The Role of Close Pass Indicators in Enhancing Road Safety: Cyclist Perceptions and Driver Behaviour: An Executive Summary.

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Study Rationale.

Cycling is a sustainable mode of transportation that helps both individual health and the environment. Promoting cycling is therefore beneficial and widely encouraged. A close pass event is defined as an incident where a driver doesn't provide sufficient lateral clearance when overtaking a cyclist, it is the most common cyclist road incident (Cubbin et al., 2024). Close pass events can often unnerve cyclists and shape their perceptions of safety whilst cycling (Rubie et al., 2023, p86). Close pass events are therefore a potential target for mitigation strategies. In reducing the number of incidents, a shift might occur in perceptions of cycling-releated safety, leading to increased cycling involvement.

This research uses close pass indicators (CPIs), examining how they influence close pass events. A CPI is a physical object which protrudes from the right-hand side of a bike wheel, often brightly coloured with a reflector, *figure one*. A CPI gives drivers a visual reminder of the correct passing distances, aiming to reduce close pass events. The research explores how CPIs impact cyclists' perceptions of safety and whether they might modify driver behaviour.

Figure 1: Images of the close pass indicator used within the study. The images show how the indicator can be folded out/in and its placement on a bike.

This study attempts to explore the main research question:

"How do close pass indicators influence cyclists' perception of road safety and driver behaviour?".

Methods and Design.

The research is based in St Andrews, a small town within North-East Fife, which experiences low levels of cycling (Barke, 2017, p2).

This exploratory study examines self-reported perceptions of cycling safety and driver awareness with the use of a CPI. This study adopts both a cross-sectional and longitudal design, combining survey and interview methods to assess potential changes in associations. Subsequent findings will provide insights into cyclists expeirences in St Andrews, informing future research and policy design for cycling safety.

The methods collected a combination of quantitative and qualitative data. Surveys were produced on Qualtrics and subsequent data analysed on SPSS. Data was collaborated and examined through both descriptive and inferential statistical methods. Qualatative data was examined in NVivo. The transcripts from participants were coded inductively using thermatic analysis.

Participants in the study were recruited via university mailing lists and advertisements placed across St Andrews.

Cyclists.

Cyclists completed two online surveys. Surveys examined their experiences of cycling in St Andrews and the occurrence of close pass events. The first survey occurred prior to their bikes being fitted with a CPI, after which, they used the device for four weeks before completing the subsequent follow-up survey. Interviews were conducted, limited to individuals who expressed consent.

Ninety participants completed survey one. Prior to analysis, 15 participants were removed due to failure to provide consent or sufficient answers. This concluded 75 participants for the final analysis. The demographic characteristics of the participants is displayed in *figure two*. Following completion of survey one, 43 close pass indicators were fitted on participants bikes across St Andrews.

Gender	Age	Employment
Female: 60% Male: 29.3% Non-binary/third gender: 6.7% No response: 4%	16-17yrs = 1.3% 18-29yrs = 85.3% 30-49yrs = 12% 50-69yrs = 0% 70yrs+ = 1.3%	Students = 90.7% Part-time employment = 5.3% Full time employment = 2.7% Retired = 1.3%

Figure 2: A table displaying the demographic characteristics of the sample in survey one, cyclists.

Twenty-nine participants who completed survey one also completed the follow-up survey. Prior to analysis, 6 participants were removed due to failure to consent to data analysis or failing to provide their unique ID code which linked their answers to their previous responses. This concluded 23 participants for the final analysis. *Figure three* displays the demographic characteristics of the participants in survey two.

Gender	Age	Employment
Female: 69.6% Male: 8.7% Non-binary/third gender: 13% No response: 8.7%	18-29yrs = 87% 30-49yrs = 13%	Students = 91.3% Part-time employment = 4.3% Full-time employment = 4.3%

Figure 3: A table displaying the demographic characteristics of the sample in survey two, cyclists.

Eight interviews were conducted on self-elected cycling participants. Prior to analysis, three interview responses were removed due to requests to withdraw from the study or poor engagement with the questions. The final sample consisted of 5 participants, 4 male, 1 female, aged between 16-29.

Drivers.

Drivers completed a singular survey assessing their perceptual awareness of cyclists on the road and the potential influences a CPI might have on their driving behaviour.

Thirty-eight participants completed the driver survey. Prior to analysis, 10 participants were removed due to not consenting to data analysis or failure to answer the survey questions. This concluded 28 participants within the final analysis. *Figure 4* displays the demographic characteristics of the driver's sample.

