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Evaluating traffic informers: Testing the behavioral and social-cognitive effects of an adolescent bicycle safety education program

Hans Feenstra, Robert A.C. Ruiter, Gerjo Kok *

Faculty of Psychology and Neuroscience, Maastricht University, The Netherlands

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ABSTRACT

In The Netherlands, 12–24 years old are over-represented in the total number of traffic fatalities and injuries. In this study, the traffic informer program – designed to promote safe traffic behavior in the pre-driver population – was experimentally evaluated, with a specific focus on bicycle use. Students were subjected to graphic videos of traffic accidents and listened to a first-person narrative provided by a traffic accident victim. The influence of the program on concepts derived from the theory of planned behavior and protection motivation theory (attitudes, norms, self-efficacy, risk-perception, intention and behavior) was assessed. Students from various schools ($N = 1593$; M age = 15 years, SD = .84) participated in a quasi-experimental study, either in an experimental or a control group, completing self-report questionnaires one week prior to the program implementation and approximately one month after the program implementation. Mixed regression analyses showed significant positive and negative time × intervention interaction effects on attitude toward traffic violations, relative attitude toward traffic safety, and risk comparison, but not on intention and behavior. More research is needed to find effective behavioral change techniques (other than increasing risk awareness) for promoting safe traffic behavior in adolescents. Research is also needed to address how these can be translated into effective interventions and educational programs.

1. Introduction

Teenagers are an identifiable risk group in traffic. Accident analyses have shown that adolescents (aged between 12 and 24 years) are particularly likely to be involved in traffic accidents. In The Netherlands, adolescents account for 12% of the population, and yet each year over 170 adolescents are killed in traffic, and 3000 are hospitalized, accounting for 21% and 19% of all traffic fatalities and injuries respectively (AVV, 2008). Adolescents in the pre-driver age category (i.e., under 18 years of age) are over-represented in the number of traffic fatalities and injuries (Wegman and Aarts, 2006). In this age category, adolescents travel mostly by bicycle (52%), on foot (18%), by moped (3%), are driven by a parent or a friend (17%), or by means of public transport (9%; Wegman and Aarts, 2006). Due to the lack of a protective vehicle (i.e., a car or a bus), the first of these three modes of transport make the adolescent particularly vulnerable in traffic.

The bicycle is the most popular form of transport at any age in The Netherlands – an estimated 8 out of 10 inhabitants own one (Lynam et al., 2005). Adolescents aged between 12 and 17 years use the bicycle for over half of all their trips (Wegman and Aarts, 2006). Traffic safety programs mostly target (young) car drivers, but even though The Netherlands is ranked among the safest countries in Europe in terms of road safety, there is a need for traffic safety education programs targeting more vulnerable adolescent road users. In this study, we experimentally evaluated a traffic safety program (traffic informers) designed to promote safe traffic behavior in the pre-driver population, with a specific focus on bicycle use.

A large body of empirical evidence regarding risk behavior and adolescent decision-making has accumulated over the years, especially in the context of driving (Brijs et al., 2014; Reyna and Farley, 2006; Steinberg, 2007; Webb and Sheeran, 2006). Notwithstanding this large pool of information, when it comes to the pre-driver population, epidemiological data is scarce (Briem et al., 2004; Elliott and Baughan, 2004; Evans and Norman, 2003;

* Corresponding author at: Maastricht University, Work & Social Psychology, P.O. Box 616, 6200 MD, Maastricht, The Netherlands. Tel.: +31 43 388 1908.
E-mail address: g.kok@maastrichtuniversity.nl (G. Kok).

