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ABSTRACT

This research sought to determine the level of conspicuity of South Australian commuting cyclists. Roadside observations were undertaken at four sites around the Adelaide CBD with two sites each covering the morning (8-9:30 am) and afternoon (4-6 pm) peak cycling commuting periods. A total of 715 cyclists (78% male) were observed, the majority of whom (59%) were estimated to be aged 30-59 years. The general level of front and rear conspicuity amongst cyclists observed commuting to and from the Adelaide CBD is concerning: 38% of cyclists were observed to have high frontal conspicuity; a small minority (8%) of cyclists were observed wearing high visibility vests. High rear conspicuity was much less common with 18% of cyclists observed to have high rear conspicuity. Over half (57%) of all cyclists observed to have high frontal conspicuity had obscured rear conspicuity, predominantly due to the use of a backpack. Further analysis of conspicuity via binary logistic regression indicated that the type of clothing worn by cyclists predicted high conspicuity (front and rear) and high visibility vest use, while age also predicted the use of a high visibility vest, and sex was also found to predict the level of rear conspicuity, including obscured rear conspicuity. These findings suggest that conspicuity may be associated with the individual characteristics of cyclists and the characteristics of different cyclist groups but further research is necessary to investigate this hypothesis. Several areas for future research addressing cyclist safety are suggested but there is a need to investigate the role of conspicuity and other cyclist characteristics in cyclist crashes, and to investigate factors contributing to crashes in which the cyclist and other vehicle are travelling in the same direction. While there is a risk that increased conspicuity may lead cyclists to become overconfident in drivers' ability to detect them, the findings of this study indicate that improving the general level of conspicuity among South Australian cyclists could yield some safety benefits.

KEYWORDS

Cyclist, Bicycle, Conspicuity, Clothing, Observational study

Summary

Conspicuity has been identified as an important safety issue for cyclists, particularly with regard to drivers' detection of cyclists. In order to truly understand the importance of conspicuity for cyclist safety it is necessary to have some indication of the general conspicuity of the cycling population. While self-reported use of conspicuous clothing or other aids may provide some insight into this behaviour, it is desirable to have a more objective indication of cyclist conspicuity. The aim of this research was to obtain information regarding the conspicuity of South Australian commuting cyclists using an observational methodology.

Roadside observations were undertaken at four locations around the Adelaide CBD during peak cycling commuting periods; two observations were conducted during the hours of 8-9:30 am, and two during 4-6 pm over a period of three days in late March and early April, 2012. A total of 715 cyclists (78% male) were observed, the majority of whom (59%) were estimated to be aged 30-59 years. Examination of the data revealed that:

- 38% of cyclists were observed to have high frontal conspicuity, a minority of whom (22%) were observed wearing high visibility vests.
- Statistical analysis indicated that the rates of frontal conspicuity were comparable for males and females, although a greater proportion of female cyclists were observed wearing a high visibility vest (11% vs 7% for males).
- Males wearing full-cycling clothing and riding road bikes generally had the lowest level of front and rear conspicuity of all cyclists and were also least likely to be observed wearing a high visibility vest. Females wearing half-cycling clothing and riding hybrid bicycles were most likely to have high front and rear conspicuity, while males wearing half-cycling clothing and riding hybrid bicycles were more likely to have high frontal conspicuity than those in the male-full-road group.
- The majority of all cyclists (82%) were observed to have low rear conspicuity.
- Significant differences in rear conspicuity were observed between male and female cyclists: females were observed to have high rear conspicuity at higher rates than males (69% vs 15%) and were also less likely to have obscured rear conspicuity (what would otherwise be considered high rear conspicuity that is obscured predominantly due to the use of a backpack) than males (15% vs 29%).
- 57% of all cyclists observed to have high frontal conspicuity had obscured rear conspicuity. Almost half of those cyclists wearing a high visibility vest were observed to have obscured rear conspicuity.

Binary logistic regressions were undertaken to identify factors predictive of high front and rear conspicuity, the use of high visibility vests, and obscured rear conspicuity. This analysis revealed that of all variables included in the model (age, sex, clothing style, bicycle type):

- Cyclists wearing half cycling clothing were 2.5 times more likely to have high frontal conspicuity than cyclists wearing full-cycling clothing
- Cyclists aged 30-59 were 3 times more likely to wear a high visibility vest than those aged 20-29
- Cyclists wearing non-cycling clothing were 16.6 times more likely to wear a high visibility vest than those wearing full-cycling clothing
- Females were 2.4 times more likely to have high rear conspicuity than males

- Males were 4.5 times more likely to have obscured rear conspicuity than females

As a whole the findings of the present study suggest that the general level of front and rear conspicuity amongst cyclists observed commuting to and from the Adelaide CBD is concerning. Analysis of the data appears to indicate that the differences in conspicuity observed between different groups of cyclist might be explained by the characteristics of each group, which are discussed with reference to riding experience and the psychological construct of self identity.

While frontal conspicuity may be important for crashes that occur at intersections, it is possible that rear conspicuity is of some importance in mid-block crashes involving a bicycle and motor vehicle travelling in the same direction. There is a need for further research regarding the role of conspicuity in cyclist crashes with a focus on the conspicuity of the cyclist at the time of the crash. There is also a need for research addressing mid-block crashes in general and the role conspicuity plays in these.

Any significant improvements in cyclist safety will most likely require a global approach addressing aspects such as driver and cyclist awareness of cyclist safety issues, the creation of a safer cycling environment through measures that separate cyclist and motor vehicle traffic, and various aspects of vehicle design. The findings of the present study indicate that the safety of cyclists may be improved further by increasing the conspicuity of cyclists.

Contents

1 Introduction

Research examining collisions between motor vehicles and bicycles at intersections has demonstrated that despite looking in the appropriate direction some drivers fail to detect a cyclist in their field of vision until it is too late to avoid a collision (Herslund & Jørgensen, 2003; Wood, Lacherez, Marszalek, & King, 2009). Indeed, a review of collisions involving bicycles in Britain has demonstrated that a failure to look properly on the part of the driver was identified in 58% of crashes, and that a failure to look properly was reported to be the contributory factor in 60% of crashes occurring at intersections (Knowles, Adams, Cuerden, Swill, Reid, & Tight, 2009). This has become known as the “look but failed to see” phenomenon, which researchers have generally associated with the conspicuity of the road user that was not detected. It is clear that factors that inhibit drivers’ ability to detect other road users is a significant safety issue, particularly for vulnerable road users (pedestrians, cyclists, and motorcyclists).

Explanations for the “looked but did not see” phenomenon may be attributed to a range of environmental factors, including visual obstructions in the driving environment (e.g., in-vehicle blind spots, roadside objects and vegetation, etc.) and poor lighting, or driver factors, including perceptual, attentional, and cognitive processes (Herslund & Jørgensen, 2003; White, 2006). It is easy to conceive circumstances where a driver does not detect a cyclist on the road due to the cyclist being hidden from view by other vehicles, other objects on or near the road, or blind spots within the vehicle. However, understanding how a driver may fail to detect a cyclist on the road in the absence of such visual obstructions is more complicated and must consider the intricate cognitive processes involved in detecting, attending, and responding to objects within complex visual environments.

