‘Safety in Numbers’ or ‘Safety in Density’? Evidence for the effect of cyclist density on potential car vs cyclist collisions at intersections
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‘Safety in Numbers’

• Safety in numbers (SiN) (Jacobsen, 2003) is a widely referenced but poorly understood phenomenon

• A wide range of academic and applied studies cite SiN as a potential solution to car vs cyclist crashes

• Problem is...No-one really knows how it works
The Safety in Numbers (SiN) Model

- Expressed as: \( I \propto E^{0.4} \)
- \( I \) = road injury risk (e.g., number of collisions), \( E \) = the proportional volume of cyclists or trips
- A doubling of cyclists in the network increases crashes by about 32%
‘Safety in Numbers’

Safety in numbers (SiN) is a widely referenced but poorly understood phenomenon. A wide range of academic and applied studies cite SiN as a potential solution to car vs cyclist crashes (Jacobsen, 2003). Except…No - one knows how it works.
Preferred theory is Behavioural Adaptation (Jacobsen, 2003, 2015)

- Cycling gets safer
- More cyclists
- Drivers ‘behaviourally adapt’
800+ citations can’t be wrong??

- **Number of critiques** e.g., Bhatia & Weir (2011), Christie & Pike (2015), Thompson et al., (2015, 2016)
- **Problem** – it is included as ‘fact’ in some cycling strategies
"I think you should be more explicit here in step two!"

Yet still....
SiN can be reproduced without Behavioural Adaptation in Agent-Based Models
SiN can be reproduced without Behavioural Adaptation in Agent-Based Models

Figure 4. Walking and bicycling in eight European countries in 1998.
SiN can be reproduced without Behavioural Adaptation in Agent-Based Models
Similar to ‘Selfish Herd’ models
SiN can be reproduced without Behavioural Adaptation in Agent-Based Models

Possible hypotheses to explain safety in numbers
Several hypotheses have been presented for explaining the Safety in Numbers effect. Ecological comparisons of the model that assumed bicyclists would favour safer roads, and shy away from dangerous traffic, showed a Safety in Numbers effect.\textsuperscript{14} However, this hypothesis fails to explain why Safety in Numbers is so widely observed without clustering; nor is it based on any empirical evidence of actual clustering by people on bicycles. Indeed, pedestrian volume was predicted to be concentrated on the busiest traffic volume streets in Oakland,\textsuperscript{15} further undermining the clustering hypothesis.

The role of self-selection in explaining Safety in Numbers is mixed and thus unlikely to qualify as a major factor. That pedestrians and bicycle riders may cluster, like ships into convoys, could also explain Safety in Numbers. An agent-based
SiN can be reproduced without Behavioural Adaptation in Agent-Based Models.

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Study Aims

• To observe micro-level interactions of cyclists and vehicles at an intersection mirroring that created in prior agent-based models
• Determine how cyclist density is associated with risk of potential cyclist vs vehicle crashes
• Gather empirical evidence of the safety-in-density (SiD) hypothesis’ operation in a real-world situation
Hypothesis

• Hypothesis: that increasing cyclists density at intersections will be associated with a decreasing risk of potential collision with cars
Method

- 5 hours recorded video footage
- 8am-9am – Canning Street, Melbourne
- Heavily signposted intersection, bikes have RoW
- Generally ‘crossing’ behaviour
Method
Method

• Time at which the cyclist moved through the centre of the intersection
• Proximity of leading cyclist to the following cyclist
• Time at which the driver arrived at the front of the intersection
• Time at which the driver moved away from the intersection
Method

• Proximity of approaching cyclists to the intersection at the moment when drivers arrived at the intersection
• The number of cyclists each driver gave way to
• Time gap between each cyclist
• Total time the driver was stopped at the intersection
• Number of cyclists passing through the intersection per minute
Results
Results
Results

- Potential collisions between cyclists and cars reduce with increasing cyclist density
- Risk approximately halves between 2 and 4 cyclists per minute, halves again at 10 cyclists per minute
Policy implications

• ‘Safety in Density’ rather than ‘Safety in Numbers’
• Local, spatial mechanism – not reliant on behavioural adaptation
• Funnelling riders along strategic routes may have large safety benefits
• Consistent with results from Agent-Based Model
• New safety theory can be developed using Agent-Based Modelling in an inductive / deductive loop, then tested in the real world
Sometimes Density Doesn’t Help

https://vimeo.com/235652714

https://vimeo.com/235652728
Interested in more?

**Major cyclist crash locations across Melbourne & the role of cycling infrastructure**

No-one deserves to be killed or injured on Melbourne’s roads - especially cyclists and pedestrians who are particularly vulnerable to injury and who are overwhelmingly not at fault in a collision or near-miss.

However, many people continue to be killed and injured. The map on your right shows the locations and intensity of 11400 recorded car vs cyclist crashes that have occurred across Victoria since 2010.

More can be done to protect the safety of cyclists and pedestrians. More must be done.

This series of maps will take you through some of the most prominent cycling areas and highest risk locations for cyclists across Melbourne. We’ll also turn our attention to areas where speed limits are about to be dropped and think about what difference this might make to safety.

At any time you can interact with the map - zooming in and out to areas of interest.
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