Gender	Age	Employment
Female: 75% Male: 21.4% No response: 3.6%	16-17yrs = 3.6% 18-29yrs = 75% 30-49yrs = 14.3% 50-69yrs = 7.1%	Students = 78.6% Full time employment = 21.4%

Figure 4: A table displaying the demographic characteristics of the sample in the drivers survey.

Results.

Data was collected through a combination of interviews and surveys. The subsequent findings were combined to produce an overall conclusion to the stated research question.

What are the common cycling experiences in St Andrews?

Cycling is percieved as somewhat of a safe activity in St Andrews, *figure 5*. Cyclists are seen to lack confidence on the roads and feel powerless to control their safety. Drivers are percieved to have good awareness of cyclists and commonly overtake at a safe distance, with this in mind, close pass events still occur, *figure 6*. Close pass events negatively impact upon cyclist experience, inducing feelings of distress, and often force participants to avoid these areas. These incidents were said to stem from frequently occuring road hazards (parked cars, pedestrians) as well as drivers attitudes towards cyclists. In sum, St Andrews is somewhat of a safe cyclist town but one which would benefit from the implementation of mitigation strategies to improve upon cyclists safety and driver behaviour.

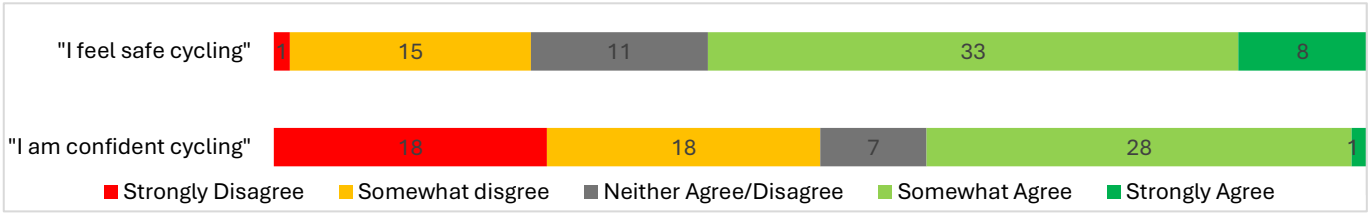

Figure 5: A graph displaying the Likert Scale responses of participants from the baseline survey, indicating their perceptions of safety and confidence levels when cycling in St Andrews, produced in Excel.

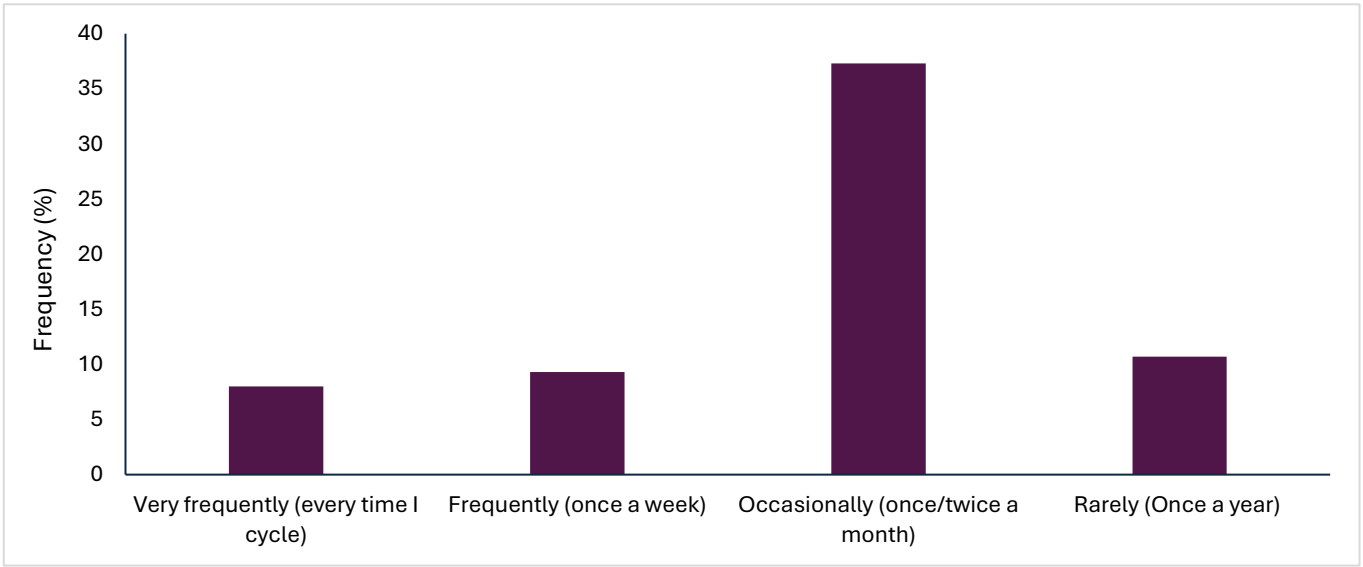

Figure 6: A bar graph displaying the frequency of close pass events experienced by cyclists in the baseline survey, produced in Excel.