In order to successfully avoid collisions drivers must detect potential hazards (i.e., other road users, objects on the road, etc.) and respond appropriately, a process that requires drivers to actively scan and search the traffic environment. This process is influenced by a driver’s knowledge and expectancies that have developed over the course of the individual’s driving history. A driver’s knowledge relates to aspects such as the road rules, speed limit along the chosen route, and where it is necessary to stop, give way, or where traffic signals may be encountered. The driver also develops expectancies with regard to the type and frequency of road users that will be encountered, which part of the road they use, the direction from which they will approach, and the movements they are expected to perform. This knowledge and expectancies are reinforced whenever the individual drives and are developed into schemas (a quick-reference mental map of what an experience, i.e., driving in traffic, entails) that shape a driver’s traffic scanning and searching strategies. To appreciate how search strategies based on such schemas can inhibit a driver’s ability to detect a cyclist it is necessary to consider how driving expectancies and knowledge shape these schemas.

When driving, other motor vehicles are encountered at a much greater frequency than are cyclists, producing an expectancy that they will encounter other vehicles before cyclists. This expectancy may result in a search strategy biased towards the detection of other motor vehicles, with visual scanning focussed on the area of the road where these can be expected. Focussing on other motor vehicles may produce inattentive blindness whereby a driver fails to detect an object due to attention being directed towards another object (White, 2006). Furthermore, the detection of objects in the central field of view is significantly better than detection of objects appearing in peripheral vision (Herslund & Jørgensen, 2003). With a driver’s gaze centred towards the middle of the road (where other motor vehicles are expected) cyclists travelling closer to the road side, and thus in a driver’s peripheral vision, may not be detected.

In a study of drivers' ability to detect motorcycles at T-junctions Crundall, Crundall, Clarke, and Shahar (2012) measured the eye movements and response time of three groups: novice drivers, experienced drivers, and dual drivers (drivers who were also experienced motor cyclists). Eye movements were used to determine the distance at which motor cyclists were detected, while the response time (indicating when it is safe to enter the intersection) was used to assess safe behaviour of participants. They found that the search strategies of each group did not differ when approaching the intersection; however, once at the intersection dual drivers delayed decisions to enter the intersection in order to search the junction, and further altered their search strategy in order to track the progress of motorcycles that were detected. Experienced drivers appeared less likely to adapt search strategies to track motorcycles and tended to fix their gaze on other cars longer than on motorcycles. These findings offer some evidence that drivers who may not expect to encounter a motorcycle (i.e., the experienced driver group) employ search strategies consistent with an expectation to encounter other cars. Drivers who may be more inclined to expect motorcycles (i.e., the dual driver group) appear more likely to adopt search strategies better suited to the detection of motorcycles. Rogé, Douissembekou, and Vienne (2012) also found evidence that drivers who were also experienced motorcyclists have a greater awareness of how motorcyclists use the road and search areas of the road where they would expect to detect a motorcycle.

Further evidence regarding the impact of expectancies on the ability to detect cyclists is provided by Rasanen and Summala (1998) in an examination of the attention problems of cyclists and drivers involved in crashes arising from conflicts between cyclists and motor vehicles at on-road bicycle crossings linking off-road cycle paths. They found that drivers were least likely to detect cyclists entering bicycle crossings from unexpected directions due to two-way off-road bicycle paths allowing cyclists to approach an intersection from the opposite direction to traffic while the driver looks in the appropriate direction to observe on-coming motor vehicles. Rasanen and Summala (1998) also found evidence that cyclists' expectancies for drivers to see the cyclist and yield right of way often resulted in crashes because drivers had not in fact detected the cyclist due to the drivers' attention being directed elsewhere.

A driver's failure to detect a cyclist arising from issues such as inattention or attentional blindness may further be exacerbated by the conspicuity of the cyclist. A cyclist that is not easily distinguished from the background will be more difficult to detect. However, a cyclist that contrasts with the surrounding environment, that is, a cyclist that is highly conspicuous may be more likely to be detected. For example, laboratory studies examining the effects of conspicuity on drivers' ability to detect motorcyclists has demonstrated that increasing the contrast between motorcycles and the surrounding environment improves the distance at which drivers can detect them (Gershon, Ben-Asher, & Shinar, 2012; Rogé, Douissembekou, & Vienne, 2012). Other research examining factors affecting the conspicuity of cyclists (e.g., the use of conspicuity aides) under various lighting conditions has shown that enhancing the conspicuity of cyclists improves drivers' detection and recognition of cyclists, which further increases the amount of time drivers have to respond appropriately (Kwan & Mapstone, 2009; Wood, Tyrrell, Marszalek, Lacherez, Carberry, Chu, & King, 2010).

In order to truly understand the importance of cyclist conspicuity for cyclist safety it is necessary to have some understanding of the general conspicuity of cyclists. While self-reported use of conspicuous clothing or other aids may provide some insight into such behaviour, it is desirable to have a more objective indication of cyclist conspicuity (Hagel, Lamy, Rizkallah, Belton, Jhangri, Cherry, & Rowe, 2007). Furthermore, investigations of bicycle collisions involving other motor vehicles demonstrates that both the frontal and rear conspicuity of cyclists is an important issue (Knowles et al., 2009; Watson & Cameron, 2006), and that rear conspicuity may be of particular importance in fatal crashes involving cyclists (Hutchinson & Lindsay, 2009; Knowles et al., 2009). The aim of the present study is to utilise an observational methodology in order to provide objective information regarding the front and rear conspicuity of South Australian cyclists. This data will be used to identify the characteristics of cyclists associated with high and low conspicuity.

2 Method

Roadside observations were conducted at four separate sites around Adelaide with observation periods encompassing the morning and afternoon commuting times on two separate days. Each site was determined based on advice from experienced bicycle commuters and an assessment of bicycle infrastructure (e.g., on-road bike lanes, off-road shared bicycle/foot paths, secondary roads, etc.) to identify other commuting routes. Furthermore, the location of observation sites was determined in order to capture a representative sample of cyclists commuting to the CBD from different directions, that is, from the North, East, South, and West. A final factor in the selection of observation sites was the need to safely accommodate observers without obstructing pedestrian, bicycle, or motor vehicle traffic. Each site is described below; a summary of observation times and locations is provided in Table 2.1.

Site 1 was located Eastern side of the central business district (CBD) at the intersection of Rundle Road and Dequetteville Terrace. Observers were positioned on the on the South-western corner of the intersection in order to easily record data for cyclists travelling West along Rundle Road. Infrastructure available to cyclists included on-road bicycle lanes, and sealed off-road shared bicycle/foot paths. Observations were conducted between 8:00 and 9:30 am.

