An evaluation of the effects of a school-based cycling education program on participation and safety

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Contents

Abstract

Cycling education programs for children could play a role in promoting both cycling participation and cycling safety. Cycling education programs for children exist in many countries – mostly in school settings – but few evaluations have used rigorous research designs to assess a range of outcomes. *Safe Cycle* is a program that incorporates typical content (bike handling skills, traffic manoeuvres) and also hazard and self-awareness training - an important inclusion for more comprehensive programs. To evaluate *Safe Cycle* online surveys were conducted at treatment schools (n=108) and (waitlist) control schools (n=28) before, immediately after, and approximately 14 weeks after, the program was delivered at treatment schools. Actual riding behaviour was measured naturalistically using instrumented research bicycles at treatment (n=6) and control schools (n=6). Delivery processes were considered via relevant survey questions and interviews with teachers (at treatment schools only). Because of issues with the control group, pre-program survey data were compared with immediate post-program, and with follow-up survey data, in the treatment group only. For the naturalistic observation data treatment schools were compared with control schools. Results provide some evidence that *Safe Cycle* increased participation in cycling, confidence in performing cycling skills, and knowledge relevant to cycling safety. The program appeared to address illusory invulnerability effectively. Nonetheless, there was no evidence that the program improved cycling safety behaviours or outcomes. The program was well-received by students and teachers alike, and results suggest strategies for optimising the beneficial effects of *Safe Cycle.*

1. Background

In view of the health benefits of cycling (Rabl & de Nazelle, 2012) a range of policies and programs exist worldwide to encourage people to ride a bicycle for transport and recreation. Encouraging children to cycle is particularly important, given the value of forming healthy habits early in life (Kuh & Cooper, 1992).

Cycling education programs for children could play a role in promoting cycling participation (Osborn, 1998) and they exist in many countries – mostly in school settings (see Hatfield, 2012; Richmond et al, 2013). Such programs may reduce the frequency of bicycle-related injuries through increased knowledge and compliance with traffic regulations (Maring & van Schagen, 1990). In Australia, between 2008 and 2009 children aged between 10 and 14 years had the highest rate (per 100,000 population) of hospitalisation due to bicycling-related injury, children aged between 5 and 17 years who were seriously injured due to land transport accidents were most likely to be riding a pedal cycle (AIHW: Henley & Harrison, 2012). Strategies for reducing bicycle-related injuries should go hand-in-hand with initiatives to promote cycling participation (OECD/International Transport Forum, 2013).

A recent review of evaluations of cycling education programs for children (Richmond et al, 2013) drew three important conclusions:

1. There are relatively few high-quality evaluations of cycling education programs for children. The 25 reviewed studies included only five Randomised Control Trials [RCTs], with the remainder being: before- after studies with a comparison group (n=6), before-and-after studies (n=7), cross-sectional studies (n=2), one case–control study, one cohort, and one retrospective cohort study. Further, the RCTs measured knowledge, attitudes regarding safe cycling, and behaviour, but did not measure crash or injury outcomes. Further, the studies suffered from a range of methodological shortcomings (see Richmond et al, 2013, p194).
2. "Educational and skills training bicycling programmes may increase knowledge of cycling safety, but this does not seem to translate into a decrease in injury rate, or improved bicycle handling ability and attitudes" (Richmond et al, 2013, p191). Two before-after studies published since the review (Hooshmand et al, 2014; Lachapelle, Noland, & Von Hagen, 2013) also demonstrated increases in knowledge. Importantly, one case-control study (Carlin Taylor & Nolan, 1998) reported that children (aged 9-14 years) who were treated in ED for injuries sustained in a cycling crash (n=148) were more likely to have participated in Bike Ed (a state-wide school-based cycling safety program) than control cyclists (n=130) - even with adjustment for sex, age, socioeconomic status, and cycling exposure.
3. The content of cycling education programs for children has changed little in the past 30 years (Richmond et al, 2013). In particular, it still tends to focus on knowledge and skills relating to vehicle handling and manoeuvring in traffic – as did early driver education. Such "first generation" driver education appears to be of little benefit (see Ker et al., 2008 for Cochrane review), and may even increase crash risk (Vernick et al, 1999) by causing overconfidence (Gregersen, 1996). "State of the art" driver education addresses higher-level capacities, including awareness of risk and self-evaluation (see Hatakka et al., 2002). Interestingly, Carlin et al (1998) hypothesised that Bike Ed "may inadvertently lead susceptible children to undertake risky behaviour" (p.26) due to perceived immunity. Risky behaviour and perceived immunity were not assessed directly.

Evaluations of cycling education programs for children have paid little attention to participation, although changes in participation are an important program outcome (given the health benefits of cycling; Rabl & de Nazelle, 2012), and may also contribute to changes in crash and injury numbers. There has also been insufficient consideration of effects on confidence and perceived safety. Studies have tended to focus on ability to perform manoeuvres correctly, while ignoring safety behaviour or risky behaviour during "real world" cycling. More consideration of crashes and injury is also warranted (since relatively studies have assessed such outcomes, focussing instead on intermediate outcomes such as knowledge and behaviour).

The present study evaluated *Safe Cycle*, a relatively new school-based cycling education program that includes hazard and self-awareness training as well as more typical cycling education content (handling skills, traffic manoeuvres). It assessed a more complete suite of outcome variables (i.e. crash, injury and participation), intermediate variables (i.e. confidence, perceived safety, illusory invulnerability, knowledge, real-world behaviour), and process variables, than has previously been assessed in a single evaluation. For a subsample of participants, in addition to self-reports naturalistic observation of real-world riding behaviour was undertaken using instrumented research bikes.

2. Methods

2.1 Surveys

2.1.1 Design

The evaluation was conducted using a Treatment/(Waitlist) Control, Pre/Post/Follow-up design (see Figure M1). However, because of issues with the control group, only Treatment group data were analysed (see Results).

	Term 2				Break	Term 3				Break	Term 4
Treatment (T) *Program delivery*	Safe Cycle (8 weeks)										
Testing	**Survey 1** start of first session			**Survey 2** end of last session							**Survey 3** as for C
Control (C) *Program delivery*											Safe Cycle (8 weeks)
Testing	**Survey 1** as for T			**Survey 2** as for T							**Survey 3** start of first session

Note: Each column represents a 2 week period

Figure M1: Overview of Treatment [T]/(Waitlist) Control [C], Pre/Post/Follow-up design

Schools were allocated to the Treatment versus (Waitlist) Control group based on when in the school year they were planning to deliver *Safe Cycle*. Schools that were delivering the program in the second school term were allocated to the Treatment group while schools that were delivering the program in the fourth school term were allocated to the (Waitlist) Control group.

Times for surveys were determined by the web-based methodology, the decision to deliver surveys at school (in order to maximise response rate), and the intention to minimise disruption for participating schools. Thus, at Treatment schools the pre-program survey (Survey 1) was conducted at the beginning of the first *Safe Cycle* session, and the post-program survey (Survey 2) was conducted at the end of the last *Safe Cycle* session (typically around 9 weeks after the pre-test). Pre- and post-program surveys at Control schools were approximately synchronised with those at Treatment schools. The follow-up survey (Survey 3) was conducted at the beginning of the first *Safe Cycle* session at Control schools, and approximately contemporaneously at Treatment schools. This amounted to a delay of around 14 weeks between the Surveys 2 and 3.

Teachers responsible for delivering *Safe Cycle* were interviewed soon after program delivery at Treatment schools.

2.1.2 Sampling and participants

The government department responsible for delivering *Safe Cycle* in schools approached 15 schools to both deliver the program and participate in the present evaluation. The principals of these schools were informed about the program, and about what would be required of participating schools. This included at least one staff member attending a training day, obtaining necessary consents, administering surveys (online) at school, and participating in a telephone interview about *Safe Cycle*. Each school was offered two “teacher release days” to facilitate their involvement.

Seven schools decided to participate, of which four were allocated to the Treatment group and three were allocated to the Control group (see Figure M2).

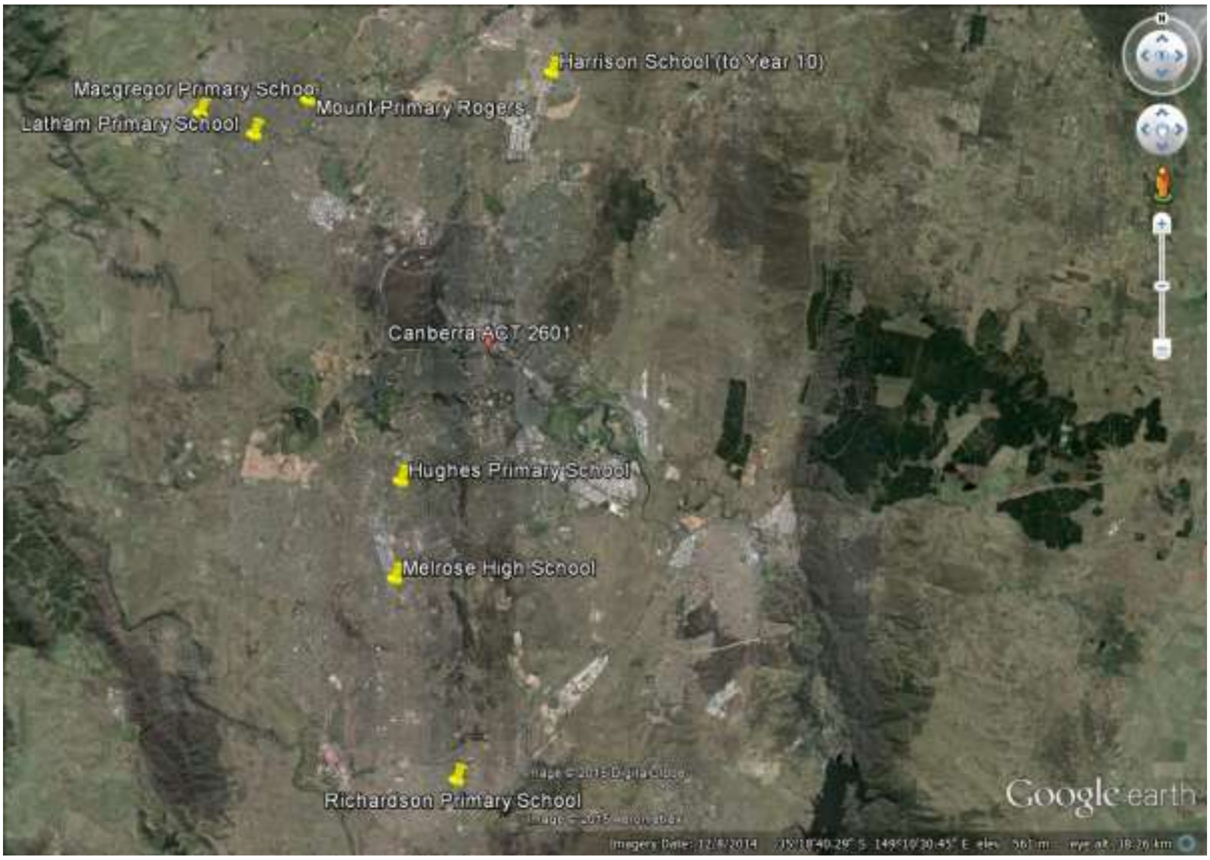

Figure M2: Map showing Treatment schools (Macgregor, Melrose, Mount Rogers, Richardson) and Control schools (Latham, Harrison, Hughes)

In order for a student to participate in the evaluation the presiding ethical committee required that both the student and their parents give consent. Early in the second school term an Information Statement and Consent Form was sent home with all students who would receive *Safe Cycle* (including at control schools). Only students who returned signed consent forms from their parents could choose to participate.

Details of response rate and sample characteristics are presented in Results.

2.1.3 Materials

Five web-based surveys were developed and administered using Survey Monkey.

Survey 1 (the pre-program survey; Appendix A) assessed personal characteristics, cycling participation and patterns, safe cycling knowledge, beliefs and behaviours, experience of crashes and near-misses. The time frame for questions relating to crashes and near-misses was 6 months.

Surveys 2T and 2C (the post-program surveys) differed from Survey 1 mainly in that there were no questions relating to crashes and near-misses. The version given to the Treatment group (Survey 2T; Appendix B) version included process questions about *Safe Cycle* (whereas the Control group version, Survey 2C, did not).

Surveys 3T and 3C (the follow-up surveys) differed from Survey 1 mainly in that the time frame for questions relating to crashes and near-misses was three months (the period since completing *Safe Cycle).* The version given to the Treatment group (Survey 3T; Appendix C) version included questions about the perceived influence of *Safe Cycle* on riding behaviour (whereas the Control group version, Survey 3C, did not).

The variables assessed in each of the surveys are summarised in Table M1.

Table M1: Summary of variables assess in Surveys 1, 2, and 3

	Survey 1	*Survey 2*	*Survey 3*
Personal characteristics	Y		
Cycling participation	Y	Y	Y
Safe cycling knowledge, beliefs, and behaviours	Y	Y	Y
Experience of near-misses	Y		Y
Impressions of *Safe Cycle (Treatment group only)*		Y	Y

The teachers responsible for delivering *Safe Cycle* at each of the treatment schools were interviewed using a structured interview protocol (see Appendix D). Questions related to their understanding of the program, the fidelity of program delivery, student response, perceived program strengths, challenges, and suggestions for improvement.

2.1.4 Procedures

Each survey was administered in class using Survey Monkey. Supervising teachers were asked to instruct students to complete the surveys on their own, and to assist students only with question comprehension.

Completed surveys were checked against lists of consented students, and teachers asked to follow up with consented students for whom a survey had not been completed (before the survey closed).

After delivery of Safe Cycle at participating schools telephone interviews were arranged and conducted with the teachers responsible for delivering *Safe Cycle* at Treatment schools.

2.2 Naturalistic observation

2.2.1 Design

The naturalistic data collection occurred after delivery of *Safe Cycle* at Treatment schools, but before delivery of *Safe Cycle* at (Waitlist) Control schools. Thus, for this component of the research the Treatment group was compared to the Control group without the use of a baseline.

2.2.2 Sampling and participants

Two Treatment schools (Melrose, Mt Rogers) and two Control schools (Latham, Harrison,) were selected to be approximately matched on age. At these schools teachers identified three consented students who were regular bike riders (total= 12 participants) to ride an instrumented research bicycle for objective recording of their cycling behaviour for two weeks.

This component of the research was outlined in the original Information Statement, and parents were required to accompany students for handover of the research bicycles and a briefing on how to use them, as a further indication of consent.

2.2.3 Equipment

The research bicycles were commercially-available mountain bikes, selected for their appeal to the age-group involved. Each bicycle was instrumented to automatically record footage of both the rider's (face, arms and torso) and the scene in front of the bicycle. The instrumentation system consisted of two GoPro HERO2 cameras mounted on the handlebars, which were set to record automatically upon start-up and controlled using a CamDo Intervaltometer. The Intervaltometer was triggered using the voltage output of a Reelight generator mounted on the front forks, which was activated by the motion of magnets mounted on the front wheel spokes. The Intervaltometer was programmed to turn on the cameras when the bicycle was in motion and turn off the cameras after two minutes of inactivity. The cameras recorded footage to a 32 GB SD card at a rate and resolution of 30 frames/sec and 720p, respectively. Each camera was also connected to Voltaic V44 USB battery pack, which replenished the camera battery when it fell below 100% charge. The battery packs were housed in a jiffy box, which was attached to the top tube using a frame bag.

2.2.4 Procedures

At each school that participated in the naturalistic data collection the responsible teacher arranged a meeting immediately after school with the three selected students and their parents.

At this meeting the technician who instrumented the bikes briefed the students and their parents on the use of the research bicycles. In particular, participants were asked to ride the research bicycles as they would their own bicycle while avoiding any trail or park riding, and to not touch any of the equipment. The technician then fitted each student to the research bicycle that they would take with them. The students were instructed to return the research bicycles to the school after two weeks, and the technician arranged a time with the teacher to collect the bicycles.

After the research bicycles had been “out” for two weeks at a particular school, the technician returned to collect the bicycles, download the recordings, recharge the batteries, correct any technical or mechanical problems, and take the bicycles to the next school.

3. Analysis

All analysis was conducted using SPSS V22. A Type 1 error rate of .05 was used for all tests. Two-tailed p-values are reported throughout, but these were halved when judging significance for tests with directional hypotheses (as noted in Results).

3.1 Survey

Only data for consented students who completed Surveys 1, 2, and 3 were employed for analysis of survey data.

For each participant data from Survey 1, 2, and 3 were matched using name as an identifier (with birthdate as a validation variable). 100% matching was achieved.

Preliminary analysis was conducted to identify and correct any problems with the data. For scales average scores were computed based on the number of items completed. Non-dichotomous categorical variables were recoded to dichotomous variables.

Descriptive analysis of survey data was conducted to describe the sample, and for process variables. Inferential analysis was conducted to compare Survey 1 measures with Survey 2 measures, and with Survey 3 measures, separately. Paired-samples t-tests were used for continuous measures, while McNemar's tests were used for dichotomous variables.

3.2 Naturalistic observation

In order to "reduce" the naturalistic cycling data to numeric data for analysis, videos were viewed and coded according to a coding scheme developed for the present research (see Appendix E).

A preliminary coding scheme was adapted from the Behaviour Assessment Form developed to assess practical riding skills and risk awareness during the observed ride that is suggested as a component of *Safe Cycle.* Changes were made to facilitate coding of data recorded with the front-camera and face-camera with which the bikes were fitted. Revisions were made to the preliminary coding scheme following comments from researchers experienced with reduction of naturalistic cycling data.