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Hasselberg et al., 2001; Nasar et al., 2008). This is mainly due to the continuous systematic underreporting of accidents and causes of accidents when there are no cars involved (Reason et al., 1990). The lack of research focus on the pre-driving population has resulted in a lack of knowledge about the underlying social cognitive factors that motivate risky traffic behavior, which in turn hinders the systematic evaluation of traffic education programs. Instead, knowledge about underlying social cognitive factors that mediate pre-driver risky traffic behavior is derived from the application of general explanatory models of health behavior (Armitage and Conner, 2000; Brewer et al., 2007; Cooper et al., 2003) and general traffic behavior theories (Rothengatter, 2005; Ulleberg, 2001; Ulleberg and Rundmo, 2003). Factors that have been identified as potential correlates of risky behavior in the pre-driver population include general risk perception (Chapman and Groeger, 2004), specific risk perception in traffic (Beullens and Van den Bulck, 2008; Bina et al., 2006; Bingham and Shope, 2004; Dahl, 2008; Harré, 2000; Keating and Halpern-Felsher, 2008; Kellermann and Martinez, 2008; Machin and Sankey, 2008; Nell, 2002; Rundmo and Iversen, 2004; Shope, 2006), parental influence (Simons Morton et al., 2008; Simons Morton and Hartos, 2003), and the influence of peers (Engstrom et al., 2008; Gardner and Steinberg, 2005; Grosbas et al., 2007; Steinberg and Monahan, 2007).

Many traffic safety interventions have been implemented in a school setting in order to educate the pre-driver population about traffic safety. However, only a very small number of these education programs have been systematically developed or evaluated. As a result, the effectiveness of school-based traffic safety education is largely unknown. The value of theory- and evidence-based development and evaluation of educational interventions has been described in detail by various researchers in the health psychology domain (Bartholomew et al., 2011; Fishbein and Cappella, 2006; Green and Kreuter, 2005; Michie and Abraham, 2004; Schaalma et al., 2004). For example Bartholomew et al. have developed the intervention mapping protocol, a planning framework for the development and evaluation of theory- and evidence-based health promotion programs (Bartholomew et al., 2011; Schaalma et al., 2004). In brief, intervention mapping requires interventionists to identify intervention change objectives, or change targets, and specify commonly-understood behavior change techniques that have been used to bring about these planned changes. By basing such decisions on previous evidence, and documenting the way in which intervention materials are designed, interventionists can communicate clearly about intervention content, thereby facilitating replication and subsequent intervention development (Abraham et al., 2010).

In the present study, the school-based traffic safety education program traffic informers was evaluated. Traffic informers was developed by the Regional Council on Traffic Safety in Limburg (no affiliation with the authors) in order to decrease the elevated risk of pre-drivers in traffic. The program consists of an eight-minute-long video of traffic accidents (in English with Dutch subtitles), and a 30-minute-long narrative by a traffic accident victim in the classroom. The concept of traffic informers was based on traffic education programs used in Denmark (these programs consist of traffic educators, including a person seriously injured in an accident, showing videos of tragic accidents, and playing out dramatic scenes in order to create awareness of risk in school children), and traffic safety videos from the UK. The traffic informer program is currently used in almost every school in the province of Limburg, The Netherlands. With approximately 600 sessions per year, about 80,000 students have participated in the traffic informer program since 2002.

The most defining feature of the traffic informer program is risk communication, whereby confrontation or fear appeals are used in order to motivate participants to adopt safer behaviors (Rogers, 1983). The use of fear arousal is widespread and popular among health education programs, for instance in anti-smoking and anti-drug abuse campaigns (Witte and Allen, 2000). The central persuasive argument that fuels these health campaigns is clear: graphically show people the negative health consequences of life-endangering behaviors and they will be motivated to moderate their current risk behavior and adopt safer alternative behaviors. However, there is a large body of evidence disputing the use of fear arousal as a means of motivating people to change their behavior (De Hoog et al., 2005, 2007; Lewis et al., 2007a,b; Ruiter et al., 2001; Taubman Ben-Ari et al., 2000; Witte and Allen, 2000). In fact, there are examples where interventions based on fear arousal have yielded defensive responses including avoidance of the health information at hand (Kessels et al., 2010, 2014), denial of the health risk (Liberman and Chaiken, 1992), and increased risky behavior (Taubman Ben-Ari et al., 2000). To counter these defensive processes, and promote self-protective action, theoretical frameworks of fear appeals emphasize the need for information about coping mechanisms – specific behavioral instructions about how to effectively deal with the health threat in question (Peters et al., 2013; Rippetoe and Rogers, 1987; Rogers, 1983; Ruiter et al., 2014).