Site 2 was located on Anzac Highway opposite the Ashford Hospital, approximately three kilometres South-west of the Adelaide General Post Office. Observers were positioned on the eastern side of Anzac Highway. Anzac Highway is an arterial road with six lanes, three lanes for each direction, separated by a wide median strip. There are on-road bicycle lanes on both sides of the road for cyclists travelling in either direction. Observations were conducted between 4:00 and 6:00 pm.

Site 3 was located on the Southern side of the CBD at the intersection of Peacock Road and South Terrace. The Mike Turtur bikeway extends from Glenelg to the CBD (where it terminates at the intersection of King William Street and Greenhill Road Unley) and generally runs parallel to the Adelaide-Glenelg tramline incorporating a mixture of off-road sealed bicycle paths and secondary roads. The bikeway feeds into Peacock Road, which has four lanes for traffic (two lanes for traffic in each direction) and has both off-road shared bicycle/foot paths and on-road bicycle lanes. An earlier pilot study identified this route as a major cycling commuter route into the CBD (see Raftery & Grigo, 2012). Observations were undertaken between 8:00 and 9:30 am.

Site 4 was located to the North of the CBD on the Torrens Linear Park trail, a shared bicycle/foot path that follows the River Torrens. Observers were positioned by the bicycle/foot path on the Northern side of the river near the University of Adelaide footbridge. Observers were able to observe cyclists travelling in either direction on both sides of the river from this location. Observations were undertaken between 4:00 and 6:00 pm.

The suitability of each site was determined by a pilot study, the results of which saw Site 3 relocated to the location described above due to difficulties conducting observations at a previous site on the same road (see Raftery & Grigo, 2012). All other sites remained unchanged.

Table 2.1
Summary of observation location, times, and weather characteristics

	Location	Date	Time	Weather	Temperature (°C)	Sunrise	Sunset
Site 1	Rundle Rd & Dequetteville Tce (Southwest corner)	4/4/2012	08:00 - 09:30	Overcast	17	06:31	
Site 2	Anzac Highway (South side Opposite Ashford Hospital)	28/3/2012	16:00 - 18:00	Fine	28		19:16
Site 3	Peacock Rd & South Terrace (Southwest corner)	29/3/2012	08:00 - 09:30	Fine	17	07:26	
Site 4	Torrens river bike path near Adelaide University footbridge (North side of river)	29/3/2012	16:00 - 18:00	Fine	26		19:14

2.1 Measures

A specialised data collection form developed in a previous study (see Raftery & Grigo, 2012) was used for the collection of data relevant to conspicuity. The form also includes additional elements to allow the identification of cyclist characteristics that may offer some insight into factors that affect conspicuity. Information regarding clothing style and bicycle type were recorded as these could be used to identify different types of cyclists. Each of the variables and categories described in Table 2.2 were included on the data collection form, where possible definitions were drawn from, or based on evidence contained within, the existing literature. A copy of the data collection form is provided in Appendix A.

A note on the age categories used: as it is difficult to ascertain age with any precision using an observational methodology, the age of cyclists was estimated according to the groupings provided in Table 2.2. These categories were chosen in order to simplify the process of estimating and recording age, while identifying groups of interest (e.g., child cyclists, adult cyclists, or elderly cyclists); other researchers have adopted a similar approach (e.g., Hagel et al, 2007). The groups are based on categories used by Hutchinson, Kloeden, and Long (2006) however, an additional group has been included in order to identify young adult cyclists (i.e., those aged 20-29 years).

Table 2.2
Coding categories and definition of variables

Variable	Coding category	Definition
Cycling infrastructure	On street	Indicates cyclists riding on the road without a bike lane, or not in a bike lane (e.g., when riding in another lane).
	Bike lane	Indicates cyclists riding in the on-street dedicated bike lane.
	Bike path	Indicates cyclists using a dedicated, off-road bike path, including shared bike/footpaths.
	Footpath	Indicates cyclists riding on a footpath not intended for shared use with cyclists.
Bicycle type	Road	Road bikes are light weight and designed for speed and performance. The most prominent features of a road bike are its curved "drop down" handle bars and thin tyres.
	MTB	Mountain bikes are designed to handle any road or trail conditions. The defining features of a road bike are its robust frame, suspension (front and sometimes rear), flat handle bars, and wide tyres.
	Hybrid	Hybrid bikes are a cross between a road bike and a mountain bike and are designed for comfort giving the cyclist a more upright riding position than a road or mountain bike. The prominent features of a hybrid bike include its large, thin wheels and flat handlebars.
	Other	This category was utilised to capture bicycles that did not fit in the other categories, for example, BMX, "fixie" or single speed bicycles, recumbent bicycles, unicycles, or tricycles.
Sex	Male	
	Female	
	Unknown	Used when sex was unable to be determined.
Estimated age	Under 16	Enables the identification of young cyclists.
	16-19	Enables the identification of adolescent cyclists.
	20-29	Enables the identification of young adult cyclists.
	30-59	Enables the identification of adult cyclists.
	60 or older	Enables the identification of older cyclists.
Light use	Front	Used to indicate cyclists' use of a front light.
	Rear	Used to indicate cyclists' use of a rear light.
	None	Used to indicate cyclists not using a front or rear light.
Helmet use	Yes	Used to indicate cyclists who were wearing a helmet.
	No	Used to indicate cyclists who were not wearing a helmet.
Clothing type	Full-cycling	Cyclists wearing a cycling jersey and cycling pants (Johnson et al, 2011).
	Half-cycling	Cyclists wearing *either* a cycling jersey *or* cycling pants (Johnson et al, 2011).
	Non-cycling	All other clothing including sportswear, casual clothing, or work attire (Johnson et al, 2011).
Frontal conspicuity	High	Used to indicate cyclists who, from the front, were determined to have high conspicuity based on clothing. In general clothing consisting of a bright, solid (i.e., all or predominantly one colour) colour, including white, yellow, and orange, or bright fluorescent colours (Kwan & Mapstone, 2009). Cyclists wearing a high visibility vest were recorded in a separate category.
	High visibility vest	Used to indicate cyclists observed wearing a high-visibility vest over other clothing.
	Low	Used to indicate cyclists who, from the front, were determined to have low conspicuity, generally due to wearing dull or dark coloured clothing.
Rear conspicuity	High	Used to indicate cyclists who, from the rear, was determined to have high conspicuity as per the definition for high frontal conspicuity, or from the use of a high visibility vest.
	Low	Used to indicate cyclists who, from the rear, were determined to have low conspicuity, generally due to wearing dull or dark coloured clothing.
	Obscured	Used to indicate cyclists who, from the rear, would normally be classified as having high rear conspicuity as per the above definition, but who were found to have this obscured by, for example, a backpack.