Using the revised coding scheme video from one participant was coded by two coders, separately. These coders met to discuss points of disagreement and other issues, and to agree on a further revisions. This process was repeated with the second participant to arrive at a final coding scheme.

All participants were coded using the final coding scheme, noting any additional information for each participant (e.g. near-misses).

Descriptive analysis of survey data was conducted to describe the sample. Treatment and Control groups were compared using independent-samples t-tests for continuous variables, and using Fisher's exact tests for dichotomous variables.

4. Results

4.1 Survey

4.1.1 Participation and completion rate

Table R1 summarises for each of the participating schools:

1. The size of the study population; i.e. the total number of students in the classes to whom *Safe Cycle* was delivered.
2. The number of students for whom parental consent was received (consented students)
3. The response rate, the percentage of the study population for whom parental consent was received
4. The number of consented students who completed each survey
5. The number of consented students who completed all three surveys
6. The completion rate, the percentage of consented students who completed all three surveys

Response rate ranged between 19.2% and 73.2% across the various schools. The requirement to obtain parental consent was felt to have reduced these rates, with non-participation often resulting from failure to return the permission form, rather than a decision not to participate *per se*. The average participation rate at Control schools (19.3%) was substantially lower than that at Treatment schools (59.93%). This may reflect a low salience of *Safe Cycle* at Control schools at the time of consent (long before the program was delivered at the schools), but may also reflect a difference between schools who chose to deliver the program at different times of year.

There were a total of nine consented students who did not complete all three surveys, and who were therefore not eligible for inclusion in the final matched dataset. Among these students, four completed surveys subsequent to the one that they missed – suggesting that they did not discontinue as such, but rather missed school on the day of the survey and could not be followed up. Survey 3 was run slightly late at Mount Rogers, making it difficult to follow-up the three students who missed the survey. Of the remaining three students who did not complete Survey 3 two are known to have left their respective schools. Thus, attrition was not a substantial issue at either Treatment or Control schools.

Table R1: Metrics relating to response and completion rate

	Study population size	Number of consented students	Participation rate	Number completed Survey 1	Number completed Survey 2	Number completed Survey 3	Number completed all three surveys	Completion rate
Treatment								
Macgregor	83	45	54.2%	44	44	44	43[a]	95.6%
Melrose	73	29	39.7%	28	29	29	28	96.6%
Mount Rogers	32	23	71.9%	23	23	20	20	87.0%
Richardson	23	17	73.9%	17	17	17	17	100.0%
Average			*73.2%*					*94.8%*
Control								
Harrison	93	18	19.4%	18	18	17	17[b]	94.4%
Hughes	N/A	N/A	N/A	3	7	7	3	N/A
Latham	52	10	19.2%	9	10	9	8[c]	80.0%
Average			*19.3%*					*87.2%*

[a] One missing Survey 1 & 3, and one missing Survey 2 only; [b] One missing Survey 3 left school; [c] One missing Survey 1, and one missing Survey 3 (left school)

4.1.1 Sample profile

Table R2 presents the respondent characteristics of the Treatment and Control groups at Survey 1. The Treatment was significantly younger than the control group ($t_{33.81} = -2.57$, $p=.015$), but did not differ significantly in terms of gender or participation in cycling participation. The groups showed a similar pattern of sources of rider training.

Table R2: Respondent characteristics for Treatment and Control schools at Survey 1

	n	*% Female*	*Mean age (s.d.)*	*% ride bike (n)*	*% taught self* [a]	*% taught by family* [a]	*% taught by school* [a]	*% taught by other* [a]
Treatment	108	60.2%	11.78 (0.98)	93.5% (101)	29.7%	77.2%	8.9%	3.0%
Control	28	50.0%	12.51 (1.43)	85.7% (24)	33.3%	66.7%	0.0%	4.2%

[a] Among bike riders.

Because the Control group was considerably smaller, significantly younger, and showed a substantially lower response rate (reflecting potential bias), than the Treatment group, it was judged inappropriate to persist with analysis based on a Treatment/Control design. Consequently the Control group was excluded from all further analysis, which focussed on comparing pre-program measures with post-program measures, and with follow-up measures, in the Treatment group only (n=108).

Bike ridership was quite high with only seven respondents reporting not riding a bike at Survey 1. Less than 1 in 10 reported any formal training, while over three quarters were taught by family members.

Figure R1 presents the percentage of all Treatment school respondents who reported riding a bike for particular purposes at Survey 1. Most respondents reported riding a bike for fun or fitness, with transport-related responses less frequently endorsed. Other reasons offered for riding included riding with family (n=3) and riding to other destinations (including sport, shops, grandmother’s house; n=4 in total). Two respondents alluded to riding being fast.

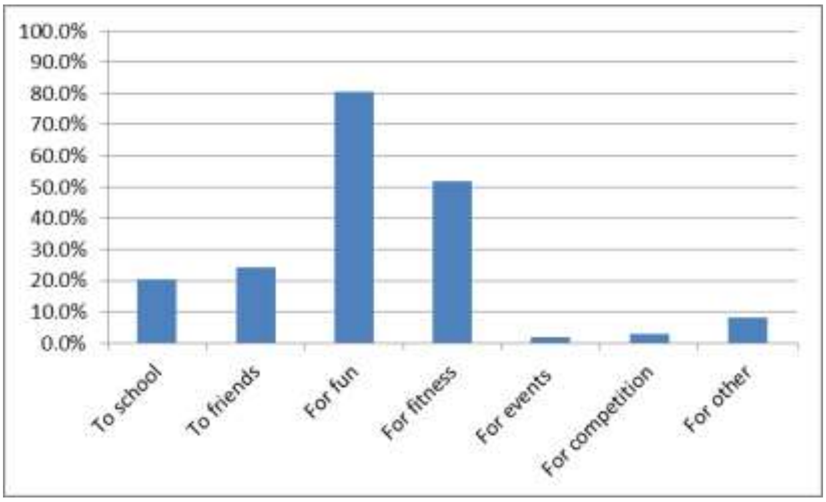

Figure R1: Percentage of Treatment respondents riding a bike for particular purposes at Survey 1

Figure R2 presents the percentage of all Treatment school respondents who reported riding a bike at particular locations at Survey 1. Most respondents reported riding on shared paths. Riding on roads, either with or without bike lanes, was substantially less common. Other locations included at home (e.g. driveway, backyard; n=5), at school, and bike-only paths. Six participants offered a "street", when they did not endorse either of the options mentioning a road, suggesting that they distinguish local streets from larger or busier roads.

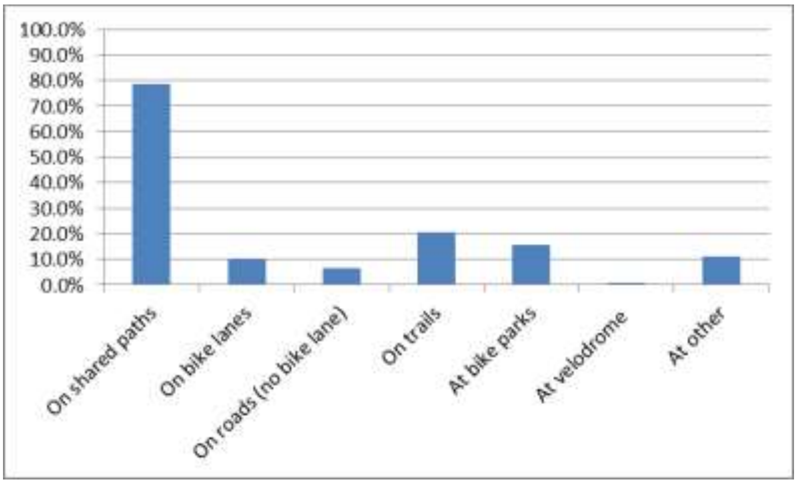

Figure R2: Percentage of Treatment respondents riding a bike at particular locations at Survey 1

4.1.2 Cycling participation

At each survey respondents were asked whether they ride a bike. Only those who answered in the affirmative were asked further questions. Among questions relating to riding purpose, we focussed on riding to school because this is a focus of many policies and initiatives. Among questions relating to riding location we focussed on riding on bike lanes, and on roads without bike lanes (which may reflect riding confidence). For these questions a negative response was assumed if respondents reported not riding a bike. Figure R3 presents the percentage of all Treatment respondents who reported riding a bike, riding a bike to school, riding on bike lanes, and riding on roads without a bike lane at Surveys 1, 2 and 3.

McNemar's test with a binomial distribution was used to determine whether the number of all participants who reported riding a bike increased from Survey 1 (before *Safe Cycle)* to Survey 2 (immediately after *Safe Cycle).* The two-sided p-value was halved for test of this directional hypothesis. The test was repeated to compare Survey 1 to Survey 3 (approximately 3 months after *Safe Cycle).* Parallel tests were conducted to compare the number of all participants who reported riding a bike in particular locations.

The number of participants who reported riding a bike increased significantly from Survey 1 to Survey 2 ($p_{2\text{-tailed}}$=.063), but the increase was no longer significant at Survey 3 ($p_{2\text{-tailed}}$ =.687). The number of participants who reported riding on shared paths, on bike lanes, and on roads without bike lanes each increased significantly from Survey 1 to Survey 3 ($p_{2\text{-tailed}}$ =.057, $p_{2\text{-tailed}}$ =.077, and $p_{2\text{-tailed}}$ =.077, respectively). Increases from Survey 1 to Survey 2 were not significant (lowest $p_{2\text{-tailed}}$ =.146).

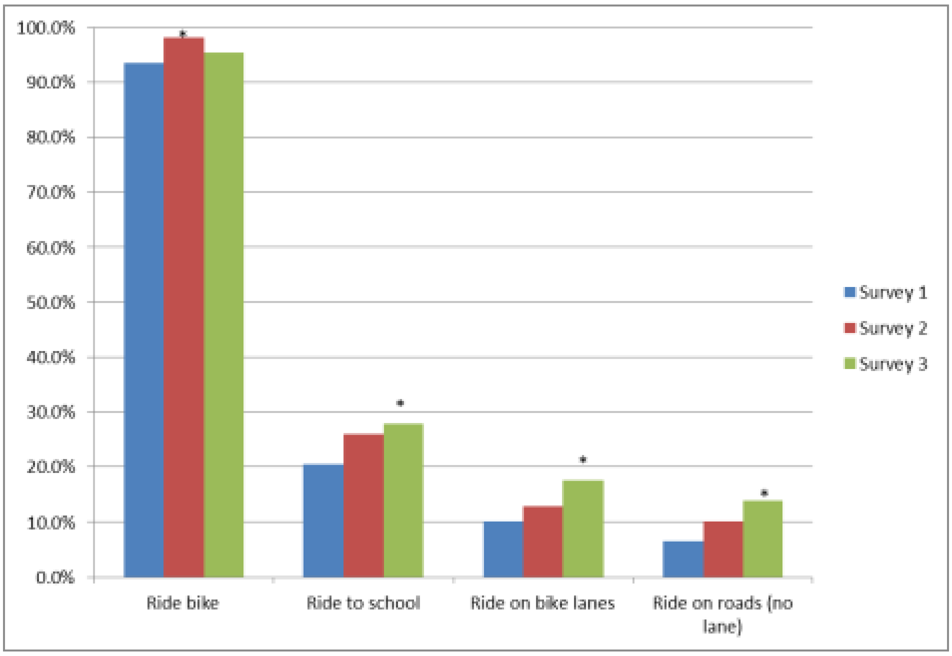

Figure R3: Percentage of respondents who reported riding a bike, riding a bike to school, riding on bike lanes, and riding on roads without a bike lane at Surveys 1, 2, and 3, , showing the results of McNemar's tests comparing Survey 1 with Survey 2, and with Survey 3, separately (* significant with $p_{1\text{-tailed}}$<.05)

Note: Purpose and location questions were asked only of respondents who reported riding a bike, and "no" was inferred for respondents who reported not riding a bike

Figure R4 shows the progression of cycling participation among the seven participants who reported not riding at Survey 1. Six participants took up cycling during the study, although only four were cycling at Study 3.

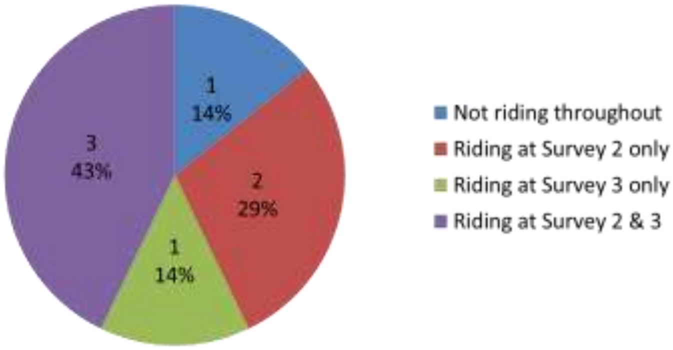

Figure R4: Progression of cycling participation among the 7 respondents who reported not riding at Survey 1

In order to consider whether *Safe Cycle* increased the overall amount of cycling at each Survey participants who reported riding a bike were asked whether they had ridden a bike on roads or paths in the last 2 weeks. Those responding in the affirmative were asked on how many days they had ridden. All other participants were automatically assigned "0 days". Figure R5 presents the mean reported number of days ridden at Surveys 1, 2, and 3 (with S.E bars).

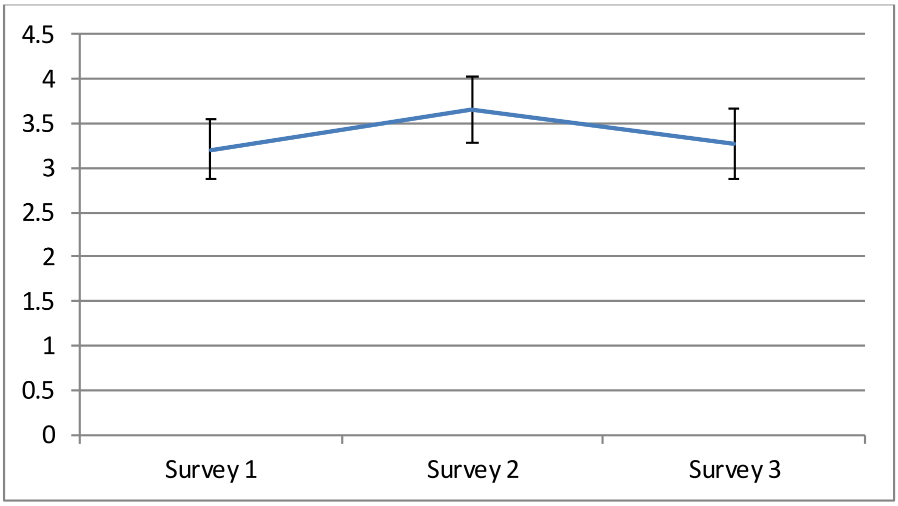

Figure R5: Mean reported number of days riding a bike on roads and paths in the past 2 weeks at Surveys 1, 2, and 3 (with S.E. bars)
Note: Zero was inferred for those who reported not riding a bike, or not riding on roads and paths in the last 2 weeks

Paired-samples t-tests were used to determine whether the mean number of days ridden increased from Survey 1 to Survey 2, and from Survey 1 to Survey 3. The increase observed from Survey 1 (mean=3.24, s.d.= 3.48) to Survey 2 (mean=3.62, s.d.= 3.78) was not-significant (t_{105}=1.15, $p_{2\text{-tailed}}$

=.254), at least in part due to substantial variability in the data. The difference in days ridden from Survey 1 (mean=3.25, s.d.= 3.47) to Survey 3 (mean=3.10, s.d.= 4.00) was in the direction opposite to that predicted and so not significant according to the 1-tailed test employed.

The 103 respondents who reported riding a bike at Survey 3 were asked "Do you think *Safe Cycle* has increased the amount you ride?" Just over half (or 48.1% of the whole sample) felt that it did (see Figure R6).

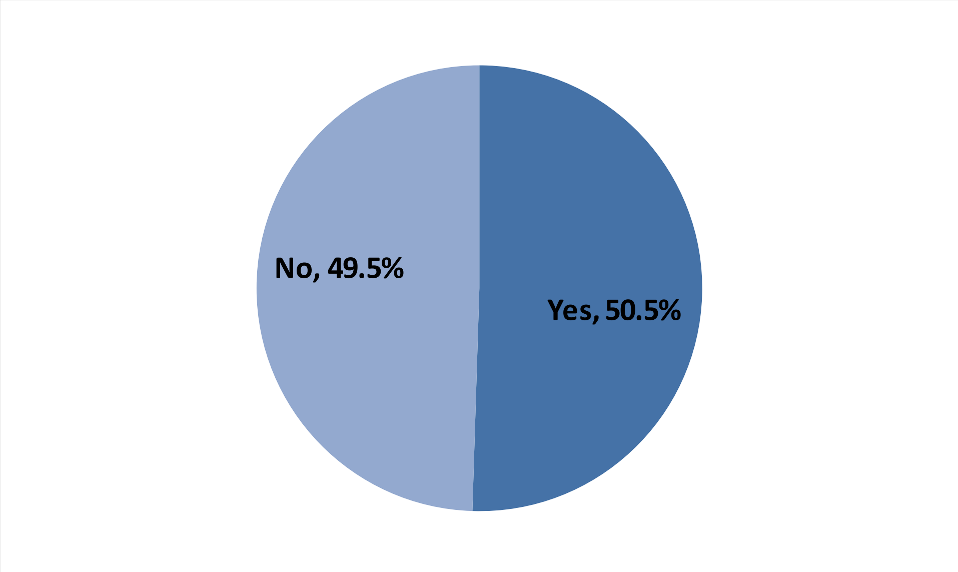

Figure R6: The percentage of respondents who reported riding a bike at Survey 3 (n=103) who gave each response to the question "Do you think *Safe Cycle* has increased the amount you ride?"