The traffic informer program, as utilized in The Netherlands, is popular with school managers, parents, politicians, and funding bodies. However, there is no empirical evidence for its effectiveness; indeed, the program may be ineffective or even counter-effective. Below, we provide a systematic evaluation of the traffic informer program as it was administered in its normal setting (i.e., in classrooms of secondary schools). A quasi-experimental design was used, in which an experimental group (intervention) was compared with a control group (no intervention, waiting list method) combined with a pretest–posttest design to control for possible differences at baseline. Since the traffic informer program lacked theory-based development, it was not apparent exactly which theoretical premises underlay the program, and therefore constructs from common theories of human behavior were used to evaluate its effectiveness, predominantly the theory of planned behavior (TPB; Ajzen, 1991) and protection motivation theory (PMT; Rogers, 1983). The TPB suggests that the intention to perform (protective) behaviors results from a positive evaluation of the pros and cons of that behavior (attitude), the perceived or estimated approval of peers when carrying out the behavior (or the idea that peers would perform that behavior in similar situations; social norms/influence), and a positive evaluation of the effectiveness or desired outcome of that behavior combined with the expected control one has over the performance of the behavior (perceived behavioral control; Ajzen, 1991). PMT suggests that people adopt protective behaviors after first assessing their risk by evaluating the personal chances of a negative outcome (vulnerability) combined with the severity of that outcome. This resulting risk-perception then creates a motivation for action. Before an action is performed, a positive evaluation of the perceived effectiveness of the recommended behavioral action, and the ability to perform that behavior, is needed (self-efficacy; Rogers, 1983). Self-efficacy, and the similar construct of perceived behavioral control, are thought to be necessary for effective behavior change, in that without them behavior is either not changed, or changed ineffectively (Carey et al., 2013).

The main behavioral outcome of interest in the present study was cycling behavior, which is the most common mode of transport among young adolescents. The expectation of those who developed and organized the traffic informers program was that it would be an effective way of raising risk perceptions through its use of fear arousal and the first-person narrative of a traffic accident victim. As students could be prompted or motivated to change their behavior as a result of the intervention, in the present study we examined the effectiveness of the program with regard to specific indices of risky cycling behavior (i.e., attitudes, intentions and behavior).

2. Method

2.1. Participants

Participants in this study were 9–11th grade students ($N = 1593$) from various high schools in the province of Limburg in the south of The Netherlands, who reported that they ride their bicycle to school more than three days per week. Approximately 10% of the students used their bike less often and were registered as either pedestrians or moped users. These participants were therefore excluded from this study. Nine school boards agreed to participate in the study. These schools varied in size (number of students ranged between 250 and 3700) as well as level of education, (strictly lower general secondary education, strictly higher general secondary education, or a combination of the two). Students from two schools that had planned to use the traffic informer program later in the school year, but had not yet used it, were used as a control group. At time of the baseline measurement, there were 390 participants in the control group (207 female and 183 male adolescents) and 1200 participants in the experimental group (624 girls, 576 boys). The average age of the female adolescents was 14.98 years (SD = .83), with ages ranging from 13 to 18 years. The average age of the male adolescents was 15.01 (SD = .85) with ages ranging from 13 to 18 years. At follow-up, there were 232 participants in the control group (59% retention rate), and 896 participants in the experimental group (75% retention rate).

2.2. Procedure

This study was approved by the Research Ethics Board of Psychology and Neuroscience, Maastricht University. Parental permission was passive: parents or guardians were informed about the study and could refuse to have their child participate by opting out. Participants were informed about the study and told that they could stop at any time without consequence; all gave informed consent.