2.2 Procedure

Observers sat at the road side a minimum of three metres from traffic and positioned so as to allow pedestrians and cyclists unhindered access to the foot/bike path. The position of observers was optimised to observe cyclists travelling to the city, although cyclists travelling in all directions were, where possible, recorded. In order to maximise efficiency and avoid recording the same cyclist twice observers were required to communicate clearly which cyclists they would record. This became particularly important when faced with multiple cyclists at a time. The number of observations made at each site is indicated in Table 2.3.

Table 2.3
Number of observations made at each site

	N	%
Rundle Road	171	24
Anzac Hwy	92	13
Peacock Rd	253	35
Torrens river bike path	202	28
Total	718	100

3 Results

The results are presented in two parts. The first part reports the results of analyses undertaken to identify differences in front and rear conspicuity as this relates to various cyclist characteristics (e.g., sex). The cross-tabulation used to produce these findings also provide some indication of the actual numbers of cyclists observed within each of the categories used in the present study. The second part reports the findings of binomial regressions to predict cyclist characteristics associated with various aspects of front and rear conspicuity.

3.1 Differences in conspicuity

Given the categorical nature of the data a series of chi-square analyses were conducted in order to determine differences in frontal and rear conspicuity for cyclist characteristics.

As can be seen in Table 3.1 around 38% of cyclists were observed to have high frontal conspicuity due to either conspicuous clothing (78%) or the use of a high visibility vest (22%). The rear conspicuity of cyclists was markedly less favourable. Table 3.2 indicates a total of 82% of cyclists were observed to have low rear conspicuity, 27% of which was due to obscured rear conspicuity.

In order to determine differences in conspicuity for different types of cyclists frontal and rear conspicuity were disaggregated by bicycle type x clothing type and sex. The results are provided in Table 3.1 and Table 3.2. With regard to frontal conspicuity, the analysis indicated the presence of significant differences, $X^2(50) = 124.75$, $p < .001$. Examination of standardised residuals indicated that these differences were attributable to the following:

- Cyclists riding a road bike and wearing full-cycling clothing: fewer males than expected were observed to wear a high visibility vest and more than expected to have low frontal conspicuity. Fewer females than expected were observed to have low rear conspicuity.
- Cyclists riding a road bike and wearing half-cycling clothing: more females than expected observed to have high frontal conspicuity and to wear a high visibility vest.
- Cyclists riding a mountain bike and wearing non-cycling clothing: fewer females than expected observed to have low frontal conspicuity
- Cyclists riding a hybrid bike and wearing half-cycling clothing: more females than expected observed to have high frontal conspicuity and fewer males than expected observed to have low frontal conspicuity.
- Cyclists riding a bike categorised as “other” and wearing non-cycling clothing: more females than expected observed to have low frontal conspicuity

As 38 cells of Table 3.1 contain fewer than five cases interpretation of these findings should be treated cautiously.

Table 3.1
Front conspicuity disaggregated by type of bicycle, type of clothing, and sex

		High		High visibility vest		Low		
Bicycle type	Clothing type	M	F	M	F	M	F	Total
Road	Full-cycling	33	4	1	-	70	5	113
	Half-cycling	11	6	4	4	15	6	46
	Non-cycling	38	4	9	1	65	22	139
MTB	Full-cycling	4	1	-	-	4	-	9
	Half-cycling	6	-	1	-	8	1	16
	Non-cycling	34	3	4	1	67	7	116
Hybrid	Full-cycling	4	1	-	-	8	2	15
	Half-cycling	6	6	3	1	2	2	20
	Non-cycling	30	12	19	9	90	42	202
Other	Full-cycling	-	-	-	-	1	-	1
	Non-cycling	6	1	1	1	15	9	33
Total		172	38	42	17	345	96	710

Note: cells with green shading indicate a count higher than expected, while red indicates a count lower than expected

With regard to rear conspicuity the analysis indicated the presence of significant differences, $X^2(50) = 108.11$, $p < .001$. Examination of standardised residuals indicated that these differences were attributable to the following:

- Cyclists riding a road bike and wearing full-cycling clothing: more males than expected observed to have low rear conspicuity and fewer females than expected observed to have low rear conspicuity
- Cyclists riding a road bike and wearing half-cycling clothing: more females than expected observed to have high rear conspicuity and more females than expected observed to have obscured rear conspicuity
- Cyclists riding a mountain bike and wearing non-cycling clothing: fewer females than expected observed to have high frontal conspicuity and fewer females than expected observed to have obscured rear conspicuity
- Cyclists riding a hybrid bike and wearing half-cycling clothing: more females than expected observed to have high rear conspicuity, fewer males than expected to have low rear conspicuity, and fewer females than expected observed to have obscured rear conspicuity.
- Cyclists riding a hybrid bike and wearing non-cycling clothing: more females than expected observed to have low rear conspicuity
- Cyclists riding a bike categorised as “other” and wearing non-cycling clothing: more females than expected observed to have low rear conspicuity

Again, as 37 cells of Table 3.2 contained fewer than five cases these findings should be interpreted with some caution.

Table 3.2
Rear conspicuity disaggregated by type of bicycle, type of clothing, and sex

Bicycle type	Clothing type	High		Low		Obscured		Total
		M	F	M	F	M	F	
Road	Full-cycling	17	3	69	5	18	1	113
	Half-cycling	4	7	15	5	11	4	46
	Non-cycling	13	8	64	18	35	1	139
MTB	Full-cycling	3	1	4	-	1	-	9
	Half-cycling	4	-	7	1	4	-	16
	Non-cycling	11	2	67	7	27	2	116
Hybrid	Full-cycling	1	-	8	2	3	1	15
	Half-cycling	4	5	2	2	5	2	20
	Non-cycling	24	17	86	40	29	5	201
Other	Full-cycling	-	-	1	-	-	-	1
	Non-cycling	3	2	15	9	4	-	33
Total		84	45	338	89	137	16	709

Note: cells with green shading indicate a count higher than expected, while red indicates a count lower than expected

Additionally, some more generalised analyses were undertaken to identify differences in frontal and rear conspicuity based solely on sex, age, type of clothing, and type of bicycle.

Sex

The rates of frontal conspicuity were comparable for males (N = 561) and females (N = 153), with 38% of male and 37% of female cyclists observed to have high frontal conspicuity due to conspicuous clothing or the use of a high visibility vest, although a greater proportion of female cyclists were observed wearing a high visibility vest (11% vs 7% for males). A chi-square test for independence revealed no significant differences in either frontal conspicuity or vest use between males and females.

Eighty five per cent of male cyclists were observed to have low rear conspicuity, 29% of which were due to obscured conspicuity. The rear conspicuity of female cyclists (N = 152) was slightly better with 69% observed to have low rear conspicuity, 15% of which were due to obscured rear conspicuity. Chi square analysis revealed significant differences in rear conspicuity, $X^2(2) = 27.78$, $p < .001$. Examination of standardised residuals revealed that these differences are mostly attributable to female cyclists, of whom more than expected were observed to have high rear conspicuity and fewer than expected observed to have obscured rear conspicuity.