How do close pass indicators impact cyclists' perceptions of road safety?

Cyclists suggested that a CPI might improve their perceptions of road safety in St Andrews, boosting individual level confidence. CPIs promoted confidence increase in some participants, allowing them to cycle in areas previously avoided. Additionally, from CPIs, participants percieved drivers as giving them greater lateral distance when overtaking. However, participants suggested that CPIs heightened their awareness to the potential risks associated with cycling, *figure seven and figure eight*. In addition to this, participants noted that CPIs do not address their main concerns affecting their perceptions of safety. When examining for a statistical difference between CPI conditions, no such findings were concluded. In sum, CPIs might be a feasible method of improving individual-level cyclists safety but would not be beneficial on a community-wide basis, due to their potential negative effects and no statistically significant impacts.

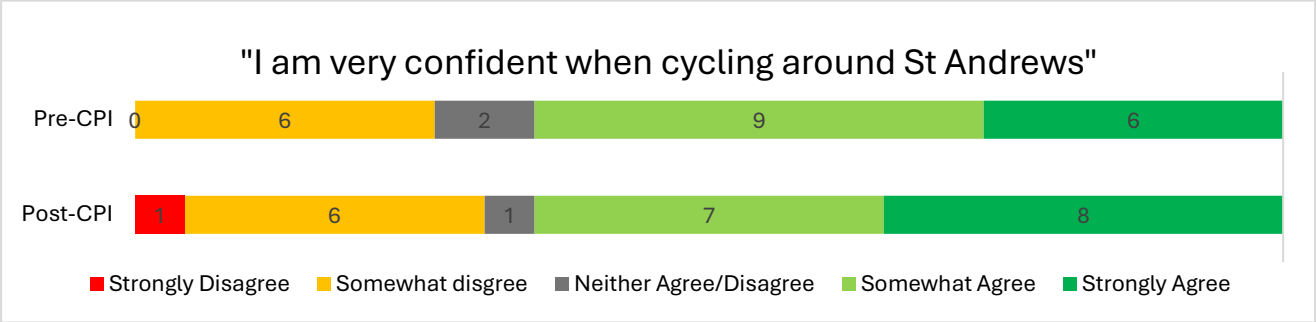

Figure 7: A graph displaying the Likert Scale responses of participants comparing across the baseline and follow-up survey. Participants indicated their confidence levels before and after using a CPI, produced in excel.

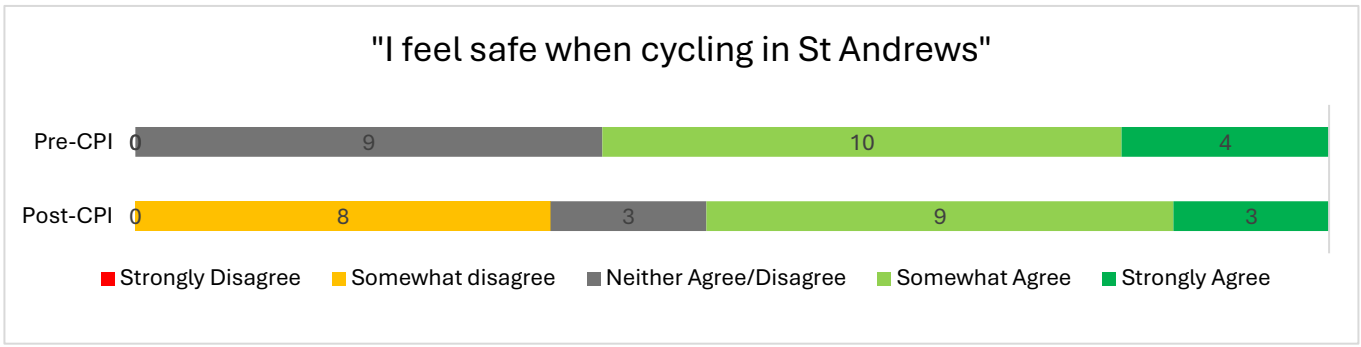

Figure 8: A graph displaying the Likert Scale responses of participants comparing across the baseline and follow-up survey. Participants indicated their safety perception before and after using a CPI, produced in excel.

