Impact of E-Scooters on Pedestrian Safety: A Field Study Using Pedestrian Crowd-Sensing

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The Goal

To ***understand*** the current state of pedestrian safety in our urban communities, and ***identify*** factors that impact pedestrian safety vis-a`-vis e-scooter services.

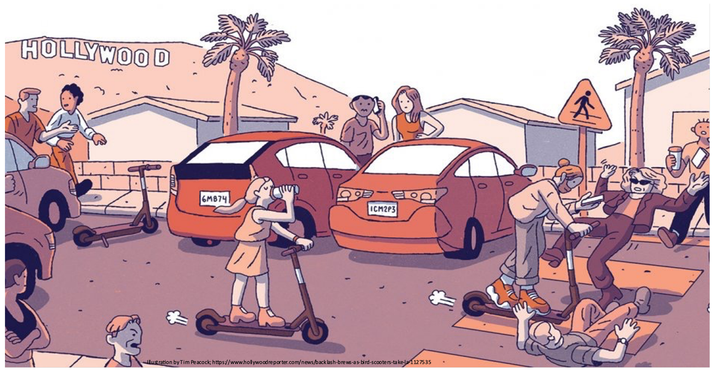


Illustration by Tim Peacock; https://www.hollywoodreporter.com/news/backlash-brews-as-bird-scooters-take-off-1127535

Key Challenge

Real-time detection and ***logging*** of *encounter data between pedestrian participants and e-scooters* directly from a ***resource-constrained*** smartwatch with ***minimal*** encounter notification frequency.

The Approach

- ***Detect*** e-scooters near a pedestrian participant via the smartwatch in real-time.
- ***Trigger*** participant feedback and ***collect*** e-scooter related encounter data.
- **Identify** mobility trends and potentially unsafe spatio-temporal hotspots for pedestrians on-campus.

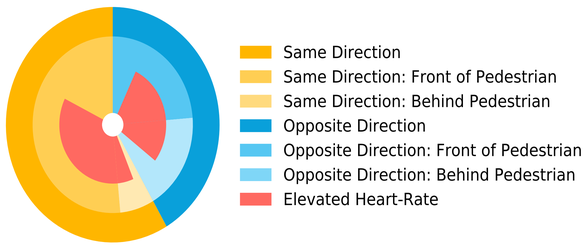
The Crowd-Sensing Setup

- Encounter detection and related feedback collection from a custom ***smartwatch app*** based on BLE data broadcasted by e-scooters.
- ***Loaned*** smartwatch equipped with encounter data collection app paired to the ***participant's*** smartphone.
- ***77*** participants across ***two*** distinct environments: UTSA's Main and Downtown campuses.
- A ***month-long*** study for each participant lasting from April 2019-June 2019.

Key Observations & Implications

Pedestrian and E-scooter Encounters

1. ***Predicted*** from the sensed BLE data (E_P)
2. ***Observed*** by the pedestrian participant (E_O)



Summary of observed (E_O) encounters for e-scooter moving direction and pedestrian line-of-sight combinations

Factor #1: Space

OBS: A vast majority of proximate encounters between e-scooter riders and pedestrians happened on narrow pedestrian paths such as sidewalks.

IMP: Conflicts and safety challenges for pedestrians and riders sharing the path owing to few bike lanes and shared-use paths in the study areas.

TABLE III: Space: Encounters by functional classification.

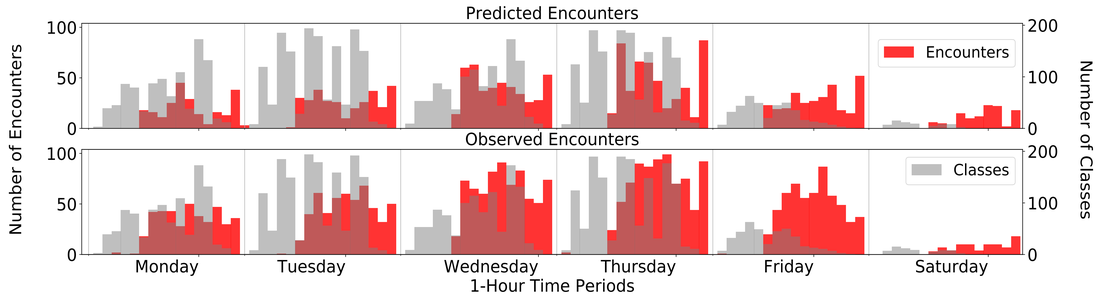
	TES[a]		*MEM*[b]		*PEM*[c]	
Functional Class[d]	E_P	E_O	E_P	E_O	E_P	E_O
Arterial Streets	998	709	146.1	60.7	6.9	2.3
Collector Streets	269	336	68.4	55.2	3.2	2.1
Local Streets	1285	2255	176.0	171.8	8.3	6.6
Shared-use Paths	102	119	306.0	432.6	14.5	16.6
Sidewalks	994	1163	617.8	470.7	29.2	18.1
Other/Unclassified	154	411	799.1	1410.0	37.8	54.2
Total	3802	4993	352.2	433.5	100.0	100.0