Age

The frontal conspicuity of cyclists across all age groups was comparable although appears to increase somewhat with age. The proportion of cyclists observed to have high frontal conspicuity due to conspicuous clothing or the use of a high visibility vest were:

- Those aged under 16 (N=3): 33%, none of whom were wearing a high visibility vest
- 16-19 (N = 20): 30%, of whom 17% were wearing a high visibility vest
- 20-29 (N = 246): 35%, of whom 12% were wearing a high visibility vest
- 30-59 (N = 425): 40%, of whom 26% were wearing a high visibility vest
- 60 or older (N = 21): 48%, of whom 40% were wearing a high visibility vest

One hundred per cent of cyclists under the age of 20 were observed to have low rear conspicuity, with 33% of those aged under 16 and 25% of those aged 16-19 observed to have obscured rear conspicuity. Of the other groups, 83% of those aged 20-29 (23% obscured), 81% of those aged 30-59 (29% obscured), and 62% of those aged 60 or older (23% obscured) were observed to have low rear conspicuity.

Together these findings indicate that both front and rear conspicuity appear to improve with age, however chi-square analyses of both front and rear conspicuity revealed no significant differences between cyclists of different age.

Type of clothing

Cyclists wearing half-cycling clothing (N = 82) demonstrated the highest proportion of high frontal conspicuity, with 58% identified as having high frontal conspicuity, of whom 27% were wearing high visibility vests. Cyclists wearing non-cycling clothing (N = 492) were found to have the second highest proportion of high conspicuity with 40%, of whom 26% were wearing high visibility vests. Cyclists wearing full-cycling clothing (N = 139) were found to have the lowest proportion at 35% of cyclists, of whom 2% wore a high visibility vest. Chi-square tests for independence revealed significant differences in frontal conspicuity according to clothing type, $X^2(4) = 29.88$, $p < .001$. Examination of standardised residuals indicated that this difference is predominantly associated with cyclists wearing full-cycling clothing wearing a high visibility vest less frequently than expected, while those wearing half-cycling clothing were observed to have high frontal conspicuity or wear a high visibility vest more often than expected and observed to have low frontal conspicuity less than expected.

With regard to the rear conspicuity of cyclists based on clothing type 83% of cyclists wearing non-cycling clothing were identified as having poor rear conspicuity, followed by cyclists wearing full-cycling clothing (82%), and half-cycling clothing (71%). Of these groups, 32% of cyclists wearing half-cycling clothing were found to have obscured rear conspicuity, as did 21% of those wearing non-cycling, and 18% of those wearing full-cycling clothing. A chi-square test for independence found that rear conspicuity differed significantly according to the type of clothing worn by cyclists, $X^2(4) = 18.07$, $p < .01$. Examination of standardised residuals indicate that this difference is mostly attributable to cyclists wearing half-cycling clothing being observed to have high or obscured rear conspicuity at a rate more than expected, and low rear conspicuity at a rate less than expected.

Type of bicycle

Examination of frontal conspicuity by bicycle type indicated that cyclists riding road bikes had the highest proportion of high conspicuity due to conspicuous clothing or the use of a high visibility vest (43%), followed by cyclists riding hybrid bikes (34%), mountain bikes (20%) and other bicycle types (3%). Cyclists on hybrid bikes accounted for the majority of cyclists wearing high visibility vests (54%), followed by those on road bikes (32%), mountain bikes (10.2%), and other bicycle types (3.4%). A chi-square test of independence revealed no significant differences in frontal conspicuity by bicycle type.

Examination of rear conspicuity by bicycle type found that 83% of cyclists riding road bikes, 85% riding mountain bikes, 78% riding hybrid bikes, and 86% riding other bicycle types had poor rear conspicuity, with 29%, 29%, 24.3%, and 13% for each group respectively attributed to obscured rear conspicuity. Chi-square analysis of independence revealed no significant differences in rear conspicuity by bicycle type.

Comparing frontal conspicuity with rear conspicuity

Disaggregation of rear conspicuity by frontal conspicuity (Table 3.3) indicated that 57% of cyclists with high frontal conspicuity have obscured rear conspicuity. Furthermore, 46% of cyclists identified as having high frontal conspicuity due to the use of a high visibility vest were found to have obscured rear conspicuity, while 59% of cyclists with high frontal conspicuity attributable to wearing conspicuous clothing were also found to have obscured rear conspicuity. These findings show that around half of all cyclists lose the benefits of conspicuous clothing for vehicles approaching from the rear. Something that stands out is the high proportion of cyclists who appear to make a conscious effort to increase their conspicuity (i.e., wear a high visibility vest) lose the advantage of this for vehicles travelling in the same direction.

Table 3.3
Cyclist rear conspicuity by cyclist frontal conspicuity

	Frontal conspicuity			
Rear conspicuity	High	High visibility vest	Low	Total
High	85	32	14	131
Low	2	-	427	429
Obscured	128	27	1	156
Total	215	59	442	716

3.2 Cyclist characteristics associated with conspicuity

Further analyses were undertaken in order to identify cyclist characteristics that predicted high frontal and rear conspicuity, the use of a high visibility vest, and obscured rear conspicuity. The results are presented below. Due to low numbers cyclists from the <16 (N = 3), 16-19 (N = 20), and 60+ (N = 21) age groups were excluded from analysis. Cyclists for whom sex was recorded as unknown (N = 3) or was missing (N = 1) were also excluded from analysis.

3.2.1 Frontal conspicuity

Two separate binary logistic regressions were undertaken. The first sought to identify cyclist characteristics predicting high frontal conspicuity (i.e., cyclists identified as having high frontal conspicuity and cyclists wearing a high visibility vest). The results are presented in Table 3.4. Examination of the coefficients (B) indicated that, compared to cyclists wearing non-cycling clothing, those wearing half-cycling clothing were more likely to have high frontal conspicuity.

A second analysis was undertaken to separately identify cyclist characteristics predicting the use of a high visibility vest. The results are displayed in Table 3.5. Examination of the coefficients (B) revealed that cyclists wearing non-cycling clothing were more likely to wear a high visibility vest than cyclists wearing full-cycling clothing, while cyclists with an estimated age of 20 to 29 years were less likely to wear a vest than cyclists with an estimated age of 30 to 59.