Testing took place between August 2006 and February 2007. After the schools accepted the invitation to participate in the study, an appointment was made to deliver the pen and paper questionnaires. These questionnaires were usually delivered to the traffic safety teacher or contact, who was then instructed to hand them out in class, one week prior to participation in the traffic informer program. The traffic safety teacher or class mentor was responsible for the administration and collection of the questionnaires. In the experimental condition, the follow-up questionnaire was administered to the classes four weeks after participation in the traffic informer program. In the control condition, follow-up questionnaires were filled out within a one month to six weeks period after administration of the first questionnaire.

2.3. Traffic informer program

Participants in the experimental condition received the traffic intervention program as planned. Participants in the control group did not receive the program at the time of testing, but later in the year. No other program was presented to the control group at the time of testing.

The traffic informer program (as it is currently used in Limburg) is called a 'classroom lesson' – starting with an eight-minute video featuring short clips and commercials involving enacted (but detailed) car crashes. These commercials are common in Australia and Great Britain, but, due to their graphic nature, are not publicly televised in The Netherlands. After the video is shown, the traffic informer (TI), a victim of a traffic accident, tells a personal story about the traffic accident that he or she was involved in. This account usually lasts around twenty to twenty-five minutes, depending on the TI and the amount of time available. Finally, there is room for questions and perhaps discussion.

2.3.1. The traffic informers

At the time of testing, there were thirteen TIs working in the program (12 male, 1 female; aged between 22 and 55 years). Since every TI has his/her own region, only those TIs who were currently working in the schools where the study took place were used. In class, each TI tells his or her own story. There were, therefore, thirteen possible stories the participants could be confronted with. The accidents recounted in these stories ranged from being hit by a car whilst travelling as a car passenger, or being hit as a pedestrian by a car, to driving and crashing a moped at high speed. Remarkably, none of the TIs had experienced a bicycle-related accident. All TIs in the study were experienced within the program, but for some TIs recounting the event leading to their accident can be emotionally strenuous. In fact, the program is in some cases used therapeutically for the TI. In those cases, the scenario of the personal story may be tailored, in that the sequence of events may be told either chronologically or reversed, in order to make it easier for the TI to retell the story.

2.3.2. The discussion

After the traffic performer has finished talking about his life and the traffic accident in question, the students in the class are then asked to participate in a discussion with the TI by asking any questions they may have after hearing the talk.

2.3.3. Objectives

Based on the behavior change method (fear arousal) used in the program, the main objective s to give students an insight into what might happen if they are involved in a traffic accident as a result of risky traffic behavior (i.e., that the consequences can be severe, if not deadly). The program developers may well have hypothesized that an increase in awareness would lead to an adjustment in behavior, in this case less risky cycling behavior (but theory suggests that this would not be sufficient, as discussed earlier).

2.4. Measures

2.4.1. Outcomes

Participants in this study were asked to fill out a questionnaire one week before and one month after the program. The questionnaire contained two parts. The self-reported behavior questionnaire was designed with the Dutch population of adolescents in mind – containing questions about risky cycling behavior. The other part of the questionnaire contained items concerning intention to behave in a risky manner while cycling, attitudes toward risky behaviors, social norms, and perceived behavioral control (TPB-variables), as well as risk susceptibility, risk severity (risk perception), and previous experience with accidents. Higher scores reflect more of the measured concept.

2.4.2. Risky cycling behavior

Self-reported risky cycling behaviors were assessed with a questionnaire containing 22 items ($\alpha = .89$; see Feenstra et al., 2011). Items that were used included: "riding a bicycle while under the influence of marijuana or other drugs", "riding in threes", and "having to brake hard because a car approached faster than anticipated". Participants were asked to state the number of times they had performed these risky cycling behaviors over the past month. Scores on the items ranged from 1 = never to 6 = always.