How do close pass indicators impact drivers behaviour on the roads?

A CPI might target drivers concern about cyclists visibility. If drivers are able to see cyclists more easily, their subsequent behaviour might change, for example, giving wide lateral clearance when overtaking. Drivers in St Andrews currently percieve themselves as giving wide lateral clearance, therefore a CPI is unlikely to impact their behaviour. Following this, additional research is needed to examine the exact effect CPIs have on driver behaviour, potentially through direct observations. In this study, drivers indicate that on rural/country roads, they often give wider distances than other roads such as those in urban environments, *figure nine*. This might also imply CPIs have varying effects in different contexts, potentially enhancing lateral clearance in urban environments but not rural. In sum, more research is needed to examine driver behaviour following CPIs. This study found that through

self-reported measures drivers would likely give cyclists increased lateral clearance from CPI use, however, already percieve themselves as giving appropriate clearance levels.

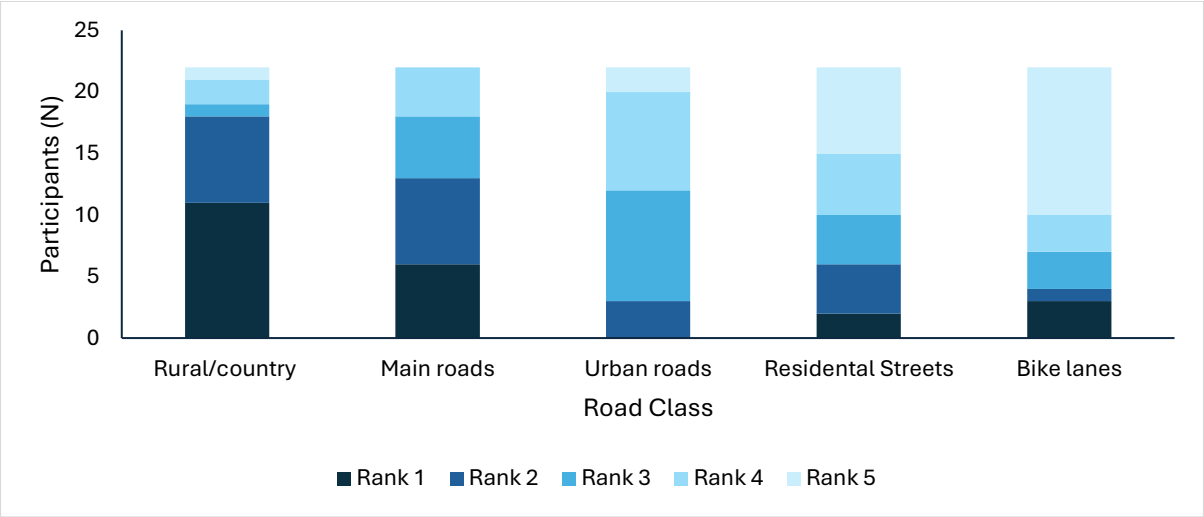

Figure 9: A bar graph showing the average ranked location of roads, with drivers indicating which road they give increased lateral distance. Rank one shows the most amount of distance between the cyclist and driver, rank 5 showing the least. Produced on Excel.

What do drivers and cyclists constitute as a safe passing distance?

An intresting finding in this study pertained to cyclists and drivers interpretation of a safe passing distance, *figure ten*. The findings concluded that drivers indicate significantly larger values than cyclists when discussing what constitutes as a safe overtaking distance. This might suggest that drivers are aware of safe passing distances, and interpret a larger lateral clearance as safer, however the road structures might prevent them from maintaining this distance. This might imply that CPIs will not be effective in St Andrews as drivers are aware and can identify safe passing distances, with these being larger than cyclists' interpretations. Changes in the road structures might be the only methods to increase the lateral clearance to reduce close pass events.