Table 3.4
Characteristics predicting high frontal conspicuity

	B	SE B	Exp(B)	95% C.I. for EXP(B)
Sex				
Female vs Male	-0.11	0.21	0.89	0.59 - 1.35
Age				
20-29 vs 30-59	-0.21	0.17	0.81	0.58 - 1.14
Bicycle Type				
MTB vs Road	-0.01	0.23	0.99	0.62 - 1.56
Hybrid vs Road	0.06	0.20	1.06	0.71 - 1.59
Other vs Road	-0.45	0.44	0.64	0.27 - 1.51
Clothing				
Full-cycling vs Non-cycling	-0.08	0.23	0.93	0.59 - 1.45
Half-cycling vs Non-cycling	0.93**	0.26	2.52	1.51 - 4.21
Constant	-0.49*	0.18	0.61	

Note: $*p < .01$, $**p < .001$

Table 3.5
Characteristics predicting use of a high visibility vest

	B	SE B	Exp(B)	95% C.I. for EXP(B)
Sex				
Female vs Male	0.61	0.40	1.84	0.83 - 4.07
Age				
20-29 vs 30-59	-1.12*	0.41	0.33	0.15 - 0.73
Type of bicycle				
MTB vs Road	-0.67	0.53	0.51	0.18 - 1.46
Hybrid vs Road	0.52	0.38	1.68	0.80 - 3.54
Other vs Road	-0.50	1.15	0.61	0.06 - 5.85
Clothing				
Full-cycling vs Non-cycling	-2.84*	1.05	0.06	0.01 - 0.46
Half-cycling vs Non-cycling	-0.30	0.42	0.74	0.32 - 1.70
Constant	-0.92*	0.33	0.40	

Note: $*p < .01$

3.2.2 Rear conspicuity

As for frontal conspicuity two separate binary logistic regressions were undertaken. The first sought to identify the characteristics of cyclists with high rear conspicuity. The results are provided in Table 3.6. Examination of the coefficients (B) indicate that females and cyclists wearing half-cycling clothing were respectively more likely to have high rear conspicuity than males and cyclists wearing non-cycling clothing.

The second analysis sought to identify cyclist characteristics predicting obscured rear conspicuity. For this analysis the sample was restricted further to those cyclists identified as having high frontal conspicuity due to conspicuous clothing or the use of a high visibility vest (N = 256). The results are provided in Table 3.7. Examination of the coefficients (B) indicate that males were more likely to have obscured rear conspicuity compared to females.

Table 3.6
Characteristics predicting high rear conspicuity

	B	S.E.	Exp(B)	95% C.I. for EXP(B)
Sex				
Female vs Male	0.88**	0.24	2.42	1.52 - 3.85
Age				
20-29 vs 30-59	-0.19	0.22	0.83	0.53 - 1.28
Bicycle type				
MTB vs Road	0.10	0.31	1.11	0.60 - 2.04
Hybrid vs Road	0.33	0.26	1.40	0.84 - 2.31
Other vs Road	-0.20	0.58	0.82	0.26 - 2.56
Clothing				
Full-cycling vs Non-cycling	0.35	0.29	1.42	0.80 - 2.53
Half-cycling vs Non-cycling	0.90*	0.29	2.47	1.39 - 4.40
Constant	-1.99**	0.24	0.14	

Note: * $p < .01$, ** $p < .001$

Table 3.7
Characteristics predicting obscured rear conspicuity

	B	SE B	Exp(B)	95% C.I. for EXP(B)
Sex				
Female vs Male	-1.50*	0.37	0.22	0.11 - 0.46
Age				
20-29 vs 30-59	0.00	0.30	1.00	0.56 - 1.81
Type of bicycle				
MTB v Road	-0.28	0.38	0.76	0.36 - 1.60
Hybrid v Road	-0.52	0.34	0.59	0.31 - 1.15
Other v Road	-0.64	0.80	0.53	0.11 - 2.51
Clothing				
Full-cycling vs Non-cycling	-0.69	0.38	0.50	0.24 - 1.06
Half-cycling vs Non-cycling	-0.17	0.38	0.84	0.40 - 1.77
Constant	0.99	0.30	2.68	

Note: * $p < .001$

4 Discussion

Roadside observations of cyclist conspicuity revealed that the general level of conspicuity among cyclists commuting to the Adelaide CBD is low, with less than half of cyclists observed to have high frontal conspicuity and only one in five identified as having high rear conspicuity. While frontal conspicuity may be important for cyclist safety at intersections, rear conspicuity may play an important role in the safety of cyclists, particularly for motor vehicles travelling in the same direction. Indeed, as same direction crashes may produce more severe injury to the cyclist (Pai, 2011) and account for a large proportion of fatal crashes (Hutchinson & Lindsay, 2009; Knowles et al., 2009), the low frequency with which high rear conspicuity was observed is concerning.

An interesting finding is that almost half of cyclists who make a conscious effort to increase their conspicuity (i.e., wear a high visibility vest), lose the value of this conspicuity from the rear by obscuring the vest with a backpack. The observational methodology employed is not suitable to infer the reasons for this, although it is possible that these cyclists place greater importance on frontal conspicuity than on rear conspicuity, are not consciously aware that the backpack has a negative effect on rear conspicuity, or may be aware of the negative effects of a backpack but lack alternative means for carrying items when they ride. Research addressing issues leading to obscured rear conspicuity may identify factors that can be addressed in order to remedy this situation.

The logistic regressions indicated that compared to cyclists who wore full-cycling clothing, those observed wearing half-cycling clothing were 2.5 times more likely to have high frontal conspicuity and those wearing non-cycling clothing were 16.6 times more likely to be wearing a vest. Female cyclists were 2.4 times more likely than males to have high frontal conspicuity and males were 4.5 times more likely to have obscured rear conspicuity. Young cyclists were also less likely to wear a high visibility vest than older cyclists. These findings offer some indication that the characteristics of cyclists, as individuals and as a group, may partly explain the differences in conspicuity.

Hoffman, Lambert, Peck, and Mayberry (2010) found some evidence that more experienced cyclists were significantly more likely to wear reflective clothing, a finding that may be comparable to high visibility vest use in the present study. As such, it is possible that cyclists observed wearing high visibility vests may be more experienced commuters. However, it is feasible to assume that cyclists in the present study observed to be wearing full-cycling clothing (82% of whom were riding road bikes) may also have higher levels of experience, and may be more involved in cycling activities such as affiliation with organised clubs and participation in competitive races, and ride more frequently and over greater distances (e.g., long rides on the weekend, etc.). Therefore, as those wearing full-cycling clothing were least likely to be wearing a high visibility vest compared to those in the half-cycling and non-cycling clothing groups, and were also less likely to have high frontal conspicuity compared to the half-cycling group, there is perhaps some psychological characteristic of these cyclists that influences their choice of clothing and use of high conspicuity aids.

While the present study is limited in the capacity to address the issue of cyclist psychological characteristics, there are some potential explanations. The use of conspicuity aids such as high visibility vests may be influenced by a cyclist's perception of themselves as a cyclist, and the image they wish to portray to other cyclists. For example, assuming that those who wear full-cycling clothing are indeed more involved in the sporting aspects of cycling they may, like amateur sports men and women everywhere, wear the "uniform" associated with their chosen sport (e.g., lycra cycling jersey and shorts, cycling shoes, expensive road bikes, helmet, etc.), which may not include a high visibility vest. This image may also be influenced by professional cyclists who serve as role models and do not wear high visibility vests when they race.