2.4.3. Risky cycling intention

Intention to perform risky cycling behavior was measured using a combination of three questions reflecting Reason's subdivision of errors (Reason et al., 1990). The first question was "how often in the next month do you intend to break traffic rules?" and pertains to violations (a deviation from what is deemed safe). The second question, "how often in the next month do you expect to get into a potentially harmful situation because of an error you make in traffic?" pertains to mistakes (conscious but wrong decisions), and the third question, "how often in the next month do you expect to break traffic rules unknowingly?" refers to slips and lapses (unconscious errors). Scores ranged from 1 = never to 6 = always (α = .60).

2.4.4. Safe cycling and self-efficacy

Self-efficacy concerning traffic skills was measured using an average score on items measuring five issues (α = .65): "compared to other cyclists of your age and sex, how do you perform in terms of: controlling the bicycle, applying traffic rules, traffic situation insight, ability to withstand temptations to take risks, and ability to withstand peer pressure?". Response options ranged from 1 = much worse to 5 = much better. Higher scores represent more confidence in one's skills.

2.4.5. Risk comparison

Participants were asked about their comparative risk judgment in terms of becoming involved in a traffic accident with a single item: "compared to other bicycle riders of my age and sex, my risk of being involved in a traffic accident is . . . " with response options ranging from 1 = much smaller to 5 = much higher (Harré, 2000).

2.4.6. Attitude toward traffic violations

Attitude toward violating traffic rules was measured using the combined score of five items (e.g., "it should be up to me whether I obey the traffic rules or not", "with no traffic in sight, stopping in front of a red light makes no sense"; α = .67). Response options ranged from 1 = totally disagree to 5 = totally agree, with higher scores thus representing a more positive attitude toward making traffic violations.

2.4.7. Attitude toward drunk driving

Attitude toward drunk driving was measured using four items (e.g., "if someone is half-drunk, I do not mind him riding a bike", "everyone riding or driving in traffic has to be sober"; α = .77). Response options ranged from 1 = totally disagree to 5 = totally agree. Some items were recoded so that higher scores represent a more positive attitude toward drunk driving.

2.4.8. Personal norm: safety for self

Attitude toward one's own risk was measured using two items: "I believe I should behave myself in traffic, and not only when there is cops around", "I think it is important not to endanger myself" r = .50). Response options ranged from 1 = disagree to 5 = agree.

2.4.9. Personal norm: safety for others

The personal norm toward endangering others was measured using the average score of five items (e.g., "everyone knows that riding or driving in traffic is risky. If someone gets hurt because of that, too bad (recoded)", "i would feel terrible if someone would get hurt because of me"; α = .68). Response options ranged from 1 = disagree to 5 = agree.

2.4.10. Relative attitude

In order to obtain a direct measure of attitude toward traffic safety, but avoid ceiling effects because of general positive evaluations of the importance and need for traffic safety, participants ranked traffic safety among six other health behaviors (i.e., "exercise", "healthy eating", "moderate drinking", "not smoking", "not doing drugs", "having safe sex") in order of importance and sensibility (r = .52). Scores on the combined scale ranged between 1 and 7, and lower scores represent more positive attitudes toward traffic safety compared with other health behaviors.

2.4.11. Perceived risk taking

The participant's personal estimate of risk taking was measured using three items (α = .72): "how much risk do you take in traffic as a moped rider/bicyclist on your own?", "how much risk do you take in traffic as a moped rider/bicyclist in a group of friends?", and "how much risk do you take in traffic as a pedestrian?" response options ranged from 1 = I do not take risks to 5 = I take quite a lot of risks.

2.4.12. Accident experience

Two items measured participants' own experience with traffic accidents: "have you had an accident in the past two years that was so severe that you had to visit a doctor or hospital?" (response options were 1 = no, 2 = nothing serious, 3 = had to see a doctor, and 4 = had to go to hospital), "have you had an accident in the past two years in which you only had material damage?" with scores ranging from 1 = no to 4 = more than twice. The scores on these items were combined to form one index of personal experience (r = .34).

2.4.13. Near accidents

One question measured the number of near accidents in which participants were involved: "how often have you almost had an

Table 1
Means, standard deviations, and *F*-values of non-significant variables.