4.1.3 Confidence

At each survey the respondents who reported riding a bike were asked about how good they felt they were at seven activities covered by *Safe Cycle* (see Table R3). With the scoring "Not good at all"=0, "OK"=1 and "Very good"=2, each respondent's average Confidence score was computed (with a range of 0-2). When the scale was partially completed the average score was computed across completed items. Figure R7 presents the mean Confidence at Surveys 1, 2, and 3 (with S.E bars).

Paired-samples t-tests were used to determine whether mean Confidence increased from Survey 1 to Survey 2, and from Survey 1 to Survey 3. The increase observed from Survey 1 (mean=1.22, s.d.= 0.41) to Survey 2 (mean=1.31, s.d.= 0.37) was significant (t_{99}=2.35, $p_{2\text{-tailed}}$ =.020). Mean Confidence no longer differed significantly at Survey 3 (mean=1.24, s.d.= 0.41) compared to Survey 1 (for this comparison: mean=1.23, s.d.= 0.41; t_{97}=0.32, $p_{2\text{-tailed}}$ =.749).

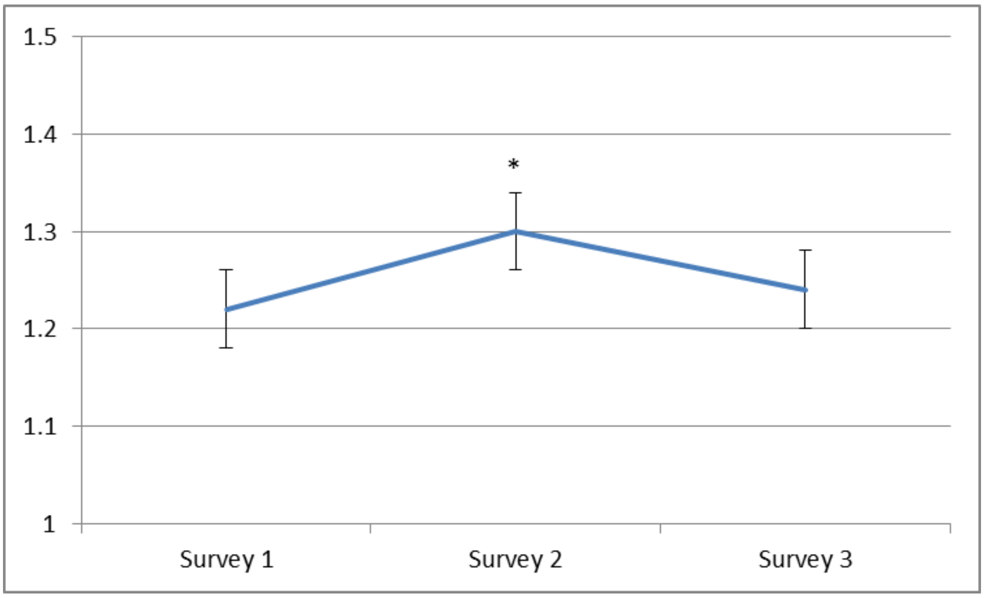

Figure R7: Mean Confidence performing activities at Surveys 1, 2, and 3 (with S.E. bars), showing the results of paired-samples tests comparing Survey 1 with Survey 2, and with Survey 3, separately (* significant with $p_{1\text{-tailed}}<.05$)

Note: Relevant questions were asked of the subsample of bike riders at each Survey

To gain insight into changes in confidence performing particular activities, answers were categorised as "Not good at all" and "OK or Very good". Table R3 presents the percentage of respondents who felt they were "OK or very good" at each practice at each Survey, along with outcomes of McNemar's tests.

A significant increase was observed in the number of respondents who felt good at arm signalling when turning and using a roundabout, at Surveys 2 and 3. Changes in the direction opposite to prediction occurred for fitting a helmet (Surveys 2 and 3) and turning right (Survey 2).

Table R3: Percentage of bike riders "OK or Very good" at activities covered by *Safe Cycle* at Surveys 1, 2, and 3, showing the results of McNemar's tests comparing Survey 1 with Survey 2, and with Survey 3, separately (* significant with $p_{1\text{-tailed}}<.05$)

	Survey 1	*Survey 2*	*Survey 3*
Checking that your bike is safe to ride	91.9%	96.2%	96.1%
Putting your helmet on properly	100.0%	98.1%	96.1%
Looking back over your shoulder when you are riding forwards	92.0%	96.2%	92.1%
Using your arm to signal when you are turning	69.8%	88.6% ($p_{2\text{-tailed}}$ =.003)*	83.3% ($p_{2\text{-tailed}}$ =.017)*
Knowing when to give way to people when you are riding	90.0%	95.2%	93.1%
Doing a right turn in traffic when you are riding	78.8%	76.5%	79.2%
Using a roundabout when you are riding	65.6%	80.6% ($p_{2\text{-tailed}}$ =.029)*	82.4% ($p_{2\text{-tailed}}$ =.013)*

Note for Surveys 2 and 3: Green font indicates a significant increase from Survey 1, Orange font indicates a non-significant increase from Survey 1; Red font indicates a difference in the direction opposite to that predicted and so not significant according to the 1-tailed test employed.

4.1.4 Perceived safety

At each survey the respondents who reported riding a bike were asked about how scared they would feel riding in four locations (see Table R5). With the scoring "Not scared at all"=0, "A bit scared"=1 and "Really scared"=2, each respondent's average Fear score was computed (with a range of 0-2). When the scale was partially completed the average score was computed across completed items. Table R4 presents the mean Fear at Surveys 1, 2, and 3 (with s.d.).

No predictions were made about how *Safe Cycle* would influence mean Fear scores because participants might feel safer because of increased confidence, or less safe because of sensitisation to risks (which are discussed in the program). Thus, two-tailed p-values were used to determine significance in the paired-samples t-tests that were used to examine changes in Fear scores (see Table R4). No significant differences were observed.

Table R4: Mean Fear riding in various locations at Surveys 1, 2, and 3 (with s.d.), showing the results of paired-samples tests comparing Survey 1 with Survey 2, and with Survey 3, separately

Survey 1	*Survey 2*				*Survey 3*			
Mean (s.d.)	Mean (s.d)	t	df	$p_{2\text{-tailed}}$	Mean (s.d.)	t	df	$p_{2\text{-tailed}}$
For comparison with Survey 2: 0.67 (0.41) For comparison with Survey 3: 0.66 (0.40)	0.74 (0.42)	1.47	99	.146	0.72 (0.43)	1.39	97	.168

Note: Relevant questions were asked of the subsample of bike riders at each Survey

To gain insight into changes in feeling scared riding in particular locations, answers were categorised as "Not scared at all" and "A bit scared or Really scared". Table R5 presents the percentage of respondents who reported that they would feel "A bit scared or Really scared" in each location at each Survey, along with outcomes of McNemar's tests. A significantly larger number of respondents reported that they would feel scared riding on a road next to parked cars at Survey 2 compared to Survey 1. No further significant changes were observed.

Table R5: Percentage of bike riders "A bit scared or Really scared" in various locations at Surveys 1, 2, and 3, showing the results of McNemar's tests comparing Survey 1 with Survey 2, and with Survey 3, separately (* significant with $p_{2\text{-tailed}}<.05$)

	Survey 1	*Survey 2*	*Survey 3*
A path that is shared with pedestrians	17.2%	15.4%	19.4%
A busy road in a bike lane	71.4%	82.5%	74.8%%
A busy road without a bike lane	89.0%	89.3%	87.4%
A road next to parked cars	34.7%	45.6% ($p_{2\text{-tailed}}$ =.043)*	46.6%

Note: Non-directional hypothesis tested with two-tailed p-value.

The 103 respondents who reported riding a bike at Survey 3 were asked "Do you think that *Safe Cycle* has made you a safer bike rider?" Around 85% felt that it did (see Figure R8).

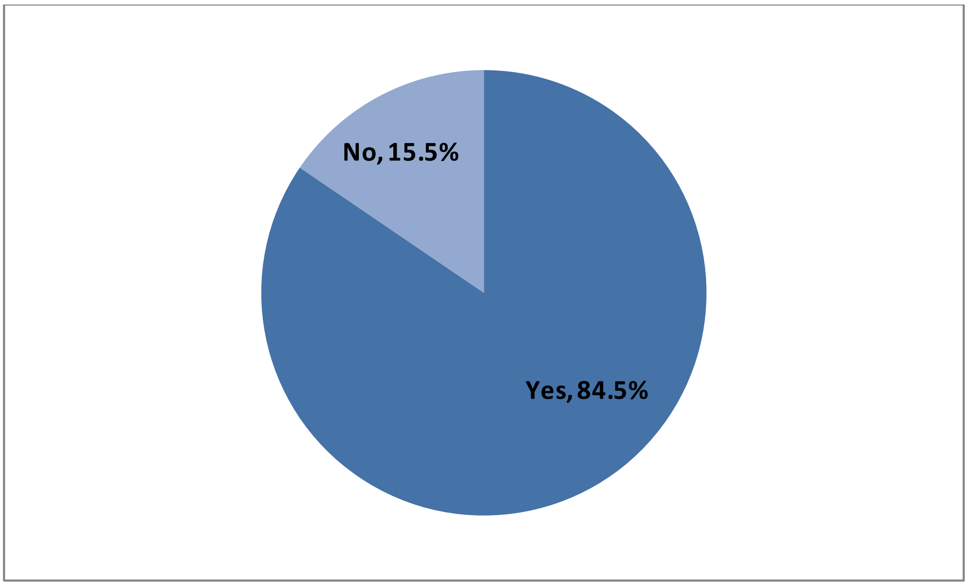

Figure R8: The percentage of respondents who reported riding a bike at Survey 3 (n=103) who gave each response to the question "Do you think *Safe Cycle* has made you a safer bike rider?"

The surveys included questions to specifically assess reductions "imagined safety" (or personal invulnerability), a type of overconfidence that is targeted directly by *Safe Cycle*. Figure R9 presents the percentage of bike riders who reported that they would be "less" likely "to have a bike crash compared to other kids your age" (rather than "about the same" or "more") at Surveys 1, 2 and 3.

At Survey 1, 50% of respondents felt that they would be less likely to have a crash than average (with only 2% reporting that they would be more likely, indicating biased judgement in the sample). This percentage was significantly lower at Survey 2 (26.4%; $p_{2\text{-tailed}}<.001$), but not at Survey 3 (42.7%; $p_{2\text{-tailed}}=.222$).

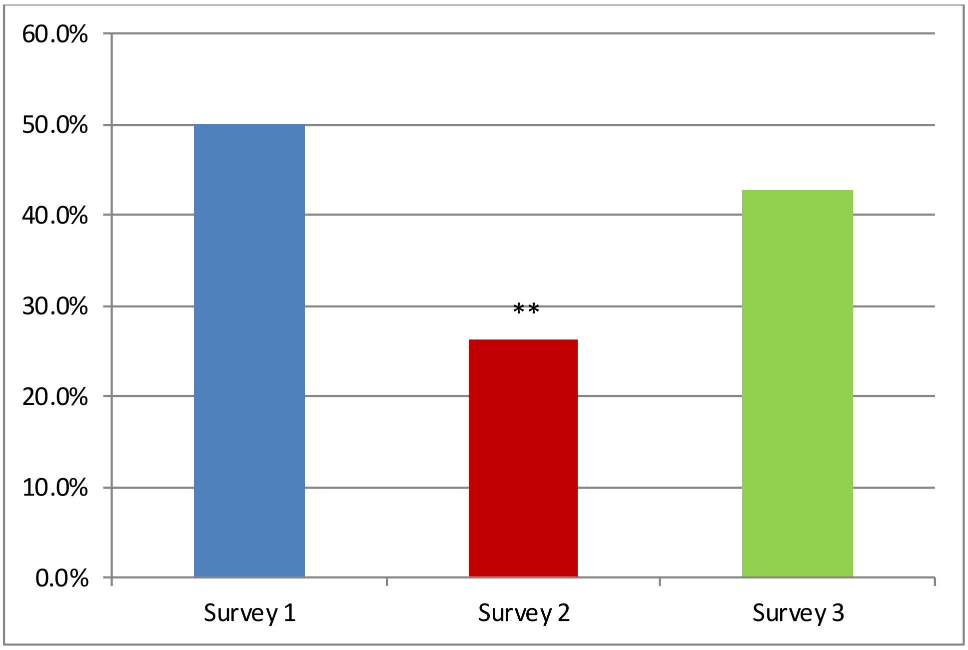

Figure R9: Percentage of bike riders who reported that they were less likely than the average person their age to have a bike crash, at Surveys 1, 2, and 3, showing the results of McNemar's tests comparing Survey 1 with Survey 2, and with Survey 3, separately (significant with $p_{1\text{-tailed}}$<.001)**

4.1.5 Knowledge

At each survey the respondents who reported riding a bike were asked 14 questions to assess their knowledge of information relevant to cycling safety that is covered by *Safe Cycle* (see Table R6). Items were scored as "correct=1" or "incorrect=0". The "average percentage correct" was computed from completed items (including when the scale was partially completed). Figure R10 presents the mean percentage correct at Surveys 1, 2, and 3 (with S.E bars).

Paired-samples t-tests were used to determine whether mean percentage correct increased from Survey 1 to Survey 2, and from Survey 1 to Survey 3. Significant increases were observed from Survey 1 (mean=55.8%, s.d.= 14.2%/14.4%) to Survey 2 (mean=64.3%, s.d.= 13.3%; t_{99}=5.51, $p_{2\text{-tailed}}$ <.001) and to Survey 3 (mean=61.0%, s.d.= 13.3%; t_{96}=3.16, $p_{2\text{-tailed}}$ =.002*).

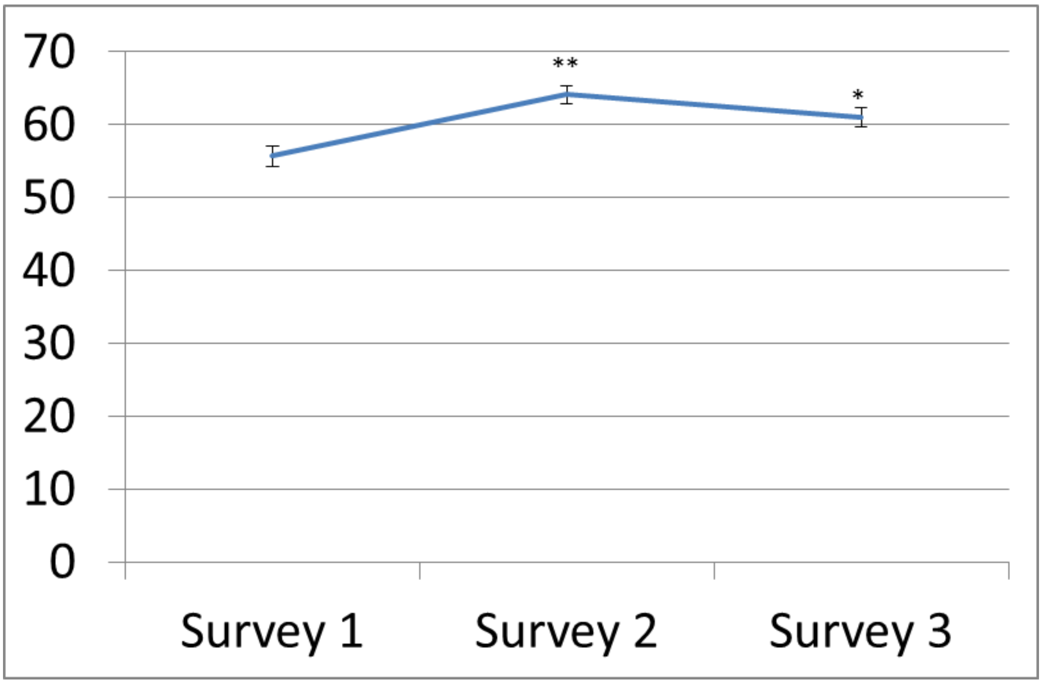

Figure R10: Mean percentage correct for questions about information relevant to cycling safety at Surveys 1, 2, and 3 (with S.E. bars), showing the results of paired-samples tests comparing Survey 1 with Survey 2, and with Survey 3, separately (* significant with $p_{1\text{-tailed}}<.05$; ** significant with $p_{1\text{-tailed}}<.001$)

Note: Relevant questions were asked of the subsample of bike riders at each Survey

To gain insight into changes in knowledge of particular facts, Table R6 presents the percentage of respondents who answered each knowledge question correctly at each Survey, along with outcomes of McNemar's tests.

A significant increase was observed in the number of respondents correct about footpath riding (Surveys 2 and 3), lighting at night (Survey 2), crossings (Survey 3), common collisions (Surveys 2 and 3), response to hazards (Survey 2), rights of way (Surveys 2 and 3), and braking technique (Survey 2). Changes in the direction opposite to prediction occurred for lighting at night (Survey 3), pedestrian use of bike paths (Surveys 2 and 3), warning devices (bells/horns; Survey 3) and "dinking (Survey 3).

