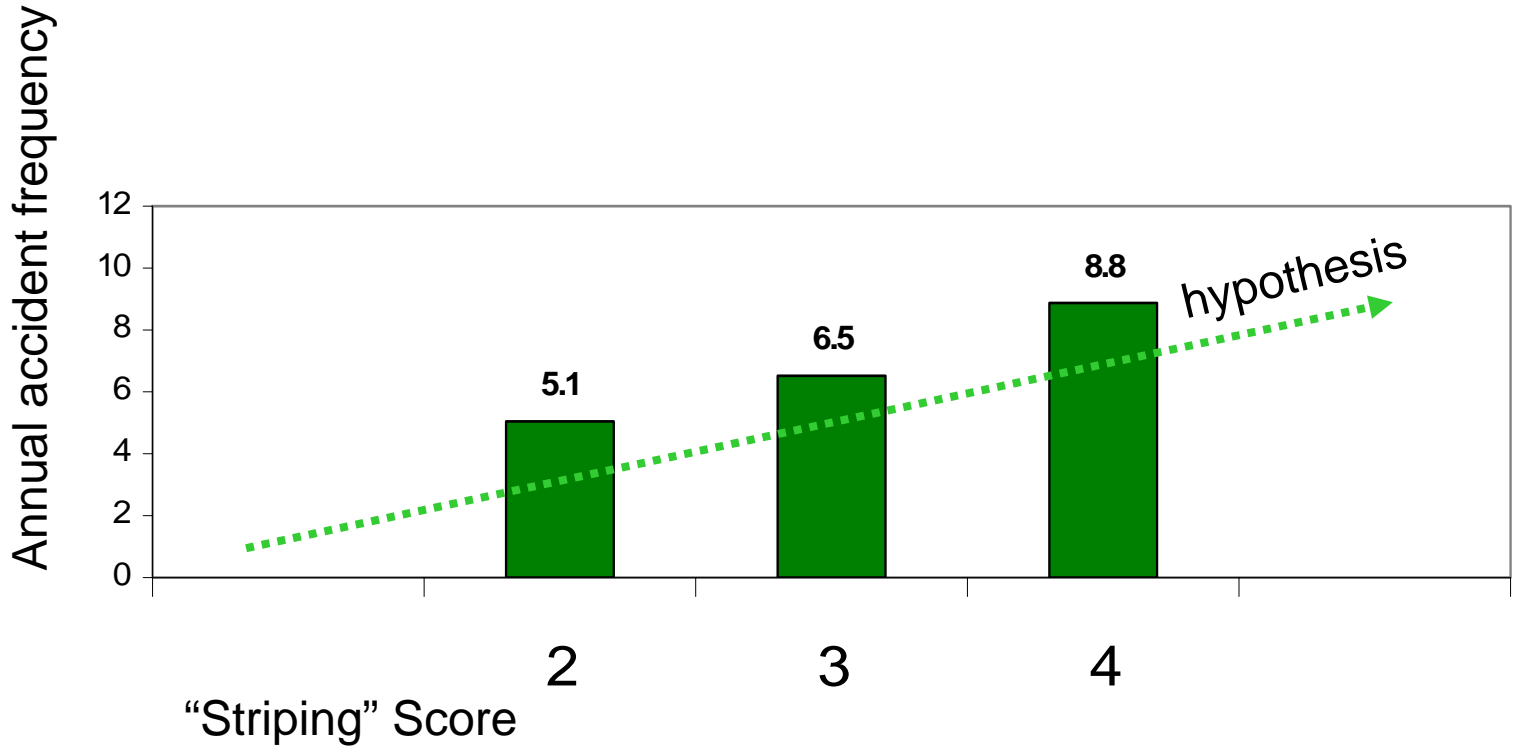


Signing Score

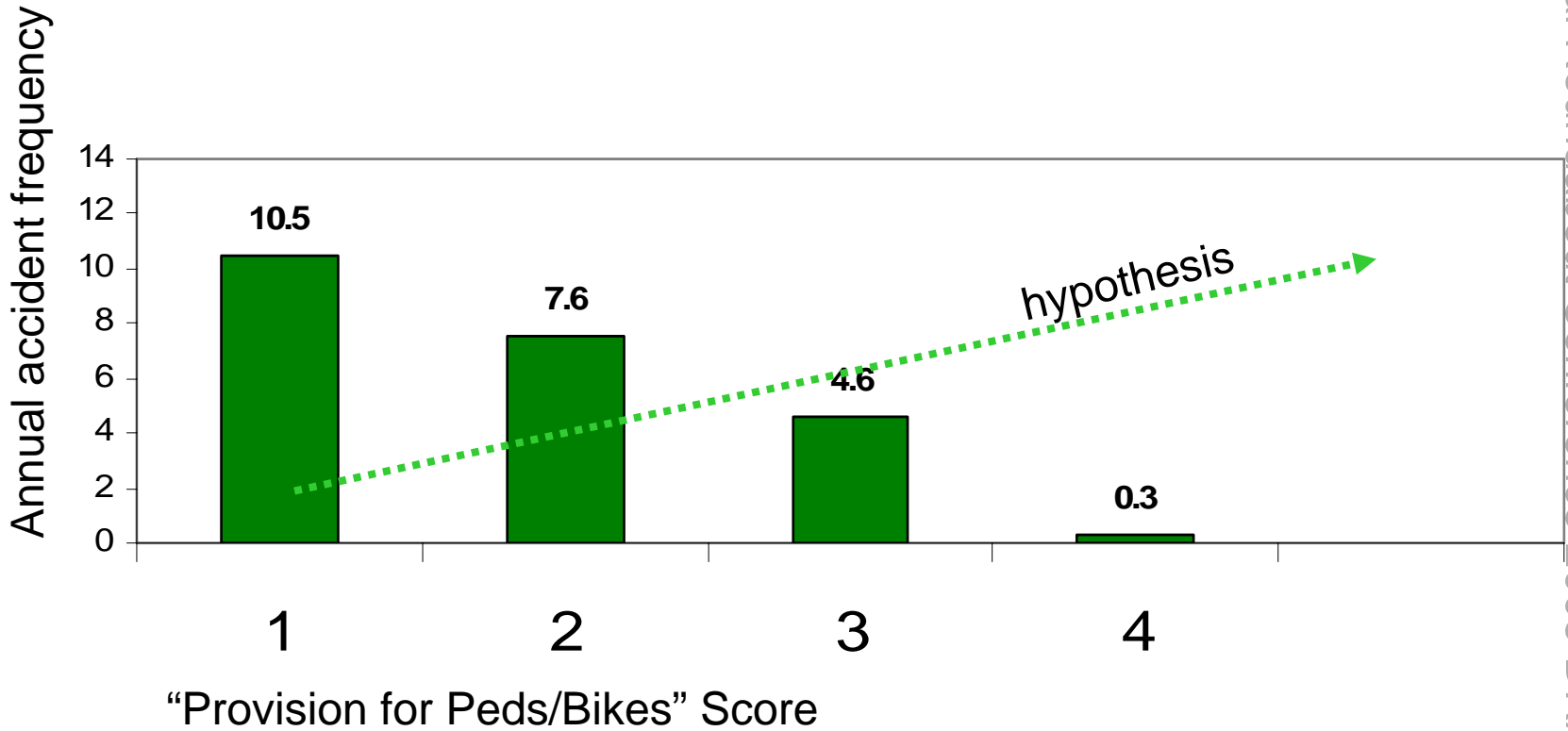


- The rating system itself?
- Human Factor Explanation?

Striping Score



“Provision for Peds/Bikes” Score



CONCLUSIONS

- Alternative way to evaluate roundabout safety performance
- We've got our work cut out for us – more to do
 - Including Flows
 - Refining Rating System
 - Conflict Studies: 4 roundabouts already filmed
 - Developing safety models for roundabouts using design features and volume