	Control *M* (SD)		Experimental *M* (SD)		*F*-value		
	t_0	t_1	t_0	t_1	Condition	Time	Interaction
Risky behavior	2.03 (.13)	2.05 (.14)	1.92 (.12)	1.87 (.13)	(1, 2613) = 7.06**	(1, 2613) = .12	(1, 2613) = 2.54
Risky intention	1.89 (.76)	1.99 (.88)	1.85 (.77)	1.85 (.77)	(1, 2574) = 10.38**	(1, 2574) = .45	(1, 2574) = .015
Safe cycling self-efficacy	3.43 (.56)	3.54 (.59)	3.43 (.55)	3.48 (.58)	(1, 2575) = .65	(1, 2575) = 3.02	(1, 2575) = .72
Risk comparison	2.63 (.86)	2.54 (.87)	2.59 (.84)	2.65 (.80)	(1, 2571) = .43	(1, 2571) = .92	(1, 2571) = 3.89*
Attitude traffic violations	3.11 (.77)	2.95 (.80)	2.86 (.79)	3.14 (.71)	(1, 2648) = 44.29***	(1, 2648) = .00	(1, 2648) = 33.15***
Attitude drunk driving	2.11 (.82)	2.48 (.83)	2.41 (.80)	2.48 (.80)	(1, 2676) = .01	(1, 2676) = 1.92	(1, 2676) = .32
Social norm: responsibility	3.87 (.69)	3.73 (.71)	3.83 (.69)	3.81 (.68)	(1, 2680) = 1.54	(1, 2680) = 5.45*	(1, 2680) = 2.64
Social norm: others	3.53 (.55)	3.48 (.58)	3.56 (.53)	3.56 (.53)	(1, 2652) = 1.57	(1, 2652) = .00	(1, 2652) = .001
Relative attitude	5.02 (1.68)	5.20 (1.57)	4.34 (1.74)	4.25 (1.76)	(1, 2600) = 25.62***	(1, 2600) = .29	(1, 2600) = 5.79*
Accident experience	1.34 (.59)	1.32 (.54)	1.37 (.60)	1.30 (.55)	(1, 2668) = .16	(1, 2668) = .98	(1, 2668) = .04
Near accidents	1.53 (.73)	1.38 (.75)	1.46 (.67)	1.36 (.62)	(1, 2646) = 2.32	(1, 2646) = 5.67*	(1, 2646) = .42

* $p < .05$.
** $p < .01$.
*** $p < .001$.

accident?", with response options ranging from 1 = practically never to 4 = practically every week.

2.5. Statistical analyses

Since a pre-existing difference between the experimental and control group at baseline was apparent, both ANCOVA and 'change from baseline' were tested, bearing Lord's ANCOVA paradox in mind (Lord, 1967; Van Breukelen, 2006). We did indeed find a difference between the Change from baseline and ANCOVA model (i.e. Lord's ANCOVA paradox) and tested whether both models would yield similar results for the control condition only. It became apparent that using the ANCOVA model, a difference between the two schools in the control condition was found, after which it was decided to opt for the Change from baseline model, which is the safer model if the study design is not a randomized controlled trial (which it is not; Van Breukelen, 2006). Therefore, repeated measures analyses were used to evaluate the effect of the traffic informer program on the outcome variables. More specifically, the linear mixed model regression analysis module in SPSS (version 15.0) was used to accommodate for participants with missing values on either of the two measurements. No information about which participants had seen which TIs was available, making a multilevel approach impossible, and therefore the traffic informer program had to be taken as a whole.

3. Results

Outcomes of the mixed regression analyses are displayed in Table 1. On three variables, a significant intervention by time interaction was found, which describes the effect of the intervention. Subsequent simple effect analyses were used to further explore the nature of this interaction.