Table R6: Percentage of bike riders answering correctly about 14 facts covered by *Safe Cycle* at Surveys 1, 2, and 3, showing the results of McNemar's tests comparing Survey 1 with Survey 2, and with Survey 3, separately (* significant with $p_{1\text{-tailed}}$<.05)

Question and correct response	*Survey 1*	*Survey 2*	*Survey 3*
In the ACT when are you allowed to ride a bike on a footpath? *At any age*	53.0%	82.1% ($p_{2\text{-tailed}}$<.001)**	79.4% ($p_{2\text{-tailed}}$<.001)**
Where does the law say you need to wear a bike helmet in the ACT? *All of the above (path, lane, road)*	91.0%	94.3%	92.2%
When riding a bike on the road are you expected to obey all the road rules? *Yes*	89.0%	91.5%	89.2%
When it is dark (sunset to sunrise) what do you need to have on your bike? *White front light, Red rear light AND Red rear reflector (BUT NOT Yellow wheel reflectors)*	5.0%	13.2% ($p_{2\text{-tailed}}$=.064)*	3.9%
Are pedestrians allowed on bike paths in the ACT? *Yes*	73.0%	66.0%	64.7%
Are you allowed to stay on your bike to cross at children's school crossings and pedestrian crossings in the ACT? *No*	79.0%	84.9%	87.3% ($p_{2\text{-tailed}}$=.064)*
Do bikes need to have a bell or horn in the ACT? *Yes*	77.0%	78.3%	74.5%
In the ACT are you allowed to give someone a dink (i.e. have someone on your bike not on a bike seat)? *No*	84.0%	86.8%	82.4%
In most collisions between a bike and a car in the ACT… *The car hits the back of the bike because the driver didn't see the bike*	35.0%	53.3% ($p_{2\text{-tailed}}$=.016)*	50.0% ($p_{2\text{-tailed}}$=.020)*
What should you check before riding your bike (from the ABC Tight test)? *Tyres in good condition, rear brake working, chain oiled*	43.0%	43.4%	48.0%
How should your helmet fit? *Snug and not wobble*	41.0%	45.3%	46.1%
Which of the following is NOT one of the recommended behaviours for reducing the risk of a crash in the picture above? *Ring bell*	21.0%	32.1% ($p_{2\text{-tailed}}$=.043)*	21.6%
Who can go first in the picture above? *The bike*	57.0%	77.4% ($p_{2\text{-tailed}}$=.002)*	71.6% ($p_{2\text{-tailed}}$=.014)*
What is the BEST technique for emergency braking on a large bike? *Just apply rear brake*	33.0%	48.1% (p=.006)*	43.1%

Note for Surveys 2 and 3: Green font indicates a significant increase from Survey 1, Orange font indicates a non-significant increase from Survey 1; Red font indicates a difference in the direction opposite to that predicted and so not significant according to the 1-tailed test employed.

At Survey 2, 107 respondents answered the question "Did you learn anything new from *Safe Cycle*?" 86.0% felt that they learned something new, including 15.9% who felt they learned "a lot" (see Figure R11).

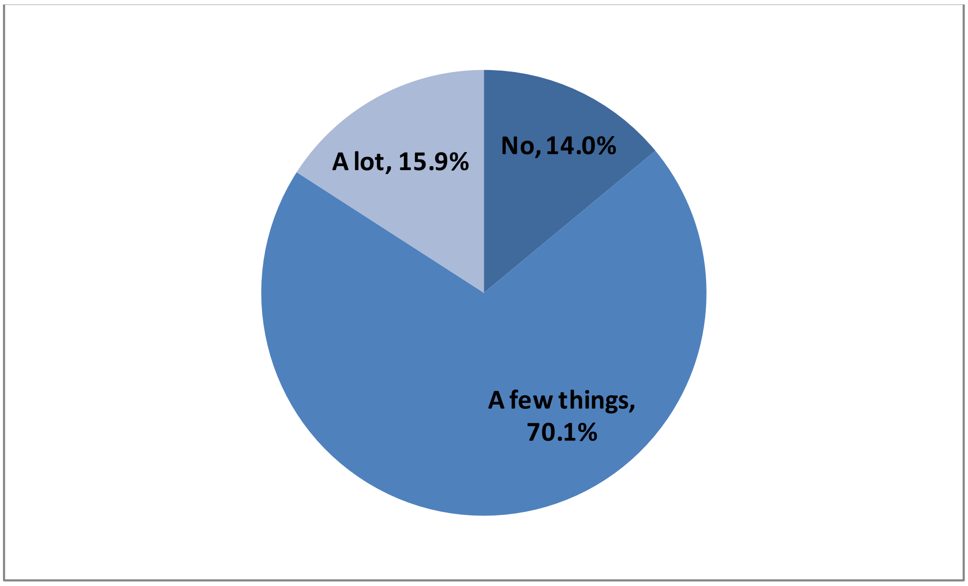

Figure R11: The percentage of respondents at Survey 2 (n=107) who gave each response to the question "Did you learn anything new from *Safe Cycle*?"

Fifty participants indicated "the most important thing" that they learnt. Table R7 presents the number of respondents indicating various aspects of *Safe Cycle* for all aspects that were mentioned by more than two respondents.

Table R7: Number of respondents indicating various aspects of *Safe* Cycle as "the most important thing" that they learned at Survey 2 (n=50)

Aspect	*Number of respondents*
Road rules	14
Hand signals	11
Shoulder checks	8
"Riding safely"	6
Braking	4
Other aspects of speed control	4
Bike safety check	3

4.1.6 Riding behaviour

Respondents who reported riding a bike on roads or paths in the last 2 weeks were asked how often they performed each of seven safety behaviours (see Table R9) and seven risky behaviours (see Table R10) while doing so. With the scoring "Never"=0, "Sometimes"=1 and "Always"=2, an average

Safety Behaviour score and an average Risky Behaviour score was computed (each with a range of 0-2) across all completed items. Table R8 presents the mean Safety Behaviour and mean Risky Behaviour scores at Surveys 1, 2, and 3 (with s.d.).

Paired-samples t-tests were used to examine changes in Safety Behaviour, and Risky Behaviour, from Survey 1 to Survey 2, and from Survey 1 to Survey 3. Hypotheses were non-directional because effects of the *Safe Cycle* on safety motivation are difficult to predict. There were no significant changes in self-reported safety-relevant behaviour when riding on paths or roads in the last 2 weeks (lowest $p_{2\text{-tailed}}$=.406)

Table R8: Mean Safety Behaviour and Risky Behaviour when riding "on roads or paths in the last 2 weeks" at Surveys 1, 2, and 3 (with s.d.), showing the results of paired-samples tests comparing Survey 1 with Survey 2, and with Survey 3, separately

Variable	*Survey 1*	*Survey 2*				*Survey 3*			
	Mean (s.d.)	Mean (s.d.)	t	df	$p_{2\text{-tailed}}$	Mean (s.d.)	t	df	$p_{2\text{-tailed}}$
Safety behaviour	For comparison with Survey 2: 1.43 (0.38) For comparison with Survey 3: 1.39 (0.39)	1.43 (0.39)	-0.02	60	.987	1.35 (0.36)	- 0.84	51	.406
Risky behaviour	For comparison with Survey 2: 0.31 (0.36) For comparison with Survey 3: 0.32 (0.36)	0.31 (0.28)	-0.20	60	.841	0.31 (0.37)	- 0.30	51	.766

Note: Relevant questions were asked of the subsample of bike riders who reported riding on roads or paths in the previous two weeks at each Survey

To gain insight into changes in particular safety behaviours, answers were categorised as "Always" and "Never or Sometimes". Table R9 presents the percentage of respondents who reported that they "Always" performed each safety behaviour at each Survey. McNemar's tests showed no significant changes.

Table 9: Percentage of respondents reporting "Always" conducting safety behaviours when riding "on roads or paths in the last 2 weeks" at Surveys 1, 2, & 3, showing the results of McNemar's tests comparing Survey 1 with Survey 2, and with Survey 3, separately

	Survey 1	*Survey 2*	*Survey 3*
Perform a bike safety check?	36.4%	43.6%	34.4%
Wear a helmet?	85.7%	88.3%	85.2%
Consider other people around you?	78.9%	64.5%	73.3%
Do a shoulder check when changing lanes?	54.1%	48.6%	41.0%
Signal when changing lanes?	29.6%	30.3%	25.0%
Signal when turning left?	24.7%	25.0%	21.3%
Actively look out for hazards?	62.7%	48.7%	47.5%

To gain insight into changes in particular risky behaviours, answers were categorised as "Never" and "Sometimes or Always". Table R10 presents the percentage of respondents who reported that they "Never" performed each risky behaviour at each Survey. Again, McNemar's tests showed no significant changes.

Table R10: Percentage of respondents reporting "Never" conducting risky behaviours when riding "on roads or paths in the last 2 weeks" at Surveys 1, 2, & 3, showing the results of McNemar's tests comparing Survey 1 with Survey 2, and with Survey 3, separately

	Survey 1	*Survey 2*	*Survey 3*
Ride through red traffic lights?	92.2%	91.0%	88.3%
Ride through a stop sign?	77.6%	76.3%	75.4%
Wear open shoes?	66.7%	64.0%	67.2%
Ride across a pedestrian crossing (e.g. zebra crossing, traffic light crossing)?	35.5%	38.5%	40.0%
Ride against the traffic on a one way street without a bike lane?	79.7%	73.7%	71.7%
Listen to something with headphones?	69.3%	67.1%	72.1%
Talk on a mobile phone (with or without hands free)?	89.3%	83.6%	86.7%

4.1.7 Self-reported crashes and near-misses

Of the 101 Survey 1 respondents who reported riding a bike, 41 (40.6%) reported having experienced a crash or near-miss on paths or roads in the last six months (although 4 subsequently reported locations besides paths and roads). One bike rider did not answer the question. Thirty-eight respondents reported having experienced at least one crash (see Table R11) and twenty-four reported having experienced at least one near-miss (see Table R12).

At Survey 3 bike riders were asked about crashes and near-misses in the last three months – to correspond to the period since completing *Safe Cycle*. Of the 103 Survey 3 respondents who reported riding a bike, 27 (26.2%) reported having experienced a crash or near-miss on paths or roads in the last three months (although 7 subsequently reported locations besides paths and roads, mostly trails or parks). Twenty-one respondents reported having experienced at least one crash and seventeen reported having experienced at least one near-miss. The reported number of crashes in three months was doubled to provide an estimated number of crashes in six months (see Tables R11 and R12).

Table R11: Number and percentage of bike riders experiencing each number of reported crashes on paths or roads in the last six months at Surveys 1, and each estimated number of crashes on paths or roads in the last six months at Survey 3[a]

Number of crashes	*Survey 1*		*Survey 3*	
	Number of respondents	*Percentage of bike riders (n=101)*	*Number of respondents*	*Percentage of bike riders (n=103)*
1	8	7.9%	0	0.0%
2	6	5.9%	5	4.9%
3	9	8.9%	0	0.0%
4 or more (max=33)	15	14.9%	16 (max=26)	15.5%

[a] For Survey 3 computed from the number of near-misses in the last three months (doubled).

Table R12: Number and percentage of bike riders experiencing each number of reported near-misses on paths or roads in the last six months at Surveys 1, and each estimated number of near-misses on paths or roads in the last six months at Survey 3[a]

Number of near-misses	*Survey 1*		*Survey 3*	
	Number of respondents	*Percentage of bike riders (n=101)*	*Number of respondents*	*Percentage of bike riders (n=103)*
1	9	8.9%	0	0.0%
2	6	5.9%	3	5.8%
3	3	3.0%	0	0.0%
4 or more (max=24)	6	5.9%	14 (max=40)	13.6%

[a] For Survey 3 computed from the number of near-misses in the last three months (doubled).

Comparison of Survey 1 with Survey 3 crash experience should be considered with caution- because of the difference in time-frame used. There is likely to be less error in the comparison of whether or not a crash (or near-miss) was experienced than in comparison of crash numbers. Further, while exposure should be included as an offset in analyses, the reported number of days ridden in the past two weeks is a very gross estimate of exposure during the time period for which crashes were reported.

Amongst respondents who reported riding a bike both at Survey 1 and Survey 3 (necessarily) McNemar's tests indicated a significant decrease in the number of respondents who reported a crash ($p_{2\text{-tailed}}$=.004), but no significant change in near-misses ($p_{2\text{-tailed}}$=.210). This analysis does not allow for exposure offset.

Table R13 presents the results of repeated-measures ANOVAs that compared the reported number of crashes and near-misses on paths or roads in the last six months at Survey 1 with the estimated number of crashes and near-misses on paths or roads in the last six months at Survey 3, both with and without offset for hours riding on paths or roads in the past 2 weeks at each survey. A non-directional hypothesis was tested. No significant differences were observed. However, a near-significant increase in near-misses at Survey 3 was no longer near-significant with offset for exposure.

Table R13 Mean reported number of crashes and near-misses on paths or roads in the last six months and mean estimated number of crashes and near-misses on paths or roads in the last six months at Survey 3, showing the results of repeated-measures ANOVAs comparing Survey 1 with Survey 3 with and without offset for hours riding on paths or roads in the past 2 weeks at each survey.

Variable	*Survey 1*	*Survey 3*	*Without exposure offset*			*With exposure offset*		
	Mean (s.d.)	Mean (s.d.)	F	df	$p_{2\text{-tailed}}$	F	df	$p_{2\text{-tailed}}$
Number of crashes in the last six months	1.91 (4.34)	1.96 (5.01)	0.01	1, 95	.921	0.02	1, 93	.921
Number of near-misses in the past six months	0.81 (2.77)	1.85 (6.53)	2.95	1, 95	.089	0.86	1, 93	.356

Note: For Survey 3 estimated from reports about three months (i.e. doubled).

4.1.8 Additional process results

At Survey 2 immediately after completing *Safe Cycle*, 107 respondents answered the question "Did you find the program engaging and fun?" All respondents answered in the affirmative, including 60.7% who found *Safe Cycle* very engaging and fun (see Figure R12).

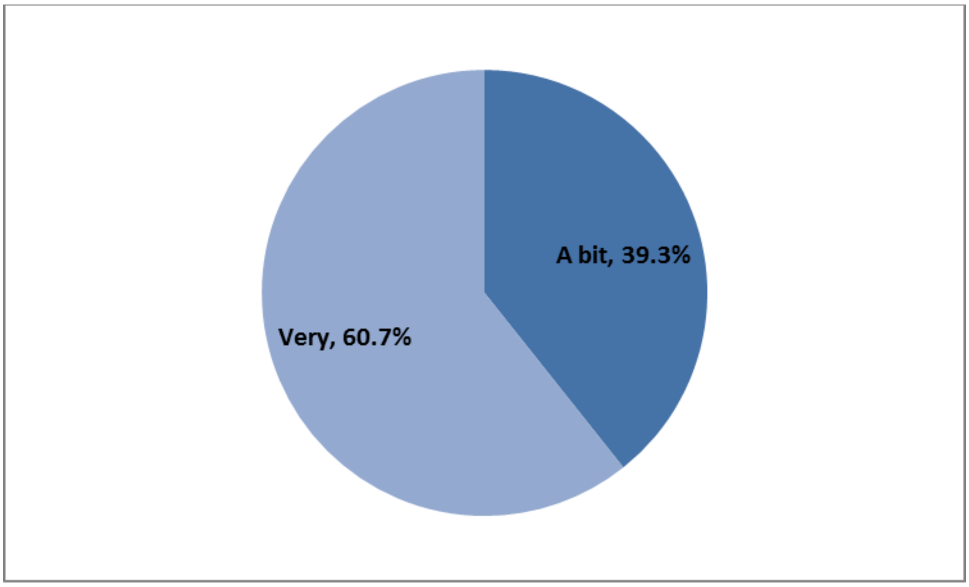

Figure R12: The percentage of respondents at Survey 2 (n=107) who gave each response to the question "Did you find the program engaging and fun?"

Table R14 presents the percentage of respondents finding particular aspects of the program the "most useful" and "least useful", with respondents able to provide more than one response.

Table R14: Percentage of respondents at Survey 2 (n=107) endorsing particular program components the "most useful" and the "least useful" (where respondents could provide more than one response).

Program component	*Percentage endorsing as "most useful"*	*Percentage endorsing as "least useful"*
Bike riding session learning how to look back over your shoulder when riding forward	45.8%	6.5%
Bike riding session learning how to do hand signals	45.8%	5.6%
Bike riding session learning how to do an emergency brake	43.0%	7.5%
Bike riding session learning how to control your speed	41.1%	10.3%
Bike riding session learning how to swerve around plastic cones	39.3%	18.7%
Learning about road rules	39.3%	7.5%
Bike riding session learning how to ride safely when close to other cyclists	37.4%	6.5%
PowerPoint shown by the teacher	29.0%	29.9%
Group work and class discussions	25.2%	29.9%
Telling stories about your accidents or near-misses	24.3%	34.6%
Other	9.3%	10.3%

Generally, participants appeared to find the bike riding sessions more useful that the classroom sessions. Nonetheless, learning about road rules was found "most useful" by nearly 4 in 10 respondents. In the bike riding sessions, "learning to look back over your shoulder" and "learning how to do hand signals" were endorsed as "most useful" by most respondents (45.8% each).

Among 10 respondents who reported finding "something else" the most useful, three mentioned riding on hills. Among 11 respondents who reported finding "something else" the least useful, two indicated that everything was useful, one mentioned learning things they already knew, and one suggested that the introduction to the program was too long.