While it is possible that cyclists in the half-cycling and non-cycling clothing groups may not be influenced by such considerations, the variability in both conspicuity and high visibility vest use within each group (including the full-cycling clothing group) further indicate that individual differences (e.g., personality) may play some role. Research seeking to understand factors that influence adolescent helmet use have found that group norms play a role, as those with friends who also wore helmets were also more likely to wear a helmet than those whose friends did not (Cryer, Cole, Davidson, Rahman, Ching, & Goodall, 1998; Lajunen & Räsänen, 2001; O'Callaghan & Nausbaum, 2006), and Loubeau (2000) has found that where the use of a helmet has a negative impact on self image it is less likely to be used. There is also some evidence that emotions such as feeling safe, proud, regretful, or disappointed affect helmet use (O'Callaghan & Nausbaum, 2006). The differential support for laws mandating helmet use also indicates that those with a more favourable view of such laws are also more likely to wear helmets (e.g., Cryer et al., 1998), but that perceptions of enforcement (e.g., perceived risk of punishment) may also influence helmet wearing (Loubeau, 2000).

Other explanations for the observed differences in conspicuity across groups and individual cyclists may be due to a tendency for some cyclists to overestimate their conspicuity (e.g., Wood, Lacherez, Marszalek, & King, 2009) while others may lack awareness regarding the safety benefits of wearing conspicuous clothing. Others still may have some awareness of the safety benefits but choose to ignore this, perhaps for one or more of the reasons proffered above.

The differences in obscured rear conspicuity indicate that males were more likely to have obscured rear conspicuity. It may be that males use backpacks with greater frequency to transport items, such as a change of clothes, which might be necessary where the cyclist is wearing at least some cycling-specific clothing and may require a change of clothes more suitable for work. On the other hand, female cyclists may prefer baskets or panniers to transport items, and also appear less likely to wear any form of cycling clothing (full or half) and thus may have less of a need to carry a change of clothes. There are two separate issues here: clothing choice, and preferred means for carrying other items, both of which may be associated with self-image as a cyclist.

4.1 Improving cyclist safety

The results of this study have demonstrated that the general level of conspicuity among cyclists commuting to the Adelaide CBD is lower than would be desirable. Studies addressing factors that affect the conspicuity of cyclists have shown that increasing conspicuity improves drivers' detection and recognition of cyclists (Kwan & Mapstone, 2009; Wood, Tyrrell, Marszalek, Lacherez, Carberry, Chu, & King, 2010). Furthermore, a recent study of cyclists presenting to hospital as the result of a crash found that only two per cent of participants were wearing what would be considered high conspicuity clothing at the time of the crash (Biegler, Newstead, Johnson, Taylor, Mitra, & Bullen, 2012). While this may be the result of some bias in the sample, it may also offer some indication that cyclists wearing high conspicuity clothing were less likely to be involved in a crash, or at least less likely to sustain an injury requiring treatment at hospital. As such, improving the conspicuity of cyclists may have benefits for cyclist safety.

The use of public education campaigns targeting cyclists and drivers may improve the conspicuity and safety of cyclists. For cyclists, an educational campaign should seek to increase cyclists' awareness of factors that influence conspicuity and the situations (e.g., common crash types) or circumstances (e.g.. lighting, weather, traffic density, etc.) under which the cyclist is at greatest risk of being involved in a crash. Such campaigns should also address strategies for improving conspicuity and reducing the risk of crashes. This approach should take care not to lead cyclists to become over reliant on their conspicuity, as research suggests that cyclists expecting that drivers have detected them and will yield right of way can also contribute to cyclist-motor vehicle crashes (Rasanen & Summala, 1998). For drivers, an educational campaign should seek to raise drivers' awareness of safety issues for cyclists in different traffic conditions, including overtaking cyclists, turning at intersections, and turning through gaps in traffic. Such campaigns could address the visual scanning practices of drivers and encourage the adoption of search strategies that improve the detection of cyclists.

Attention conspicuity refers to the ability of an object to attract an observer's attention when it is not expected while search conspicuity, on the other hand, refers to the ability of a target to be located by a visual search (Langham & Moberly, 2003). While both of these are applicable in the context of the present study, evidence would tend to suggest that a failure to detect cyclists is most likely a product of attention conspicuity. However, the notion of search conspicuity offers another avenue for increasing the conspicuity of cyclists: increase the salience of cyclists to drivers. For example, studies of conspicuity have demonstrated that drivers primed to detect a specific target appear to adopt search strategies that increase the likelihood of detecting the object (e.g., Gershon, Ben-Asher, & Shinar, 2012; Langham & Moberly, 2003). A similar effect might be achieved through signage at intersections encouraging drivers to look for cyclists. This already takes place to some extent with different coloured bicycle lanes on some roads that are designed to stand out so that the driver is more aware of the presence of the bicycle lane at that location, although the affect of these on drivers' visual searching behaviour or cyclist safety requires further investigation.

Other methods for improving cyclist safety include, for example, increased enforcement of cyclist behaviours (such as red light running and other unsafe practices) and driver behaviours such as parking, driving, or stopping in or blocking bicycle lanes (which cause cyclists to enter other lanes of traffic exposing them to risk from other vehicles). The ultimate means to ensure cyclist safety is the use of well-designed infrastructure to separate of bicycle and motor vehicle traffic.

The advent of new active and passive safety technologies for motor vehicles also has the potential to improve cyclist safety. These include forward and side scanning radars and cameras that are able to detect pedestrians and cyclists on or near the road and warn the driver of their presence and, in some instances, initiate vehicle braking in order to avoid a collision (Anderson, Hutchinson, Linke, & Ponte, 2011). Wireless vehicle to vehicle communication technologies (V2V) may also yield safety benefits for cyclists but this would require some means for vehicles to communicate with cyclists, which may be possible using mobile phone technology or radio frequency identification (RFID) tags (S. Doecke, personal communication, 22nd August, 2012). Other advances in vehicle design that may also reduce the severity of cyclist (and pedestrian) crashes include airbags on the exterior of vehicles and lifting bonnets that are designed to soften an impact when it occurs (Fredriksson & Rosén, 2012).

4.2 Future research

The extant literature regarding cyclist conspicuity leads to a general consensus that improving the conspicuity of cyclists should yield safety benefits. However, there are a number of gaps in knowledge that remain to be addressed.

While the present study offers some indication that individual differences may influence cyclist conspicuity, research is required to identify what such factors may be and the manner in which they influence conspicuity. This research should also seek to identify factors in the decision making processes that influence, for example, decisions regarding the use of safety equipment or clothing choice of cyclists. Research along such lines generally addresses issues of why individuals *do not* adopt safe behaviours (e.g., helmet use) but it is also important to identify factors that induce individuals to engage in those behaviours. Such research would provide useful information that could be used in the development of strategies or campaigns to improve cyclist conspicuity.