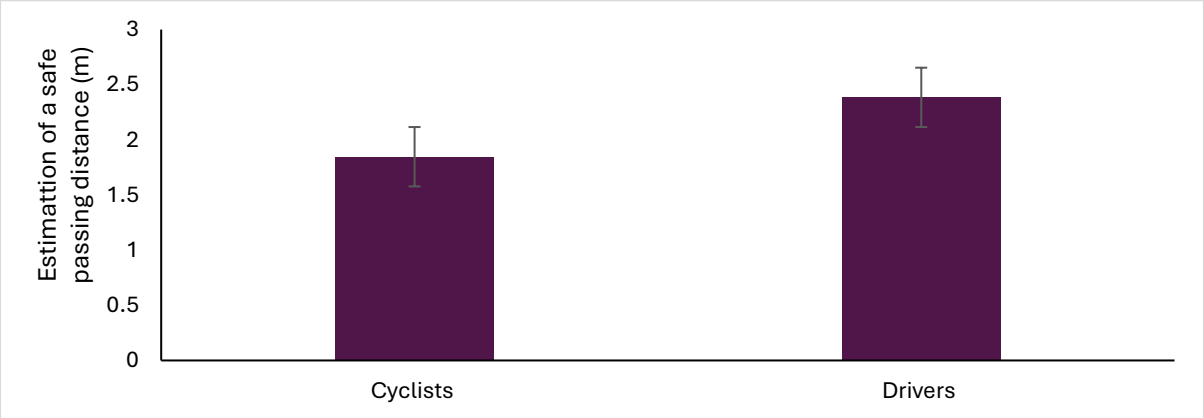

Figure 10: A bar graph representing the average distance cyclists and drivers understand as a safe pass. Produced in Excel.

Does a CPI impact cycling engagement?

Participants highlighted that improving cyclists safety would likely increase cyclist engagement, *figure eleven*. CPIs might not be the method to improve such safety. It was seen that participants experienced no significant changes in their cycling habits as a result of CPI usage. Whilst being regarded positively, CPIs might not be the best driver for cycling engagement. Large scale infrastructural changes are suggested to be the most effective method at increasing cycling in St Andrews.

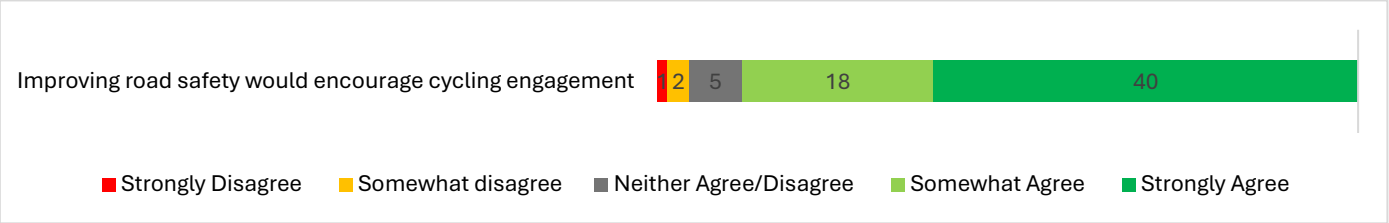

Figure 11: A graph displaying the Likert Scale responses of participants from the baseline survey, indicating their opinions of the impact improved road safety might have upon cycling engagement, produced in Excel.

Summary.

This study was able to demonstrate the safety concerns of cyclists in St Andrews. The road hazards and close pass events often result in cyclists becoming apprehensive or avoiding certain areas. CPIs were suggested to be a potential cost-effective method of reducing close pass events, modifying driver behaviour resulting in improved levels of cyclists safety and engagement.

In summary, CPIs are seen as potentially beneficial at influencing individual-level cycling safety perceptions but will likely be ineffective as a community-wide scheme. The impact of CPIs is mixed, some participants felt that CPI usage made an impact whilst others, they heightened their concern to potential hazards on the roads. Participants did report that drivers had increased levels of awareness, but no significant effect was found between any factors as a result of CPI use. CPIs have some value, but they do not address broader safety issues. In order to create meaningful change in these factors, large-scale modifications are needed in infastructure and driver attitudes.

Future Directions.

Future studies would need to assess observed changes as a result of CPI usage, as self-reported data can often suffer biases. Additionally, future work needs to improve upon participant retention in which 1/3 of participants from the baseline survey completed the follow-up survey, potentially effecting the ability to detect an effect. Finally, CPIs might be context dependent. Future research should look at the impact of CPIs within different environments (rural/urban).

References.

Barke, C. (2017). *St Andrews Cycle Routes*. https://www.transitionsta.org/wp-content/uploads/2017/08/Cycle-Report.pdf

Cubbin, W., van Paridon, K., Keyes, H., & Timmis, M. (2024). Close passes caught on camera – How knowledge and behavioural norms relate to perceptions of liability when cars overtake cyclists. *Transportation Research Part F: Traffic Psychology and Behaviour*, *100*, 308–322. https://doi.org/10.1016/j.trf.2023.12.002

Rubie, E., Haworth, N., & Yamamoto, N. (2023). Passing distance, speed and perceived risks to the cyclist and driver in passing events. *Journal of Safety Research*, *87*, 86–95. https://doi.org/10.1016/j.jsr.2023.09.007

Figures.