4.2 Teacher interviews

4.2.1 Understanding of *Safe Cycle* objectives

The interviewed teachers generally expressed the view that *Safe Cycle* aims to teach children who can already ride a "higher level" skills and abilities that are important for cycling safely. Particular skills mentioned were hazard awareness, risk management, self-awareness and behavioural control. Nonetheless, practicing basic riding skills in a formal environment was also mentioned by all teachers. Learning road rules was mentioned by two teachers. Introducing children to the road environment, which is new for many of them, was mentioned by two teachers. Increasing confidence and cycling participation (including riding to school) was seen as an important outcome by all teachers.

4.2.2 Training and delivery

Safe Cycle was taught by two teachers at one participating schools, and by a single teacher at the three remaining schools (because of the evaluation at one of these).

All teachers delivering the program had participated in a *Safe Cycle* orientation session and received the program resources. All teachers had experience teaching other cycling programs, and/or received training relating to the teaching of cycling programs. Interviewed teachers were very positive about the training and resources. Two highlighted that the resources facilitated handover of teaching responsibilities. There was some sense that additional training could be useful, particularly for teachers with limited cycling background. One teacher stressed the usefulness of training relating to managing groups of bike riders, and to cycling games. Another mentioned having participated in a bike maintenance course.

The program was generally delivered as intended. Due to time restrictions, no schools did the cross-curricular extension activities. Three teachers mentioned compressing the theory sessions, while one mentioned reducing or adapting material relating to roads, and adding some "skills" activities to engage more experienced riders.

4.2.3 Student response

Students were uniformly described as responding positively to the program. Specific descriptors were "engaged" and "excited". One teacher of Year 7/8 students highlighted that the students generally found the program relevant at a time when they are beginning to have an interest in taking risk, and in transport that is independent of parents.

There was a consistent theme that students preferred the practical sessions. Nonetheless, teachers stressed that students could understand the value of the theoretical sessions, and generally found the content interesting and relevant. One teacher of Year 5/6 students felt that the program was designed well to achieve a link between the theoretical and practical components, and encouraged teaching techniques to highlight this link. He suggested:

The practical stuff is where we hook them and the theoretical stuff is where we teach them.

4.2.4 Strengths

Teachers were generally extremely positive about the program, and identified that their school planned to continue with it. Specific outcomes that teachers reported observing were:

1. Non-riders learning to ride
2. More children riding to school
3. Children signalling turns more
4. Children taking more care of their helmets
5. Parents buying children helmets that meet the Australian Standard
6. Children using the language of risk management (Year 7/8)

The focus of the program on developing risk awareness and self-awareness was felt to be a particular strength.

Program elements that were highlighted as working particularly well were:

1. telling stories about personal crash experiences and discussing ways in which they could have been avoided
2. risk perception videos
3. "imagined safety" presentation
4. identifying local hazards

One teacher of Year 7/8 students spoke of Safe Cycle offering a tool for opening discussions about the value of risk in the context of appropriate controls, in the area of cycling safety, but also more generally. He spoke about the emergency braking session as providing an opportunity to practice controlling risk, and challenging the overconfidence of some students.

4.2.5 Challenges and improvements

The interviewed teachers mentioned a few challenges, along with existing or suggested solutions.

Not all students could ride a bike, as assumed by the program – particularly among younger age groups, and culturally diverse students. Moreover, riding experience, ability and confidence differed across students. At all schools this was managed by dividing students into groups with different skill levels, and adapting the program to the groups. At two schools, this was facilitated by there being sufficient support staff. For the other schools this was more challenging. One of these schools used "student leaders" to manage different groups. For younger age groups more emphasis on basic riding skills may be required. Where *Safe Cycle* is delivered to older students, delivery of a basic riding skills program at an earlier age may be beneficial.

A specific issue was mentioned in relation to experienced, overconfident, male riders being disengaged with the program, and behaving recklessly with the bikes. Strategies for dealing with this were starting the program with a clear overview and rationale, and using activities to keep these students interested while challenging their overconfidence in a relatively safe environment (e.g. emergency braking).

Three schools adopted strategies to engage students with theoretical contents. These included compressing theoretical sessions, and highlighting the relevance of theoretical materials. A lower proportion of theoretical content may be appropriate, particularly for younger students.

Two teachers of Year 5/6 students identified challenges involved with practical activities off school grounds. Both mentioned the onerous paperwork involved with taking children away from the school, while clearly acknowledging the value of the relevant activities. One mentioned a lack of confidence in managing the group and knowing what to do in the event of a crash. Specific training may assist with this. Another indicated that many parents would not allow children to ride on roads (while footpaths were acceptable), and had reduced the "road-relatedness" of some *Safe Cycle* content.

At schools that did not have sufficient bikes for all students this was found to be a real challenge, while schools that did have sufficient bikes stressed the value of this. One teacher went further to explain the value of having sufficient bikes at the school rather than relying on students to bring their own, or to have bikes in good enough condition to pass the safety check that is a precondition for *Safe Cycle* practical sessions. At one school with only 18 bikes classes were split to allow each student to have a bike for the *Safe Cycle* sessions, but this increased the time pressure for getting through all of the program content.

Choice of bike-type was raised as another issue. One teacher found it a challenge to teach some aspects of the program (e.g. braking) with a fleet comprised half of BMXs and half of MTBs because of differences between these bike types. This teacher also described difficulties with persuading students to use a type of bike that they had not used before (when there was not enough of the other type). Another teacher mentioned that while small mountain bikes (MTBs) were best for teaching non-riders, boys were excited to ride BMXs and this helped to engage them with the program.

Other issues relating to equipment were initial hassles with obtaining all of the bikes and the tools required to maintain them. Maintaining a large fleet of bikes was acknowledged as a challenge, and the value of having systems in place (e.g. relationship with a bicycle shop/workshop) was highlighted.

One teacher highlighted the importance of a "whole school" approach to the success and sustainability of the program. Commitment from the school community (executive staff, teachers, parents, students), opportunities to share with staff not involved in teaching the program (e.g. at staff meetings) and links with other school programs (e.g. environment education) were identified as key elements of this approach. A teacher from another school expressed his confidence that the program would continue by describing how it was embedded in the school culture.

Finally one teacher of Year 5/6 students spoke about the need for techniques to help children to retain knowledge. In particular he encouraged repetition/revision of course contents; across lessons, school terms or school years.

4.3 Naturalistic observation

4.3.1 Sample profile

At each of the four schools involved in the naturalistic observation one participant was female and two were male (N=12). Participants rode the research bike on between 1 and 9 days (mean=4.42; s.d.=2.58). Table R15 provides descriptive data for the footage provided by participants. The treatment group provided significantly more riding footage than the control group ($t_{5.58}$=2.69, $p_{2\text{-tailed}}$=.039).

All participants rode on footpaths (which are treated as shared paths in the ACT). While all participants road on a road (including for crossings), only 11 rode along a road for a stretch of more than one minute duration at least once. Two participants from each group (n=4) always rode with their parents.

Table R15: Descriptive data for the footage provided by participants

	Mean	*Std. Deviation*	*Minimum*	*Maximum*
Total time of footage from front-facing camera	2:41:07	2:04:21	0:39:47	6:05:02
Total time of footage from face-facing camera	2:49:04	1:58:21	0:44:30	6:05:02
Total time of footage while riding	1:58:10	1:40:25	0:20:60	5:31:37

4.3.2 Safety-relevant behaviour

For the ten practical riding skills shown in Table R16 participants were recorded as having demonstrated, or not demonstrated, the skill when they had a relevant opportunity. For example, if a participant made a turn, they were either recorded as having signalled the turn or not having signalled the turn. Using this data, the percentage of skill demonstration across relevant opportunities was computed for each skill, for each participant. Only participants who encountered relevant opportunities could be included in analyses using the "percentage of skill demonstration" indices.

A further six safety-relevant behaviours were assessed across the whole ride (those listed Table R17, and riding with at least one hand removed from the handle bars when not signalling).

Five participants' faces were not visible for at least some of their footage – because of the participant standing while riding and/or camera adjustment. For two participants there was some misalignment of front camera and face camera footage, making coding of face camera footage difficult. Thus, the face camera results should be treated with some caution.

Table R16 shows for each of ten skills[1] the number of participants from the Treatment and Control groups for whom at least one opportunity occurred, and across these participants the mean percentage of opportunities for which the skill was demonstrated. Results from independent samples t-tests comparing the treatment and control groups are also shown in Table R16.

[1] No participant rode through a roundabout and so relevant behaviours (lane position when entering and hand signalling on exit) were not observed. Similarly, because no participant encountered an obstacle on a road (effective) swerving behaviour could not be observed.

Table R16: For ten practical riding skills the number of participants from the Treatment and Control groups for whom at least one opportunity occurred, and across these participants the mean percentage of opportunities for which the skill was demonstrated (with s.d.), with independent samples t-tests comparing the Treatment with Control group (shading: unreliable test).

Practical Riding Skills	*Opportunity to demonstrate (or not demonstrate) the skill*	*Number of Ps with opportunity (i.e. included in analyses)* Treatment	Control	*Mean % of opportunities on which skill demonstrated (s.d.)* Treatment	Control	*t*	*df*	$p_{2\text{-tailed}}$
Maintained gap of around 10m	Riding straight ahead with another cyclist in front	5	1	28.1% (27.1%)	100.0%	N/A	N/A	N/A
Slowed	Approached pedestrians (incl. scooters) [a]	6	6	17.1% (9.2%)	36.0% (37.2%)	-1.21	10	.255
Maintained 1m envelope	Passed another cyclist or pedestrian [a]	6	6	48.8% (18.9%)	40.1% (28.1%)	0.63	10	.545
Slows	Approached potential hazard (e.g. blind corner, parked cars)	6	6	27.9% (12.6%)	31.8% (40.5%)	-0.22	5.96	.831
Conducted rear head checks before merging	Changed lane on a path or road (including path to/from road)	4	6	7.1% (14.3%)	17.5% (32.2%)	-0.60	8	.568
Looked in multiple directions before entering the intersection (including to turn)	Arrived at intersection (on path or road) [b] without traffic signals	6	6	66.0% (32.9%)	44.0% (34.9%)	1.12	10	.287
Gave way as required	Arrived at intersection (on path or road) without traffic signals and traffic present	6	5	100.0% (0.0%)	90.0% (14.9%)	1.50	4.00	.208
Stopped	Arrived at an intersection with a red traffic signal	2	1	100.0% (0.0%)	100.0%	N/A	N/A	N/A
Made hand signals	Turned	6	6	0.5% (0.8%)	0.0% (0.0%)	1.51	5.00	.191
Responded to sudden changes in riding conditions to avoid a crash	Arrived at e.g. unexpected uneven surface, or unexpected interaction with another path/road user	6	5	100.0% (0.0%)	99.5% (1.1%)	1.00	4.00	.374

[a] Interactions with accompanying family or friends were not recorded; [b] Includes any X-intersection, and any T-intersection where the cyclist is on the non-continuing road/path.
Coded as no only if the cyclist would have an insufficient view without moving their head.
N/A Test not performed because at least one group too small

Table R17: For ten practical riding skills the number of participants from the Treatment and Control groups for whom at least one opportunity occurred, and the percentage of these participants who always performed the skill, with Fisher's exact tests comparing the Treatment with Control group

Practical Riding Skills	*Opportunity*	*Treatment*		*Control*		$p_{2\text{-tailed}}$
		Number of participants with opportunity	*% always demonstrating*	*Number of participants with opportunity*	*% always demonstrating*	
Maintained gap of around 10m	Riding straight ahead with another cyclist in front	5	0.0%	1	100.0%	.167
Slowed	Approached pedestrians (incl. scooters)	6	0.0%	6	16.7%	1.00
Maintained 1m envelope	Passed another cyclist or pedestrian	6	0.0%	6	0.0%	N/A
Slows	Approached potential hazard (e.g. blind corner, parked cars)	6	0.0%	6	16.7%	1.00
Conducted rear head checks before merging	Changed lane on a path or road (including path to/from road)	4	0.0%	6	0.0%	N/A
Looked in multiple directions before entering the intersection (including to turn)	Arrived at intersection (on path or road) [a] without traffic signals	6	33.3%	6	0.0%	.455
Gave way as required	Arrived at intersection (on path or road) without traffic signals and traffic present	6	100.0%	5	60.0%	.182
Stopped	Arrived at an intersection with a red traffic signal	2	100.0%	1	100.0%	N/A
Made hand signals	Turned	6	0.0%	6	0.0%	N/A
Responded to sudden changes in riding conditions to avoid a crash	Arrived at e.g. unexpected uneven surface, or unexpected interaction with another path/road user	6	100.0%	5	80.0%	.455

[a] Includes any X-intersection, and any T-intersection where the cyclist is on the non-continuing road/path. Coded as no only if the cyclist would have an insufficient view without moving their head.

N/A Test not performed because both groups evidently equal

No significant effects were observed. Only 2 tests (not shaded in Table R17) could be considered reliable because others involved either inflated variance, or no variance.

As an alternative approach to analysis participants who had an opportunity to demonstrate each practical skill were coded as always having demonstrated the skill or not, and the groups were compared using Fisher's exact tests (see Table R17). Again, no significant effects were observed.

Table R18 shows the percentage of participants from the Treatment and Control groups demonstrating each of five safety-relevant behaviours throughout their ride. Results from Fisher's exact tests comparing the Treatment and Control groups are also shown in Table R18.

No significant effect was observed. Nonetheless only participants in the Treatment group sometimes failed to maintain spatial awareness, or demonstrated high-risk riding behaviour. Specifically:

- One male treatment participant rode in the middle of the road.
- One male treatment participant talked or looked around unnecessarily while riding
- One female treatment participant engaged in high risk behaviours in five separate instances:
    - Riding without hands (resulting in a near-miss)
    - Riding while carrying a ball in one hand, and playing with the ball
    - Jumps and jumping down stairs

Table R18: Number of participants from the Treatment group (n=6) and Control group (n=6) demonstrating four practical riding skills, and performing high risk behaviour, across the whole ride, with Fisher's exact tests comparing the Treatment with Control group

	Treatment	*Control*	$p_{2\text{-tailed}}$
Braked safely throughout (i.e. no need for sudden braking)	66.7%	83.3%	1.00
Controlled bicycle well when travelling straight (i.e. no wobbles)	100.0%	100.0%	N/A
Controlled bicycle well when turning (i.e. no wobbles)	100.0%	100.0%	N/A
Maintained spatial awareness throughout (i.e. looked only where needed for riding task)	16.7%	100.0%	1.00
Demonstrated high risk behaviour	50.0%	0.0%	.182

N/A Test not performed because both groups evidently equal

There was no difference in frequency of removing one or both hands from handle bars (other than to signal) between the Treatment group (mean=51.33; s.d.=38.33) and the Control group (mean=27.83 ; s.d.=29.80; t_{10}=1.19, $p_{2\text{-tailed}}$=.263).

5. Discussion

The results of the present evaluation provide some evidence that *Safe Cycle* increased participation in cycling, confidence in performing cycling skills, and knowledge relevant to cycling safety (including road rules. While the program appeared to address overconfidence effectively, there was a slight suggestion that students who participated in the program may ride in a more risky manner. The program was well-received by students and teachers alike, and results suggest strategies for optimising the beneficial effects of *Safe Cycle.*

5.1 Cycling participation

Before the delivery of *Safe Cycle* bike ridership was fairly high, with 93.5% of respondents at Treatment schools and 85.7% of respondents from Control schools reporting already riding a bicycle. Because only seven respondents at Treatment schools did not ride a bicycle there was limited scope for *Safe Cycle* to convert non-riders into riders. Nonetheless, the number of riders had increased significantly by the end of the program, there being five new riders at Survey 2. By three months after the program one additional respondent reported having taken up riding, but some respondents no longer reported that they ride a bike, so that bike ridership at Survey 3 did not differ significantly from bike ridership at Survey 1. With no clear reason for students to stop cycling it is possible that some respondents falsely reported that they did not cycle in order to skip to the end of the questionnaire (a tendency that would arguably have been strongest by Survey 3 when the questionnaire was already familiar to them).

Among participants who reported riding a bike (and so free of motivation to skip to the end of the questionnaire) there was an upward trend in riding to school, which was significant by three months after the program. This is a particularly important outcome because encouraging riding to school is a central focus of the *Ride or Walk* to school program of which *Safe Cycle* is a component. The same pattern was observed for reported riding in road environments, which may be particularly indicative of increased confidence (Garrard Crawford, & Hakman, 2006; Daley, Rissel, & Lloyd, 2007). While there was no significant effect on the number of days ridden per week large variance in the data made analyses unreliable.

Without a Control group included in analyses (see Limitations), it is difficult to attribute observed changes in participation to *Safe Cycle*. It is possible that some children would have taken up cycling, cycling to school, or cycling in road environments, during the course of the year regardless of the program (e.g. as a part of their development). Indeed the pattern of results for riding to school and riding in road environments may seem consistent with such an account. Nonetheless, it is highly likely that observed increases in self-efficacy (as reflected in confidence and knowledge) would encourage increased cycling (Bandura, 1997). Moreover, teachers involved in delivering *Safe Cycle* reported that they had taught non-riders to ride during the program, and that the number of students riding to school had increased as a direct result of *Safe Cycle* being delivered at their school. Just over half of the respondents who reported riding a bike at Survey 3 reported that *Safe Cycle* had increased the *amount* they ride.