While research addressing the looked-but-failed-to-see crash phenomenon generally propose cyclist conspicuity as a contributory factor for some crashes, there is little research examining the actual role of conspicuity in crashes. Research addressing this deficit might employ either an at-scene methodology of bicycle-motor vehicle crashes or retrospective studies of crash-involved cyclists and drivers. Factors that should be considered include the crash type and mechanisms, the conspicuity of cyclist clothing (front and rear) based on direct observation and other cyclist characteristics (e.g., cycling experience, trip purpose, age, sex, bicycle type, etc.), driver characteristics (e.g., driving experience, age, sex, etc.), road characteristics (e.g., number of lanes, presence of bike lanes, etc.), and environment (time of day, lighting conditions, weather, traffic density, etc.). This information could also be obtained retrospectively through surveys of drivers and cyclists.

The current lack of research addressing mid-block crashes between cyclists and other road users should be addressed and may provide some insight into factors associated with same direction crashes, particularly the rear conspicuity of the cyclist. As above, data collection could employ either at-scene or retrospective methodologies.

Research assessing drivers' ability to identify and detect motorcyclists has demonstrated variability in the search patterns of drivers based on driving experience, with more experienced drivers less likely to employ search strategies suitable to detect motorcyclists, while drivers with experience riding motorcycles are more likely to search areas of the road in which a motorcyclist may be expected (Crundall, Crundall, Clarke, & Shahar, 2012; Rogé, Douissembekou, & Vienne, 2012). A similar vein of research may seek to identify whether drivers who are also experienced cyclists differ in their road searching/scanning practices (i.e., where they look, how long they look, etc.) to drivers without cycling experience. The findings of such research might be useful for the development of educational campaigns.

Other research might also investigate the influence of various road treatments on the detection of cyclists. Treatments such as coloured bicycle lanes might be expected to increase a driver's awareness of cyclists on the road and may, therefore, trigger/prompt drivers to search more actively for cyclists. Signs alerting drivers to the possible presence of cyclists may also have a similar effect. Studies addressing the effect of these on driver traffic search strategies would provide some evidence of the utility and effectiveness of different countermeasures targeted at drivers.

An audit of cyclist infrastructure (e.g., the width and condition of bike lanes) based on Austroads guidelines might also identify other areas in which cyclist safety could be improved. Such research may point to, for example, deficits in bicycle lane width that might increase the risk of same-direction crashes. Audits might also consider the proximity of roadside objects (e.g., signs and vegetation) that may also obscure a driver's vision of cyclists.

Finally, the advent of new technologies also offer further avenues for research. Some effort should also be directed towards monitoring the effect of new vehicle technologies on cyclist safety. For example, the ability or effectiveness of camera-based collision avoidance technologies to detect cyclists may also be influenced by the conspicuity of cyclists.

5 Conclusion

Observations of South Australian cyclists indicate that the general levels of front and rear conspicuity among cyclists commuting to the Adelaide CBD are not ideal. Existing evidence suggests that frontal conspicuity has implications for the safety of cyclists, particularly with regard to crashes at intersections. Although same-direction crashes that occur mid-block are largely overlooked in the current literature, there is also some evidence indicating that the rear conspicuity of cyclists may assist in preventing such crashes. Future research should seek to address the deficit in knowledge regarding factors contributing to mid-block crashes in which a bicycle and other vehicle are travelling in the same direction.

One finding of note from the present research is the relatively high prevalence of obscured rear conspicuity among cyclists wearing high visibility vests. Assuming these cyclists take active steps to increase their conspicuity, the apparent lack of concern for rear conspicuity warrants further investigation.

Evidence also indicates that cyclist conspicuity differs between different cyclist groups and between cyclists within those groups. While the data collected for the study were not designed to address individual differences in terms of psychological aspects, the observed differences between types of cyclists based on clothing style and type of bicycle they were riding provide some indication that factors associated with self-identity and identity as a cyclist may affect conspicuity. A brief search of existing literature revealed a few studies addressing aspects such as personality on motivations for cycling but these tend to focus more on aspects of performance for competitive cycling or differences between competitive cyclists and recreational cyclists. Other research addressing cyclist safety behaviours tends to focus on self-reported behaviour or attitudes; as yet the factors that underpin such behaviour have not been fully explored. Furthermore, there appears to be little research addressing the role of individual differences in cyclist safety. Research investigating the influence of characteristics of cyclists such as riding experience, the function of cycling, personality traits, identity formation and on conspicuity would not only provide an interesting, and perhaps novel line of research but may also identify new approaches or avenues for addressing cyclist safety and may also prove beneficial in the development or delivery of educational interventions.

There is a general consensus in the literature that improving cyclist conspicuity increases the likelihood of a driver detecting a cyclist under various lighting conditions but the detection and recognition of a cyclist does not guarantee that a driver will respond appropriately. Furthermore, other evidence indicates that some cyclists tend to overestimate their conspicuity or expect drivers to yield when the cyclist has right of way, factors that may also contribute to some cyclist crashes. As such, any intervention to address cyclist safety issues through the improvement of conspicuity should recognise these issues and seek to minimise the potential harms associated with these.

Any significant improvements in cyclist safety will most likely require a global approach addressing aspects such as driver and cyclist awareness of cyclist safety issues, the creation of a safer cycling environment through measures that separate cyclist and motor vehicle traffic and various aspects of vehicle design. The findings of the present study indicate that the safety of cyclists may be improved further by increasing the conspicuity of cyclists.

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Appendix A – Observation data collection form

SITE: ____

INFRASTRUCTURE: road only ☐ road with bike lane ☐ shared bike/foot path ☐ footpath ☐

DATE: _________________ **TIME**: ______________

LIGHTING: fine daylight ☐ overcast daylight ☐ rain ☐ dusk/dawn ☐ night ☐

TEMPERATURE: _______ °C

Road	Type	Sex	Age	Light	Helmet	Clothing	Conspicuity (F)	Conspicuity (R)
On street □ Bike lane □ Bike path □ Footpath □	Road □ MTB □ Hybrid □ Other □	Male □ Female □ ? □	< 16 □ 16 - 19 □ 20-29 □ 30-59 □ 60 +□	None □ Front □ Rear □	Yes □ No □	Full cycling □ Half cycling □ Non - cycling □	High □ Vest □ Low □	High □ Low □ Obscured □
On street □ Bike lane □ Bike path □ Footpath □	Road □ MTB □ Hybrid □ Other □	Male □ Female □ ? □	< 16 □ 16 - 19 □ 20-29 □ 30-59 □ 60 +□	None □ Front □ Rear □	Yes □ No □	Full cycling □ Half cycling □ Non - cycling □	High □ Vest □ Low □	High □ Low □ Obscured □
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