[a] Total Encounters per Segment (TES) is the sum of all detected proximal pedestrian-scooter encounters in a network segment.
[b] Mean Encounters per Mile (MEM) is the average number of encounters per segment divided by the length of the segment in miles.
[c] Percent Encounters per Mile (PEM) refers to the percentage of TES w.r.t sum total of all encounters over all segments.
[d] Arterial streets include OpenStreetMap (OSM) API tags "primary" and "secondary". Collector streets include OSM tags "tertiary". Local streets include OSM tags "residential" and "service". Shared-use paths include OSM tags "path" and "cycleway". Sidewalks include OSM tags "footway" and "pedestrian". Other/unclassified uses all other OSM tags.

Factor #2: Time

OBS: The average #encounters on specific days are higher than the rest of the week showing the occurrence of encounters follows closely with class schedules.

IMP: Higher chances of pedestrian-rider collisions and encounters near the class buildings during the days with the highest number of classes.

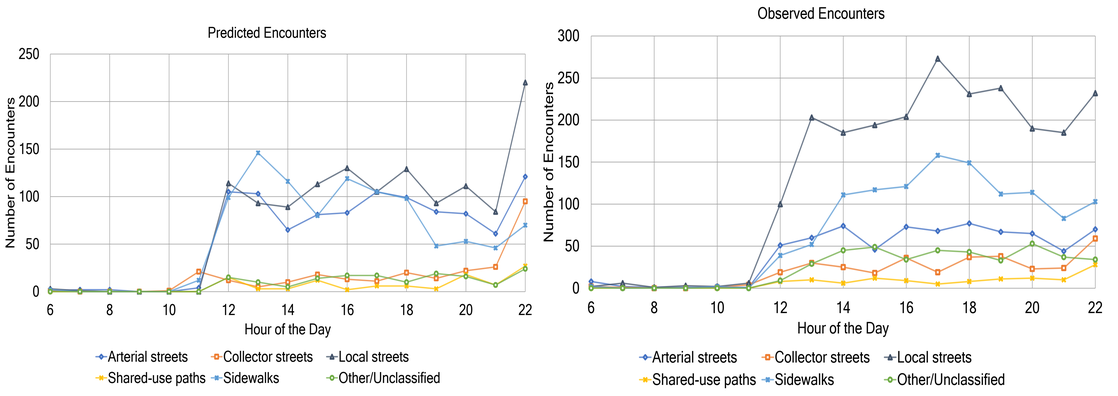


Number of predicted (E_P) and observed (E_O) encounters in each of the 102 1-hour periods (sorted chronologically), between 06:00-23:00 for six days of a week, plotted along with the number of classes scheduled in the corresponding time periods.

Factor #3: Space & Time

OBS: Local street encounters peak during mid-day and at 17:00, suggesting an increased interaction with pedestrians during lunch breaks and commuting.

IMP: Higher chances of conflicts for pedestrians and riders sharing the streets during those peak hours exacerbated by the lack of sidewalks in the areas.



Number of predicted (E_P) and observed (E_O) encounters in each 1-hour time period between 06:00-23:00, plotted for each functional classification of road network segments. The x-axis unit represents the next 1-hour time period

Takeaways

Identified hotspot areas could be targeted to optimize transit options and remediate lack of adequate critical infrastructure.

The timing of frequent e- scooter encounters could be used in combination with other travel modes to compliment last-mile connections and reduce conflicts.

Space-time coordination may be more critical for special events and in separated land uses, as compared with mixed-use settings with activities spread throughout the night and day.

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