The high levels of reported bike ridership at the start of the program highlight the point that for the age-group targeted by *Safe Cycle* there is limited value to teaching basic bicycling skills. Most respondents had already learned basic bicycling skills (mostly from their parents), so that the “higher order” skills addressed by *Safe Cycle* were of much greater potential value to them. Several of the teachers involved in delivering *Safe Cycle* stressed this point.

Most previous evaluations of cycling education programs for children have not considered the effects of the training on participation.

5.2 Confidence

Participants in *Safe Cycle* are given information and practice to perform various safety-relevant activities including : checking that a bike is safe to ride, putting a helmet on properly, checking over the shoulder when riding forwards, arm-signalling when turning, giving way appropriately, turning right in traffic, using a roundabout correctly. Respondents reported feeling better at these seven activities (on average) immediately after *Safe Cycle* than they did before the program. This increase in confidence was no longer evident three months after the program, suggesting that respondents felt they had forgotten some of these skills with time and/or lack of practice.

When the activities were examined separately, arm-signalling when turning and using a roundabout correctly showed a significant increase in the proportion of respondents who felt "OK or Very good" (Survey 2 and 3). With 100% of respondents feeling "OK or Very good" at putting a helmet on properly before *Safe Cycle* it was not surprising to see reductions in this percentage at Surveys 2 and 3 (which were not significant because of the directional hypothesis made). A non-significant increase in confidence about giving way appropriately was matched by a significant improvement in knowledge about giving way in the particular situation tested.

Most previous evaluations of cycling education programs for children have not considered the effects of the training on confidence.

5.3 Perceived safety

Safe Cycle involves several components to promote awareness of the risks involved with cycling, and to teach participants to manage these risks. For example, participants tell stories about crashes or near-misses that they have had, and discuss ways in which the incident could have been avoided. Participants are shown real-world images of scenes that they may encounter while riding (from the rider's perspective), highlight the hazards in the scenes, and discuss ways of managing their risk. Participants are taught how to be alert to opening car doors, and practice this skill on their bikes.

It was considered possible these components of *Safe Cycle* might make participants feel less safe because of sensitisation to the risks which are discussed in the program, or more safe because of learning skills to manage the risks. A significantly larger number of respondents reported that they would feel scared riding on a road next to parked cars at Survey 2 compared to Survey 1 – suggesting a sensitisation to risk produced by the "car dooring" activities. No further changes in perceived safety were observed –in any of four locations (shared path, bike lane, road without bike lane, road with parked cars) or averaged across locations. Different responses by different participants (e.g. sensitisation versus confidence) may have balanced each other out, resulting in no net change.

Participants were asked directly whether they thought that "*Safe Cycle* has made you a safer bike rider?" (at Survey 3). Thus the 85% of respondents who felt that it did may have felt safer on their bikes as a result of the program. Alternatively, this question may have been interpreted as asking about whether they ride more safely (i.e. engage in more safety behaviours and less risky behaviours), which is somewhat conceptually distinct from perceived safety.

Perceived safety relative to others is believed to be an important behavioural determinant, such that the phenomenon of "illusory invulnerability" (aka "optimism bias") may promote risky behaviours (Dillard, McCaul& Klein, 2006). Illusory invulnerability refers to a tendency to believe that one is less likely that one's peers to experience negative events – potentially reducing motivation to take appropriate precautions (Weinstein and Klein, 1996). Illusory invulnerability may be inadvertently promoted by training programs that focus on skills but not on risk awareness. For this reason, in addition to components addressing risk awareness *Safe Cycle* includes a module addressing illusory invulnerability – renamed "imagined safety" to facilitate comprehension in school-aged children. The illusory invulnerability that was present in the sample at Survey 1 was significantly reduced at Survey 2 (though not at Survey 3). This is notable because illusory invulnerability is recognised as being an extremely robust phenomenon (Weinstein and Klein, 1995).

Most previous evaluations of cycling education programs for children have not considered the effects of the training on perceived safety or illusory invulnerability.

5.4 Knowledge

Improvement in knowledge of information relevant to cycling safety was the most durable outcome of *Safe Cycle.* Given that much of the information was specifically covered by *Safe Cycle,* and not particularly likely to have been encountered by another means during the months of the program, the observed improvement in knowledge most probably owes to the program. The durability of the improvement is not particularly surprising – given that much of the information was fairly simple, and so unlikely to be forgotten once known. For example, after participating in *Safe Cycle* participants were more likely to know that in the ACT cycling is allowed on footpaths at any age. Results suggested that while knowledge about the lighting requirements of bicycles was improved at Survey 2, this more complex information was forgotten by Survey 3. There appeared to be some confusion about pedestrian use of bike paths, for which there was a large reduction in the percentage of respondents who respondent correctly at Surveys 2 and 3 (significance not tested because of change in the direction opposite to prediction).

Respondents confirmed that they had learned something new from *Safe Cycle.* When asked directly around 70% of respondents felt that they had learned "a few things" while around 16% felt that they had learned "a lot". Road rules and traffic safety manoeuvres (hand signals and shoulder checks) appeared to be aspects that participants felt were the most important.

Previous research also indicates that cycling education programs for children may improve knowledge relating to cycling. Three of five relevant RCT studies, and seven of 13 relevant observational studies (four before-after studies with a comparison group, eight before- after studies, and one cohort study) demonstrated an increase in knowledge relevant to bicycling safety (Hooshmand et al, 2014; Lachapelle et al, 2013; Richmond et al, 2013).

5.5 Riding behaviour

This evaluation found no evidence that *Safe Cycle* changed riding behaviour – either according to participants' self-reports or naturalistic observation. Overall Safety Behaviour and Risky Behaviour scores, computed from self-reports of behaviours when riding on roads or paths in the previous two weeks, did not differ from baseline measures either immediately after or three months after program delivery. Although this analysis was based on a subsample of participants (who rode on roads or paths in the previous two weeks), the lack of a significant result does not reflect inadequate statistical power – because mean scores are almost identical at each survey.

Similarly, the percentage of respondents who reported "Always" performing each safety behaviour did not change from Survey 1 to the post-program surveys, and the percentage of respondents who always reported "Never" performing each risky behaviour did not change from Survey 1 to the post-program surveys. These categorisations were chosen because safety arguably requires that precautions be taken consistently, however the opposite categorisations (e.g. respondents who reported “Never” performing each safety behaviour versus the rest) did not change the pattern of results.

Bearing in mind the shortcomings of the naturalistic data collection (see Limitations) it also provided no evidence that *Safe Cycle* changed riding behaviour: this time in terms of the comparison between students who had done the program with those who had not (without baseline measures). Treatment participants did not differ from control participants in likelihood of performing any of ten safety-relevant behaviours when they had the opportunity (e.g. hand-signalling when they turned), in likelihood of performing any of six further safety-relevant behaviours throughout their ride (e.g. controlling the bicycle well when travelling straight), or in frequency of riding with at least one hand removed from the handle bars when not signalling.

The aforementioned results notwithstanding, teachers involved in delivering *Safe Cycle* reported that they had observed improvements in safety-relevant behaviours, including specific mention of hand signalling and taking better care of helmets.

Again, previous literature is generally consistent with the present results; providing little evidence for a positive effect of that cycling education programs for children on behaviour. Both relevant RCT studies and six relevant 11 observational studies (five before-after studies with a comparison group, four before-after studies, one cross-sectional study, and one cohort study) reviewed by Richmond et al (2013) found no significant improvements in bicycling behaviour. Most of these studies assessed the ability to perform cycling manoeuvres correctly (principally via direct observations), and “day-to-day” risk-relevant behaviours were rarely considered (but see Colwell and Culverwell, 2002; who used self-report).

Although not significant some potentially problematic behavioural outcomes were observed, which is important in the context of possible mechanisms for increases in injury reported by Carlin et al (1998). For example, the surveys showed a *reduction* of more than 10% in the proportion of respondents who reported always considering surrounding people (Survey 2), always doing a shoulder check (Survey 3) and always looking out for hazards (Survey 2 and 3). In the naturalistic data collection only participants in the Treatment group sometimes failed to maintain spatial awareness, or demonstrated high-risk riding behaviours (such as riding in the middle of the road, riding while carrying or playing with a ball, and jumping down stairs).

Naturalistic observation of children’s cycling behaviour is fairly innovative, and the present results highlight behaviours which might be targeted by cycling safety initiatives. Participants controlled their bicycles well, gave way appropriately to traffic at intersections, and stopped at red lights. However, participants frequently removed one or both hands from the handlebars, and very rarely signalled turns, conducted over-shoulder-checks when changing lanes, or looked in multiple directions at intersections (except when crossing a road)- all behaviours that are addressed by *Safe Cycle*. In general terms self-reports of safety-relevant behaviours confirmed the need to target these behaviours (but see Limitations).

It is generally recognised that knowledge, and even beliefs, are more readily changed than behaviours (Grossman & Rivara, 1992). The improvements in knowledge and self-efficacy that were achieved by *Safe Cycle* are an important step toward behavioural change (Michie, Atkins, & West , 2015). It is also likely that the program served to increase participants’ awareness of their own safety-relevant behaviours. However, for these improvements to translate into safer behaviour it is also important to address motivation. For example, despite the increase in self-reported confidence in hand-signalling a turn (at Survey 2 and 3), self-reported frequency of conducting this behaviour did not increase significantly, and participants in the naturalistic study were rarely observed to perform this behaviour. Similarly, although at Survey 3 more riders correctly identified the requirement to dismount when crossing at pedestrian crossings, the percentage of respondents who reported riding across a pedestrian crossing had not changed significantly (and was actually non-significantly larger; both comparisons with Survey 1). The benefits of *Safe Cycle* might be enhanced by including elements to increase the perceived importance of particular safety-relevant behaviours (e.g. signalling turns), and to make safer practices habitual (Nilsen, Bourne, & Verplanken, 2008).

5.6 Self-reported crashes and near-misses

A substantial percentage of participants (40.6%) reported having experienced at least one crash (n=38) or near-miss (n=24)on paths or roads in the six months before participating in *Safe Cycle*, confirming that there is a cycling safety issue for this age group (see AIHW: Henley & Harrison, 2012, p19, Figure 4.3.1), and offering the possibility of examining the effect of *Safe Cycle* on safety outcomes. Unfortunately, the validity of comparison with post-program crash/near-miss experience is undermined by the necessary use of a different time frame. That is, because Survey 3 was conducted three months after delivery of *Safe Cycle* participants were asked about their experiences in the past three months, and crash/near-miss numbers were doubled to provide an estimated number of crashes in six months. These estimates are likely to exaggerate the number of participants with no crash experience, so the observed significant decrease in the number of participants who had experienced a crash must be treated with caution – especially in view of Carlin's (1998) finding that children treated in ED for injuries sustained in a cycling crash were more likely to have participated in Bike Ed (a school-based cycling safety program) than control cyclists (n=130). When the reported *number* of crashes and near-misses at Survey 1 was compared with the estimated *number* of crashes at Survey 3, no significant differences were observed. A near-significant increase in near-misses was no longer near-significant with offset for exposure. However, the exposure offset employed (reported number of days ridden in the past two weeks) is a very gross estimate of exposure during the time period for which crashes were reported.

Except for Carlin et al (1998) previous literature (one before-after study with a comparison group, one before-after study, two cross-sectional studies, and two retrospective cohort studies) is consistent with the present study in showing no significant effect of cycling education programs for children on crash or injury outcomes (Richmond et al, 2013).

In the present study, with no observed change in safety-relevant cycling behaviour it is unsurprising to find no effect on self-reported crashes and near misses, and if improved safety behaviour can be achieved with refinement of the program, then improvements in safety outcomes might also be observed. It is gratifying not to observe the increases in crashes and near-misses that might have been expected on the basis of Carlin's (1998) finding – particularly in the context of the observed increases in participation. Perhaps the reductions in illusory invulnerability observed in the present study counteracted the overconfidence that Carlin (1998) suggested may underlie the worsened safety outcomes observed in his study.

5.7 Durability of program effects

Durability of program effects is a key issue for any public health initiative, and it is a strength of the present evaluation that durability was assessed (albeit only over a period of three months). According to the review of Richmond et al (2013) very few evaluations of cycling education programs for children reported the post-program follow-up period they employed. One study that included a 7-month follow-up reported that the improvement in manoeuvring that was observed immediately after the program was no longer evident after seven months.

Similarly, several of the positive effects that were observed in the present study at Survey 2 (specifically participation, confidence, feeling scared near parked cars, and illusory invulnerability) were no longer observed at the three-month follow-up. This highlights the need for refinements to *Safe Cycle* to enhance the durability of its benefits, and converges with suggestions by teachers for broadening the impact of the program. Specifically, teachers suggested repetition of aspects of the program across time (school terms and years) as well as subject areas ("a whole school approach").

5.8 Process issues

Students appeared to respond extremely well to *Safe Cycle*. Immediately after completing *Safe Cycle* all respondents reported finding the program engaging and fun, and interviewed teachers confirmed an overwhelmingly positive response from students. Both students' self-reports and teacher interviews indicated that students preferred the practical components of *Safe Cycle* to the theoretical components. Nonetheless, teachers reported that students recognised the value of the theoretical components, and emphasised the particular importance and relevance of these components (and particularly risk awareness and self-awareness) to the target age-group. Teachers stressed the importance of explicitly discussing with students the links between theoretical and practical sessions, and indicated that for younger students somewhat reduced emphasis on the theoretical components might be appropriate. Since the present evaluation was conducted, revised content has been written for primary school aged students. Safe Cycle Years 5 and 6 is available for review at http://paf.org.au/safecycle/.

Interviewed teachers generally demonstrated a good understanding of the objectives of *Safe Cycle* and reported that they had delivered the core program (without the cross-curricular extension activities) according to the training and resources they received. While they found the training adequate, several comments suggested that additional training relating to supervising a group of children on out-of-school rides, and possibly to bicycle maintenance, could be helpful. The teachers commended the resources as facilitating uptake and handover of program delivery.

Interviews with teachers addressed several practical issues that are relevant to the successful implementation of *Safe Cycle*:

1. In order to manage differences in riding experience, ability and confidence across students, it is useful to divide students into groups based on ability-level – supervised either by support staff or "student leaders".
2. At schools where *Safe Cycle* is delivered to older students, delivery of a basic riding skills program at an earlier age may be beneficial.
3. In order to engage experienced, overconfident, male riders it may be useful to start the program with a clear overview and rationale, and to use activities to keep these students interested while challenging their overconfidence in a relatively safe environment.
4. It is easiest to run the program if there are enough bicycles for each student in a class session to have one (without relying on any student to bring a bicycle in adequately good condition). Teaching is simplest if all bikes are the same. A good system for bicycle maintenance (e.g. an arrangement with a bicycle shop) is also important.
5. The program is most likely to be successful and sustainable if its value is understood by the whole of the school community and embedded in the school culture. This may also assist with allaying parent concerns about allowing students to ride off the school grounds.

5.9 Limitations

The results of the present evaluation must be interpreted in the context of several unavoidable methodological limitations.

Firstly, although survey data were collected at waitlist control schools these data could not be used in analysis. For practical reasons, schools were assigned to Treatment or Control groups on the basis of when they planned to deliver *Safe Cycle.* Schools that planned to deliver the program in Term 4 were assigned to the (waitlist) Control group so that Surveys 1, 2 and 3 could be conducted concurrently with Treatment schools, and before *Safe Cycle* was delivered at Control schools. This does not represent a random assignment of schools to Treatment and Control conditions and raises the possibility of biases that should be examined and/or controlled for in analyses. Moreover attrition was greater at control schools, suggesting the introduction of further biases. Indeed preliminary analyses suggested Treatment and Control schools differed significantly in terms of gender, and there are likely to be further differences that were not assessed. Because only three Control schools ended up participating in the evaluation, and because of the relatively high attrition at Control schools, the Control sample was too small for reliable analyses including the Control group and attempting to control for potential biases.

Changes from pre-program to post-program (either immediate-post or follow-up) in the Treatment group (without comparison to the Control group) cannot be attributed confidently to *Safe Cycle.* This has been discussed in detail in relation to participation. Similar arguments can be made in terms of Confidence and Knowledge. For example, merely with the passage of time participants may have learnt more information relevant to safe cycling and become more confident performing safe cycling practices. However, the decay of the immediate post-program increase in confidence suggests that it was achieved at least in part by the program. Further, participants reported that they learnt new information and became safer riders as a direct result of *Safe Cycle.*

Use of self-reported information can also be regarded as a limitation of the evaluation, although some variables can only be assessed directly via self-report. For example, the only way of knowing how good an individual feels at performing a task is to ask them. The only way of knowing how safe an individual feels in a particular situation is to ask them. In contrast, behaviours can be observed directly and this is a less potentially biased measurement technique than self-report. Self-reports can be intentionally or unintentionally inaccurate. Research participants may be motivated to present themselves in a particular light, or to give the answer that they think the researcher wants (or doesn't want!). For example, in the present study respondents may have wished to appear more confident after participating in *Safe Cycle* even if they did not *feel* more confident. However, it is difficult to account for the decay in immediate post-program confidence in this manner. Moreover, it is in the nature of the Knowledge questions that they cannot be faked.

