Incidents in FOTs and Naturalistic Driving Studies: What Can Learn from the Traffic Conflict Technique

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The Safety Pyramid (Hyden, 1987)

- Serious conflicts
- Slight conflicts
- Potential conflicts
- Undisturbed passages
- Accidents
Another way to look at it

Risky Behaviour → Event/ Conflict → Near Miss/ No Crash → Crash!
The standard international definition of a traffic conflict

“A traffic conflict is an observable situation in which two or more road users approach each other in space and time to such an extent that a collision is imminent if their movements remain unchanged.”

(Amundsen and Hyden, 1977)
The Swedish TCT

Note:

• The estimation is made at the time that one of the participants make an avoiding action

• It is the speed of the “avoider” that is used in calculation

• “Time to Accident” is the same as Time to Collision at the moment of the avoiding action
A movie
An example: TCT to evaluate an implementation

The location:

- Four-arm signalised junction in Bradford (West Yorkshire)
- 2 lanes on each road
- Simple 2-stage signals
- Pedestrian injury accidents about 15 in 3 years
- Pedestrian accidents equally distributed around the arms
- Signal engineers unwilling to install pedestrian signals
System operation
BRADFORD 1990/07/03–06
Conflicts Before II

Carlisle Road

Marlborough Road

Lumb Lane

Car
Pedestrian

Car-Ped 23
Car-Car 5
BRADFORD 1990/09/10–14
Conflicts After
BRADFORD 1991/05/07–09
Conflicts After II

Carlisle Road

Lumb Lane

Marlborough Road

Car

Pedestrian

Car-Ped 12

Car-Car  5
Aim: study the reliability of the TCT and compare conflict numbers and patterns with accident numbers and patterns

Findings:
- TCT useful for identifying safety problems
- “Reasonable” agreement between conflicts and accidents, but there was one situation (opposing left turns off the main street) where conflicts were identified but there were no accidents
- Some between-observer reliability issues

Also, a suggestion that average Required Braking Rate may be a good measure of the overall severity of conflicts at a location
• Is well validated for:
  – Reliability
  – As a predictor of underlying safety at urban intersections and crossings

• But much more problematic for:
  – Rural intersections
  – Rural links (note experience in PORTICO evaluation)

• Definitional issues for a high-speed location:
  – How to calculate conflicting speeds (e.g. rear-end vs. head-on)
Data from a vehicle data acquisition system (DAS)
The next step in the U.S.

- 1900 vehicle Naturalistic Driving study with at least 2 years of driving
- Drivers selected in various areas across the U.S.
- Very sophisticated DAS (five camera views)
- 500 terabytes of data are expected
• Aimed to use jerks (m/s³) above a certain threshold as an incident indicator

• Evidence was study by Nygård (1999)

• 3 criteria were used to define events of interest:
  – Deceleration ≥5 m/s², and
  – Jerk ≥ −0.8 m/s³, and
  – Driver was braking

• Then the data analyst looked at all the candidate events and manually filtered out some false ones, e.g. too short
An example jerk
How did the jerk analysis pan out?

- Total of 43 events across the 4 trials:
  - 22 without ISA (2 months of driving per participant)
  - 21 with ISA (4 months of driving)
- 49 participants had no jerk ever
- 30 participants had from 1 to 4
- Jerks per 1000 km:
  - 0.10 without ISA
  - 0.06 with ISA active (enabled)
- Poisson process?
Longitudinal events

• Some simulator data

• Scenario
  – Car following on rural two-lane road
  – Lead car brakes suddenly
“Incident” no. 1
“Incident” no. 2

Graph showing the following parameters over time:
- Deceleration
- Speed
- Time Headway
- TTC

Axes:
- X-axis: Time (sec)
- Y-axis: Various values (0 to 1)

Legend:
- Deceleration (blue)
- Speed (red)
- Time Headway (green)
- TTC (brown)

Graph indicates changes in these parameters over time, with specific interactions and trends visible.
“Incident” no. 3

Graph showing the relationship between time (sec) and various metrics such as deceleration, speed, time headway, and TTC.
Some issues regarding vehicle-based incident identification

• How are “incidents” related to the severity of accidents?
  – The U.S. Naturalistic Driving Studies classify even a tyre collision with a kerb as an accident
  – Serious conflicts as classified by the Swedish TCT have been shown to have a better correspondence to injury accidents than to damage-only accidents
  – We need to identify incidents that are related to injury accidents

• Longitudinal and lateral:
  – Longitudinal events are easier to identify and classify than lateral ones
  – Lateral events often have lower TCTs and smaller required response times

• Intersection events:
  – Hard to identify and classify from a vehicle
Some further problems

• We cannot afford to identify and categorise incidents manually

• We need data fusion of:
  – CAN bus data
  – Video data
  – Radar data

• We need to apply data mining techniques for this task
Svensson and Hydén (2006)

Interaction frequency (interactions per observation hour) for different severity levels. Straight ahead driving vehicles versus pedestrians. The pedestrian is taking evasive action.

A non-signalised intersection (DSp) and a signalised intersection (VSp).

Lesson:
It is important to look at a continuum and not just at events over a given threshold.
Conclusions

• We are about to be overwhelmed with data on “events”
• Some of the simple approaches do not work very well
• TCT tells us that there is a relationship between events and safety
• Defining relevant events will be a complex task
Thank you for your attention!

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