When results from data collected in different ways converge then there can be greater confidence in the result. For example, in the present evaluation students' reports of increased participation in bicycle riding converged with teachers' reports of increased student participation. The present evaluation also included a small naturalistic cycling study in which students' behaviours were directly observed. Survey results should be compared with naturalistic observation results with caution because the former involves comparison of pre- with post-program measures in the Treatment group, and the latter involves comparison of Treatment with Control groups using post-program measures. Both self-report and naturalistically observation methodologies indicated that red-light running is a very rare behaviour in the age group that participated in the present evaluation. However, some naturalistic observation results suggest some bias in self-reporting of cycling safety behaviours. Specifically, while around 45% of respondents reported "always" conducting an over-the-shoulder check, no Treatment group participant in the naturalistic component was observed to "always" conduct this behaviour. Similarly, while around 25% of respondents reported always hand-signalling (when turning left or changing lanes) no Treatment group participant in the naturalistic component was observed to "always" conduct this behaviour.

The naturalistic observation component of the research itself suffered from a number of shortcomings, again for practical reasons (mainly time constraints). First, it involved only post-program measurements and no pre-program measurements, such that any differences between Treatment and Control groups could have been pre-existing (and so not attributable to the program). Second, only 12 students participated, and these provided just less than 24 hours of data, limiting the reliability and generalizability of the results. Finally, some technical difficulties rendered some footage unusable for recording of some variables (e.g. because the face camera was not positioned on the riders' face, sometimes because the rider stood up while riding). For future naturalistic studies it would be useful to check footage after each participant's first ride to rectify any problems (either via instructions or repositioning equipment).

6. References

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7. Acknowledgements

The authors wish to thank NRMA/ACT Road Safety Trust for funding the project, and the ACT Government Health Directorate and the Education and Training Directorate for facilitating it. We would also like to express our appreciation to the principals and teachers at the participating schools for agreeing to be involved in the project, and for their invaluable assistance. Finally, we offer a big thank you to all of those budding bike riders for their contribution as research participants.

Appendix A – Survey 1

(Not showing skip logic; Grey bars indicate page breaks)

Welcome to the Evaluation of Safe Cycle Study. Thank you for helping with this important research.

Please read each question carefully and answer as accurately as you can.

Don't worry if there is something that you don't know. Just make your best guess. You aren't being graded on this.

First a few questions about you:

1. What school do you go to?

- ◯ Harrison
- ◯ Hughes
- ◯ Latham
- ◯ Macgregor
- ◯ Melrose
- ◯ Mount Rogers
- ◯ Richardson

2. What is your name?

First or given name __________

Surname or family name __________

3. What is your date of birth?

	Day	Month	Year
Date			

4. Are you male or female?

- ◯ Male
- ◯ Female

5. Do you ride a bike?

- ◯ Yes
- ◯ No

Now some questions about your riding:

6. Why do you ride your bike? (Check all that apply)

- ☐ To get to/from school
- ☐ To get to friends' houses
- ☐ Fun
- ☐ Fitness
- ☐ Special cycling events (e.g. fun ride or fundraising ride)
- ☐ Competition (e.g. racing or stunt riding)
- ☐ Other

If "Other" please write why

7. Where do you ride your bike? (Check all that apply)

- ☐ Paths that are shared with pedestrians (footpaths and shared paths)
- ☐ On-road bike lanes
- ☐ Roads without a bike lane
- ☐ Off-road trails (e.g. fire trails, mountain bike trials)
- ☐ Skate parks or dirt parks or BMX tracks
- ☐ Criterium circuit or velodrome
- ☐ Other

If "Other" please write where

8. Who taught you to ride a bike? (Check all that apply)

- ☐ You taught yourself
- ☐ Your mum/ female carer taught you
- ☐ Your dad/ male carer taught you
- ☐ You did a course run by your school
- ☐ You did a course run somewhere else
- ☐ Someone else

If "Someone else" please write who

9. How good are you at...

	Not good at all	OK	Very good
.... checking that your bike is safe to ride?	◯	◯	◯
... putting your helmet on properly?	◯	◯	◯
... looking back over your shoulder when you are riding forwards?	◯	◯	◯
... using your arms to signal when you are turning?	◯	◯	◯
.... knowing when to Give Way to people when you are riding?	◯	◯	◯
... doing a right turn in traffic when you are riding?	◯	◯	◯
... using a roundabout when you are riding?	◯	◯	◯

10. How scared would you feel riding on...

	Not scared at all	A bit scared	Really scared
... a path that is shared with pedestrians?	◯	◯	◯
... a busy road without a bike lane?	◯	◯	◯
... a busy road in a bike lane?	◯	◯	◯
... a road next to parked cars?	◯	◯	◯

11. Compared to other kids your age how much time do you spend riding your bike?

◯ Less

◯ About the same

◯ More

12. Compared to other kids your age how likely do you think you are to have a bike crash?

◯ Less

◯ About the same

◯ More

Next some questions about riding generally:

13. In the ACT when are you allowed to ride a bike on a footpath?

◯ Until you are 5 years old

◯ Until you are 12 years of age

◯ Until you are 18 (no longer a minor)

◯ At any age

14. Where does the law say you need to wear a bike helmet in the ACT?

- ◯ On footpaths, shared paths or bike paths
- ◯ On on-road bike lanes
- ◯ On roads without a bike lane
- ◯ All of the above

15. When riding a bike on the road are you expected to obey all the road rules?

- ◯ Yes
- ◯ No

16. When it is dark (sunset to sunrise) what do you need to have on your bike? (Check all that apply)

- ☐ Front light showing an unbroken or flashing white beam that is clearly visible from 200 metres
- ☐ Rear light showing an unbroken or flashing red beam that is clearly visible from 200 metres
- ☐ Red reflector visible from the rear of the bike
- ☐ Yellow reflectors fitted to both sides of each pedals (except for clip-in pedals)

17. Are pedestrians allowed on bike paths in the ACT?

- ◯ Yes
- ◯ No

18. Are you allowed to stay on your bike to cross at children's school crossings and pedestrian crossings in the ACT?

- ◯ Yes
- ◯ No

19. Do bikes need to have a bell or horn in the ACT?

- ◯ Yes
- ◯ No

20. In the ACT are you allowed to give someone a dink (i.e. have someone on your bike not on a bike seat)?

- ◯ Yes
- ◯ No

21. In most collisions between a bike and a car in the ACT...

- ◯ the car hits the bike side-on when the bike runs a red light
- ◯ the car hits the back of the bike because the driver didn't see the bike
- ◯ the bike hits a car that cuts in front of the bike to turn left
- ◯ the bike hits a car that turns right across the bike

22. What should you check before riding your bike (from the ABC Tight test)?

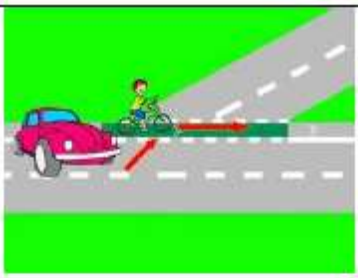
- ◯ Air in tyres, bottle of water, crank tight
- ◯ Tyres in good condition, working rear brake, chain oiled
- ◯ Air in tyres, working front brake, chain oiled
- ◯ Tyres in good condition, bottle of water, chain oiled

23. How should your helmet fit?

- ◯ Helmet should be loose so that your head can breathe
- ◯ Straps are tight enough if you can't fit your fingers underneath them
- ◯ Helmet should be snug and not wobble
- ◯ Helmet should be tilted back slightly so that it protects the back of your head

24. Which of the following is NOT one of the recommended behaviours for reducing the risk of a crash in the picture above?

- ◯ Slow down
- ◯ Keep left
- ◯ Ring bell
- ◯ Check for right-turning traffic from behind



25. Who can go first in the picture above?

- ◯ The car
- ◯ The bike
- ◯ Whichever gets there first

26. What is the BEST technique for emergency braking on a large bike?

- ◯ Apply front brake and lean forward
- ◯ Apply rear brake and slide the bike at 90 degrees to the direction of travel
- ◯ Just apply front brake
- ◯ Just apply rear brake

For this part of the questionnaire please think about riding that you did ON PATHS OR ROADS IN THE LAST 2 WEEKS.

If you rode on off-road trails, on a race track, in stunt parks, or similar places, don't include this riding in your answers.

27. In the last 2 weeks did you ride a bike on paths or roads?

- ◯ Yes, in the last 2 weeks I rode my bike at least once on a path or a road
- ◯ No, I didn't ride on paths or roads

28. On how many days did you ride a bike on paths or roads in the last 2 weeks?

Days [ ]

29. On days that you rode on paths or roads how long did you usually spend riding?

Hours per day [ ]

30. When you rode on paths or roads how often did you...

	Never	Sometimes	Always
... perform a bike safety check?	◯	◯	◯
... ride through red traffic lights?	◯	◯	◯
... ride through a stop sign?	◯	◯	◯
... wear a helmet?	◯	◯	◯
... wear open shoes?	◯	◯	◯
... ride across a pedestrian crossing (e.g. zebra crossing, traffic light crossing)?	◯	◯	◯
... consider other people around you?	◯	◯	◯
... ride against the traffic on a one way street without a bike lane?	◯	◯	◯
... listen to something with headphones?	◯	◯	◯
... do a shoulder check when changing lanes?	◯	◯	◯
... signal when changing lanes?	◯	◯	◯
... signal when turning left?	◯	◯	◯
... actively look out for hazards?	◯	◯	◯
... talk on a mobile phone (with or without hands free)?	◯	◯	◯

This part of the questionnaire asks about any collisions or falls or near misses you have had while riding your bike ON PATHS OR ROADS IN THE LAST 6 MONTHS.

* A near miss is an unexpected event that would have been a collision or a fall if you or another person didn't take sudden evasive action.

31. Have you experienced any collisions, falls or near misses while riding on paths or roads in the last 6 months?

◯ Yes

◯ No

32. How many collisions did you have while riding on paths or roads in the last 6 months? (Write 0 or a number greater than 0)

33. How many falls did you have while riding on paths or roads in the last 6 months? (Write 0 or a number greater than 0)

34. How many near misses did you have while riding on paths or roads in the last 6 months? (Write 0 or a number greater than 0)

***A near miss is an unexpected event that would have been a collision or a fall if you or another person didn't take sudden evasive action**

Please answer the following questions about THE MOST SERIOUS INCIDENT (collision, fall, or near miss) that you have had while riding ON PATHS OR ROADS IN THE LAST 6 MONTHS:

35. Was the most serious incident in the last 6 months a...

- ◯ collision?
- ◯ fall?
- ◯ near miss?

36. Who or what did the most serious incident in the last 6 months involve? (Check all that apply)

- ☐ A motor vehicle (including motorcycles)
- ☐ Another bike
- ☐ A pedestrian
- ☐ An animal
- ☐ A stationary object
- ☐ No one or nothing else
- ☐ Something else

If "Something else" please write who/what

37. Where did it occur? (Check all that apply)

- ☐ On a path that is shared with pedestrians (footpaths and *shared paths)
- ☐ On an on-road bike lane
- ☐ On a road (without a bike lane)
- ☐ Other

If "Other" please write where

38. What injuries did you get? (Check all that apply)

- [ ] No injuries
- [ ] Bumps and bruises
- [ ] Cuts or scratches
- [ ] Sprained muscles or torn ligaments
- [ ] Broken bones
- [ ] Other

If "Other" please write what

39. What treatment did you get?

- ◯ No treatment
- ◯ Treated at home
- ◯ Treated by a doctor but not in hospital
- ◯ Treated by a doctor in hospital but without staying overnight
- ◯ Treated by a doctor in hospital and stayed at least one night

You have finished the questionnaire. Thank you for your help.

Please click "Done" below to close the questionnaire.

Appendix B – Survey 2T (Treatment group)

(Not showing skip logic; Grey bars indicate page breaks)

Welcome to the second part of the Evaluation of Safe Cycle Study. Thank you again for your help.

Please read all questions carefully and answer as accurately as you can.

Don't worry if there is something that you don't know. Just make your best guess. You aren't being graded on this.

First some questions about you:

1. What is your name?

First or given name

Surname or family name

2. What is your date of birth?

	Day	Month	Year
Date			

Now some questions about how you found Safe Cycle:

3. Did you find the program engaging and fun?

- Not at all
- A bit
- Very

4. Which part of the program did you find most useful? (Check any that apply)

- Group work and class discussions
- Powerpoints shown by the teacher
- Telling stories about your accidents or near misses
- Learning about road rules
- Bike riding session learning how to look back over your shoulder when riding forward
- Bike riding session learning how to control your speed
- Bike riding session learning how to do an emergency brake
- Bike riding session learning how to ride safely when close to other cyclists
- Bike riding session learning how to do hand signals
- Bike riding session learning how to swerve around plastic cones
- Something else

If "Something else" please write what

5. Which part of the program did you find least useful? (Check any that apply)

- [ ] Group work and class discussions
- [ ] Powerpoints shown by the teacher
- [ ] Telling stories about your accidents or near misses
- [ ] Learning about road rules
- [ ] Bike riding session learning how to look back over your shoulder when riding forward
- [ ] Bike riding session learning how to control your speed
- [ ] Bike riding session learning how to do an emergency brake
- [ ] Bike riding session learning how to ride safely when close to other cyclists
- [ ] Bike riding session learning how to do hand signals
- [ ] Bike riding session learning how to swerve around plastic cones
- [ ] Something else

If "Something else" please write what

6. Did you learn anything new from Safe Cycle?

- ○ No
- ○ Yes, a few things
- ○ Yes, a lot

If you answered Yes, please describe what stands out as the most important thing that you learnt

Next some questions about your riding:

7. Do you ride a bike?

- ○ Yes, and I was a bike rider before doing the last Safe Cycle Study questionnaire (about 2 months ago)
- ○ Yes, I have started riding a bike since doing the last Safe Cycle Study questionnaire (about 2 months ago)
- ○ No

8. Who taught you to ride a bike? (Check all that apply)

- [ ] You taught yourself
- [ ] Your mum/ female carer taught you
- [ ] Your dad/ male carer taught you
- [ ] You did a course run by your school
- [ ] You did a course run somewhere else
- [ ] Someone else

If "Someone else" please write who

9. Why do you ride your bike? (Check all that apply)

- [ ] To get to/from school
- [ ] To get to friends' houses
- [ ] Fun
- [ ] Fitness
- [ ] Special cycling events (e.g. fun ride or fundraising ride)
- [ ] Competition (e.g. racing or stunt riding)
- [ ] Other

If "Other" please write why

10. Where do you ride your bike? (Check all that apply)

- [ ] Paths that are shared with pedestrians (footpaths and shared paths)
- [ ] On-road bike lanes
- [ ] Roads without a bike lane
- [ ] Off-road trails (e.g. fire trails, mountain bike trials)
- [ ] Skate parks or dirt parks or BMX tracks
- [ ] Criterium circuit or velodrome
- [ ] Other

If "Other" please write where

11. Do you think that Safe Cycle has made you a safer bike rider?

- ○ Yes
- ○ No

12. How good are you at...

	Not good at all	OK	Very good
... checking that your bike is safe to ride?	◯	◯	◯
... putting your helmet on properly?	◯	◯	◯
... looking back over your shoulder when you are riding forwards?	◯	◯	◯
... using your arms to signal when you are turning?	◯	◯	◯
.... knowing when to Give Way to other people when you are riding?	◯	◯	◯
... doing a right turn in traffic when you are riding?	◯	◯	◯
... using a roundabout when you are riding?	◯	◯	◯

13. How scared would you feel riding on...

	Not scared at all	A bit scared	Very scared
... a path that is shared with pedestrians?	◯	◯	◯
... a busy road without a bike lane?	◯	◯	◯
... a busy road in a bike lane?	◯	◯	◯
... a road next to parked cars?	◯	◯	◯

14. Compared to other kids your age how much time do you spend riding your bike?

◯ Less

◯ About the same

◯ More

15. Compared to other kids your age how likely do you think you are to have a bike crash?

◯ Less

◯ About the same

◯ More

Next some questions about riding more generally:

16. In the ACT when are you allowed to ride a bike on a footpath?

◯ Until you are 5 years old

◯ Until you are 12 years of age

◯ Until you are 18 (no longer a minor)

◯ At any age

17. Where does the law say you need to wear a bike helmet in the ACT?

◯ On footpaths, shared paths, or bike paths

◯ On on-road bike lanes

◯ On roads without a bike lane

◯ All of the above

18. When riding a bike on the road are you expected to obey all the road rules?

◯ Yes

◯ No

19. When it is dark (sunset to sunrise) what do you need to have on your bike? (Check all that apply)

☐ Front light showing an unbroken or flashing white beam that is clearly visible from 200 metres

☐ Rear light showing an unbroken or flashing red beam that is clearly visible from 200 metres

☐ Red reflector visible from the rear of the bike

☐ Yellow reflectors fitted to both sides of each pedals (except for clip-in pedals)

20. Are pedestrians allowed on bike paths in the ACT?

◯ Yes

◯ No

21. Are you allowed to stay on your bike to cross at children's school crossings and pedestrian crossings in the ACT?

◯ Yes

◯ No

22. Do bikes need to have a bell or horn in the ACT?

◯ Yes

◯ No

23. In the ACT are you allowed to give someone a dink (i.e. have someone on your bike not in a bike seat).

◯ Yes

◯ No

24. In most collisions between a bike and a car in the ACT...

- ◯ the car hits the bike side-on when the bike runs a red light
- ◯ the car hits the back of the bike because the driver didn't see the bike
- ◯ the bike hits a car that cuts in front of the bike to turn left
- ◯ the bike hits a car that turns right across the bike

25. What are three things you should check before riding your bike (from the ABC Tight test)?

- ◯ Air in tyres, bottle of water, crank tight
- ◯ Tyres in good condition, working rear brake, chain oiled
- ◯ Air in tyres, working front brake, chain oiled
- ◯ Tyres in good condition, bottle of water, chain oiled

26. How should your helmet fit?

- ◯ Helmet should be loose so that your head can breath
- ◯ Straps are tight enough if you can't fit your fingers underneath them
- ◯ Helmet should be snug and not wobble
- ◯ Helmet should be tilted back slightly so that it protects the back of your head

27. Which of the following is NOT one of the recommended behaviours for reducing the risk of a crash in the picture above?

- ◯ Slow down
- ◯ Keep left
- ◯ Ring bell
- ◯ Check for right-turning traffic from behind

28. Who can go first in the picture above?

- ◯ The car
- ◯ The bike
- ◯ Whichever gets there first

29. What is the BEST technique for emergency braking on a large bike?

- ◯ Apply front brake and lean forward
- ◯ Apply rear brake and slide the bike at 90 degrees to the direction of travel
- ◯ Just apply front brake
- ◯ Just apply rear brake

For this part of the questionnaire please think about riding that you did ON PATHS OR ROADS IN THE LAST 2 WEEKS.

If you rode on off-road trails, on a race track, in stunt parks, or similar places, don't include this riding in your answers.

30. In the last 2 weeks did you ride a bike on paths or roads?

- ◯ Yes
- ◯ No

31. On how many days did you ride a bike on paths or roads in the last 2 weeks?

Days ☐

32. On days that you rode on paths or roads how long did you usually spend riding?

Hours per day ☐

33. When you rode on paths or roads how often did you...

	Never	Sometimes	Always
... perform a bike safety check?	○	○	○
... ride through red traffic lights?	○	○	○
... ride through a stop sign?	○	○	○
... wear a helmet?	○	○	○
... wear open shoes?	○	○	○
... ride across a pedestrian crossing (e.g. zebra crossing, crossing at traffic lights)?	○	○	○
... consider other people around you?	○	○	○
... ride against the traffic on a one way street where there is no bike lane?	○	○	○
... listen to something with headphones?	○	○	○
... do a shoulder check when changing lanes?	○	○	○
... signal when changing lanes?	○	○	○
... signal when turning left?	○	○	○
... actively look out for hazards?	○	○	○
... talk on a mobile phone (with or without hands free)?	○	○	○

You have finished the questionnaire. Thank you for your help.

Please click "Done" below to close the questionnaire.

Appendix C – Survey 3T (Treatment group)

(Not showing skip logic; Grey bars indicate page breaks)

Welcome to the third part of the Evaluation of Safe Cycle Study. Thank you again for your help.

Please read all questions carefully and answer as accurately as you can.

Don't worry if there is something that you don't know. Just make your best guess. You aren't being graded on this.

First some questions about you:

1. What is your name?

First or given name

Surname or family name

2. What is your date of birth?

	Day	Month	Year
Date			

Now some questions about your riding:

3. Do you ride a bike?

- ◯ Yes, and I was a bike rider before doing the last Safe Cycle Study questionnaire (about 3 months ago)
- ◯ Yes, I have started riding a bike since doing the last Safe Cycle Study questionnaire (about 3 months ago)
- ◯ No

4. Who taught you to ride a bike? (Check all that apply)

- ☐ You taught yourself
- ☐ Your mum/ female carer taught you
- ☐ Your dad/ male carer taught you
- ☐ You did a course run by your school
- ☐ You did a course run somewhere else
- ☐ Someone else

If "Someone else" please write who

5. Why do you ride your bike? (Check all that apply)

☐ To get to/from school

☐ To get to friends' houses

☐ Fun

☐ Fitness

☐ Special cycling events (e.g. fun ride or fundraising ride)

☐ Competition (e.g. racing or stunt riding)

☐ Other

If "Other" please write why

6. Where do you ride your bike? (Check all that apply)

☐ Paths that are shared with pedestrians (footpaths and shared paths)

☐ On-road bike lanes

☐ Roads without a bike lane

☐ Off-road trails (e.g. fire trails, mountain bike trials)

☐ Skate parks or dirt parks or BMX tracks

☐ Criterium circuit or velodrome

☐ Other

If "Other" please write where

7. Do you think Safe Cycle has increased the amount you ride?

○ Yes

○ No

8. Do you think Safe Cycle has made you a safer bike rider?

○ Yes

○ No

9. How good are you at...

	Not good at all	OK	Very good
... checking that your bike is safe to ride?	◯	◯	◯
... putting your helmet on properly?	◯	◯	◯
... looking back over your shoulder when you are riding forwards?	◯	◯	◯
... using your arms to signal when you are turning?	◯	◯	◯
.... knowing when to Give Way to other people when you are riding?	◯	◯	◯
... doing a right turn in traffic when you are riding?	◯	◯	◯
... using a roundabout on your bike when you are riding?	◯	◯	◯

10. How scared would you feel riding on...

	Not scared at all	A bit scared	Very scared
... a path that is shared with pedestrians?	◯	◯	◯
... a busy road without a bike lane?	◯	◯	◯
... a busy road in a bike lane?	◯	◯	◯
... a road next to parked cars?	◯	◯	◯

11. Compared to other kids your age how much time do you spend riding your bike?

◯ Less

◯ About the same

◯ More

12. Compared to other kids your age how likely do you think you are to have a bike crash?

◯ Less

◯ About the same

◯ More

Next some questions about riding in general:

13. In the ACT when are you allowed to ride a bike on a footpath?

◯ Until you are 5 years old

◯ Until you are 12 years of age

◯ Until you are 18 (no longer a minor)

◯ At any age

14. Where does the law say you need to wear a bike helmet in the ACT?

- ◯ On footpaths, shared paths, or bicycle paths
- ◯ On on-road bike lanes
- ◯ On roads without a bike lane
- ◯ All of the above

15. When riding a bike on the road are you expected to obey all the road rules?

- ◯ Yes
- ◯ No

16. When it is dark (sunset to sunrise) what do you need to have on your bike? (Check all that apply)

- ☐ Front light showing an unbroken or flashing white beam that is clearly visible from 200 metres
- ☐ Rear light showing an unbroken or flashing red beam that is clearly visible from 200 metres
- ☐ Red reflector visible from the rear of the bike
- ☐ Yellow reflectors fitted to both sides of each pedals (except for clip-in pedals)

17. Are pedestrians allowed on bike paths in the ACT?

- ◯ Yes
- ◯ No

18. Are you allowed to stay on your bike to cross at children's school crossings and pedestrian crossings in the ACT?

- ◯ Yes
- ◯ No

19. Do bikes need to have a bell or horn in the ACT?

- ◯ Yes
- ◯ No

20. In the ACT are you allowed to give someone a dink (i.e. have someone on your bike not in a bike seat)?

- ◯ Yes
- ◯ No

21. In most collisions between a bike and a car in the ACT...

- ◯ the car hits the bike side-on when the bike runs a red light
- ◯ the car hits the back of the bike because the driver didn't see the bike
- ◯ the bike hits a car that cuts in front of the bike to turn left
- ◯ the bike hits a car that turns right across the bike

22. What are three things that you should check before riding your bike (from the ABC Tight test)?

- ◯ Air in tyres, bottle of water, crank tight
- ◯ Tyres in good condition, working rear brake, chain oiled
- ◯ Air in tyres, working front brake, chain oiled
- ◯ Tyres in good condition, bottle of water, chain oiled

23. How should your helmet fit?

- ◯ Helmet should be loose so that your head can breath
- ◯ Straps are tight enough if you can't fit your fingers underneath them
- ◯ Helmet should be snug and not wobble
- ◯ Helmet should be tilted back slightly so that it protects the back of your head

24. Which of the following is NOT one of the recommended behaviours for reducing the risk of a crash in the picture above?

- ◯ Slow down
- ◯ Keep left
- ◯ Ring bell
- ◯ Check for right-turning traffic from behind

25. Who can go first in the picture above?

- ◯ The car
- ◯ The bicycle
- ◯ Whichever gets there first

26. What is the BEST technique for emergency braking on a large bike?

- ◯ Apply front brake and lean forward
- ◯ Apply rear brake and slide the bike at 90 degrees to the direction of travel
- ◯ Just apply front brake
- ◯ Just apply rear brake

For this part of the questionnaire please think about riding that you did ON PATHS OR ROADS IN THE LAST 2 WEEKS.

If you rode on off-road trails, on a race track, in stunt parks, or similar places, don't include this riding in your answers.

27. In the last 2 weeks did you ride a bike on paths or roads?

- ◯ Yes, in the last 2 weeks I rode my bike at least once on a path or a road
- ◯ No, I didn't ride on paths or roads

28. On how many days did you ride a bike on paths or roads in the last 2 weeks?

Days ______

29. On days that you rode on paths or roads how long did you usually spend riding?

Hours per day ______

30. When you rode on paths or roads how often did you...

	Never	Sometimes	Always
... perform a bike safety check?	◯	◯	◯
... ride through red traffic lights?	◯	◯	◯
... ride through a stop sign?	◯	◯	◯
... wear a helmet?	◯	◯	◯
... wear open shoes?	◯	◯	◯
... ride across a pedestrian crossing (e.g. zebra crossing, traffic light crossing?	◯	◯	◯
... consider other people around you?	◯	◯	◯
... ride against the traffic on a one way street without a bike lane?	◯	◯	◯
... listen to something with headphones?	◯	◯	◯
... do a shoulder check when changing lanes?	◯	◯	◯
... signal when changing lanes?	◯	◯	◯
... signal when turning left?	◯	◯	◯
... actively look out for hazards?	◯	◯	◯
... talk on a mobile phone (with or without hands free)?	◯	◯	◯

This part of the questionnaire asks about any collisions or falls or near misses* you have had while riding ON PATHS OR ROADS IN THE LAST 3 MONTHS (ie. since completing Safe Cycle).

*A near miss is an unexpected event that would have been a collision or a fall if you or another person didn't take sudden evasive action.

31. Have you experienced any collisions, falls or near misses while riding on paths or roads in the last 3 months?

◯ Yes

◯ No

32. How many collisions did you have while riding on paths or roads in the last 3 months? (Write 0 or a number greater than 0)

33. How many falls did you have while riding on paths or roads in the last 3 months? (Write 0 or a number greater than 0)

34. How many near misses did you have while riding on paths or roads in the last 3 months? (Write 0 or a number greater than 0)

***A near miss is an unexpected event that would have been a collision or a fall if you or another person didn't take sudden evasive action.**

Please answer the following questions about THE MOST SERIOUS INCIDENT (collision, fall, or near miss) that you have had while riding ON PATHS OR ROADS IN THE LAST 3 MONTHS:

35. Was the most serious incident in the last 3 months a...

- ◯ collision?
- ◯ fall?
- ◯ near miss?

36. Who or what did the most serious incident in the last 3 months involve? (Check all that apply)

- ☐ A motor vehicle (including motorcycles)?
- ☐ Another bike?
- ☐ A pedestrian?
- ☐ An animal?
- ☐ A stationary object?
- ☐ No one or nothing else?
- ☐ Something else?

If "Something else" please write who/what

37. Where did it occur? (Check all that apply)

- ☐ On a path that is shared with pedestrians (footpaths and shared paths)
- ☐ On an on-road bike lane
- ☐ On a road without a bike lane
- ☐ Other

If "Other" please write where

38. What injuries did you get? (Check all that apply)

- [ ] No injuries
- [ ] Bumps and bruises
- [ ] Cuts or scratches
- [ ] Sprained muscles or torn ligaments
- [ ] Broken bones
- [ ] Other

If "Other" please write what

39. What treatment did you get?

- ◯ No treatment
- ◯ Treated at home
- ◯ Treated by a doctor but not in hospital
- ◯ Treated by a doctor in hospital but without staying overnight
- ◯ Treated by a doctor in hospital and stayed at least one night

You have finished the questionnaire. This was the final questionnaire in the Evaluation of Safe Cycle Study.

We really appreciate your help, and will give your school a summary of our results as soon as the study is complete.

Please click "Done" below to close the questionnaire.

Appendix D – Structured protocol for teacher interviews

Hi my name is [*insert name*] and I am a researcher at UNSW.

I am calling because you are involved with the *Safe Cycle* program, and you have indicated that you are willing to be interviewed about how you found *Safe Cycle* and whether you have any suggestions for improvements.

The interview takes approximately 15 minutes. Are you willing to be interviewed?

If "No", end call "OK. Thank you for your time"

If "Yes" "Thank you, is now a good time?"

Conduct interview or schedule a call back.

Thank you for agreeing to be interviewed today. Your responses will be really helpful in helping us to understand how *Safe Cycle* is going, and how it could be improved.

There are a couple of things we need to cover before we get started. First, being involved in this interview is voluntary, you are under no obligation to consent to participate, and we can stop the interview at any time. You will not be identifiable in reports of this research. Finally, we would like to record today's interview for checking and quality control. Your name will not be stored with the recording.

Are you still willing to be interviewed?

Ok let's get started *[provide similar bridges between questions throughout, frequently thanking participant for their responses]*

1. To start, we would like to get a general sense of how you see *Safe Cycle*.
    a. What is *Safe Cycle* all about?
    b. What is *Safe Cycle* designed to do?

2. Now we would like to hear about your involvement in *Safe Cycle*.
    a. What is your role in *Safe Cycle*?
    b. To what Year do deliver *Safe Cycle?*
    c. What training and support have you received?
        i. When you first started?
        ii. On an on-going basis?
    d. What are your thoughts on the training and support that is available?
        i. Which aspects work well?
        ii. Are there any aspects that you feel could be improved?
        iii. In which areas do you feel you could use additional training or support?
    e. What do you like about your role?
        i. Which aspects work well?
    f. Are there any challenges or obstacles in your role?
        i. What are they?
        ii. How do you deal with them?

3. Next we would like to get your thoughts on the *Safe Cycle* program itself in terms of how well it is going and any barriers or issues which could have the potential to impact the Program's effectiveness.
    a. To what extent do you think that students engage with *Safe Cycle*?
        i. Is the response from students mostly positive or mostly negative?
        ii. What do students say about *Safe Cycle*?
    b. Are there particular aspects of Safe Cycle that students respond well to?
        i. Do you have a sense of what students perceive as the most useful aspect of *Safe Cycle*?
    c. Are there particular aspects of *Safe Cycle* that students do not respond well to?
        i. Do you have a sense of what participants perceive as the least useful aspect of the Program?
        ii. Is there a solution?
    d. Do you feel that there are individual differences in how respond to *Safe Cycle*?
        i. What are they? (explore differences like gender, metro vs rural, socioeconomic background, indigenous status)
        ii. Why?
    e. Do you feel that *Safe Cycle* is appropriate for the age group you deliver it to?
        i. Would you make any changes to *Safe Cycle* to make it more age-appropriate?
    f. Is *Safe Cycle* being delivered as it was originally planned?
        i. Are there any "work-arounds" that have been put in place in order to respond to any challenges with the Program delivery?
        ii. Have you extended the *Safe Cycle* program in any way to reinforce learning goals? If yes, please explain how you extended Safe Cycle.
    g. Do you feel that the Program is achieving its goals?

4. To finish, we would like to get your thoughts on key lessons learnt and insights.
    a. Based on your experiences with *Safe Cycle*, what are the key lessons learnt for conducting cycling education programs for school-aged children?

5. Is there anything further that you think we should cover in this interview?

That's the end of the interview.

Thank you for your time. Your responses will be really helpful in our evaluation of *Safe Cycle*.

Appendix E – Coding sheet for reduction of naturalistic observation footage

School	**Student ID**	**Gender**	
Front camera days	**Front camera time**	**Face camera days**	**Face camera time:**
Ride days	**Number of rides**	**Ride time**	

Front camera

	Opportunity	Practical Riding Skills	Evidence that "No"	Evidence that "Yes"	No opportunity for evidence
1	Riding straight ahead with another cyclist in front	Maintains a gap of around 10m			
2	Approaches pedestrians (incl. scooters)	Slows			
3	Passes another cyclist or pedestrian	Maintains a 1m envelope			
4	Approaches potential hazard (e.g. blind corner, parked cars)	Slows			
5	Meets obstacle – on a road	Swerves around without entering lane of traffic			
6	Arrives at intersection (on path or road) without traffic signals (incl. roundabout) and traffic present	Gives way as required			
7	Arrives at an intersection with a roundabout	Enters from central lane position			
8	Arrives at an intersection with a red traffic signal	Stops			
9	Whole ride	Rides along road (i.e. not just crossing, >1min)			
10	Whole ride	Rides on footpath			
11	Whole ride	Controls safely when travelling straight (no wobbles)			
12	Whole ride	Controls safely when turning (no wobbles)			
13	Whole ride	Brakes safely (ie. no need for sudden braking)			
14	Whole ride	Keeps both hands on handle bars unless signalling			
15	Whole ride	Doesn't engage in high risk behaviour (e.g. wheelies, jumps)			
16	Whole ride	Able to respond to sudden changes in riding conditions (e.g. unexpected uneven surface, or unexpected interaction with another path/road user) to avoid a crash			

Face camera (opportunities to be identified from Front camera)

1	Opportunity	Practical Riding Skills	Evidence that "No"	Evidence that "Yes"	No opportunity for evidence
2	Changes lane on a path or road (including path to/from road)	Conducts rear head checks before merging			
3	Arrives at intersection (on path or road) without traffic signals (incl. roundabout)*	Looks in multiple directions before entering the intersection (including to turn)			
4	Leaves an intersection with a roundabout	Hand signals			
5	Turns	Hand signals			
6	Whole ride	Maintains spatial awareness (looks only where needed for riding task)			