A significant interaction effect was found on attitude toward traffic violations. Simple effects analysis revealed, at baseline (before the intervention), a significant difference between the conditions, $F(1, 1548) = 25.91$, $p < .001$, Cohen's $d = .32$; participants in the control condition reported more positive attitudes toward making traffic violations (which is undesirable) than those in the experimental condition. After the intervention, this effect reversed, in that at follow-up there was a significant difference between the conditions, $F(1, 1099) = 10.49$, $p < .01$, Cohen's $d = .26$, with participants in the experimental condition reporting more positive attitudes toward traffic violations than those in the control condition. Note that this effect runs counter to the program objectives.

Another significant interaction effect was found on the variable risk comparison. Simple effect analyses showed, at baseline, no significant difference between conditions, $F(1, 1528) = .50$, ns, Cohen's $d = .04$; participants in the experimental condition scored as high as participants in the control condition. At follow-up, a significant difference between conditions was found, $F(1, 1040) = 4.11$, $p < .05$, Cohen's $d = .16$. Participants in the experimental condition indicated their risk to be higher than those in the control condition, (participants in both conditions were asked to compare themselves to others of similar age and sex).

The last significant interaction effect was found on relative attitude. Single effect analyses showed a difference between conditions at baseline, $F(1, 1534) = 22.66$, $p < .001$, in that participants in the control condition reported a less positive attitude toward traffic safety than those in the experimental condition. This effect became stronger at follow-up, $F(1, 1066) = 45.93$, $p < .001$, where participants in the control condition scored higher than before, and participants in the experimental condition scored lower than before. A lower score means that traffic safety was ranked higher among other protective behaviors. These findings thus support the program objectives.

4. Discussion

The aim of this paper was to evaluate the traffic safety program traffic informers, which is currently implemented in the province of Limburg, The Netherlands. The program has been widely adopted and both policy makers and users (i.e., schools and students) are very enthusiastic about it. To the best of our knowledge, the program was not developed in a systematic manner; that is, the program was not grounded in clearly formulated theoretical principles or available empirical evidence. Rather, the program developers adopted a confrontational approach, which they believed to be effective in 'waking up' the participants, by showing graphic videos of accidents and having a victim of a traffic accident talk about the repercussions of the accident in the classroom. Some items were recoded so that higher scores represent a more positive attitude toward drunk driving.

The results of the present evaluation provide little support for the effectiveness of the traffic informer program, as reflected in both the self-reported behavior of the participants and in intentions to perform less risky traffic behavior. In fact, one of the three significant results we found was in the opposite direction to that expected in terms of the program objectives. The attitudes toward violating traffic rules became slightly more positive after participation in the program. This result was significant, but had a small effect size. Two other significant results were in the desired direction. First, after participating in the traffic informer program, students indicated that traffic safety was significantly higher on their priority list of health behaviors than it was before the program. Second, participants who participated in the traffic informer program judged their own risk of becoming involved in a traffic accident (as compared to their peers) slightly higher than they did before participating in the program. These results, however, had small to negligible effect sizes, which suggests that the significance of the results was more likely due to the number of participants in the study, rather than to the effect itself. Our finding does not stand alone; Moan and Ulleberg (2007) found the same lack of effect in a comparable Norwegian program ("being dead isn't cool"). Twisk et al. (2014) evaluated five road safety education programs, including traffic informers, and also reported a lack of effect for traffic informers.

There may be a number of reasons contributing to the lack of effectiveness of the traffic informer program. First, there have been years of debate surrounding the use of confrontational messages (or fear-appeals) in health messages (Biener and Taylor, 2002; Hastings and MacFadyen, 2002; Janssens and De Pelsmacker, 2007; Slavin et al., 2007). It appears to be the case that the fear-arousing messages in the traffic informer program are not at all effective. These results are in line with other studies that have used fear-appeals, including another study about traffic informers (Moan and Ulleberg, 2007; Twisk et al., 2014), and two meta-analyses (Peters et al., 2013 regarding fear appeals; Carey et al., 2013 regarding traffic education). Psychologically, fear is a powerful tool that can be used to attract attention to something. The use of fear in awareness-raising messages is therefore somewhat logical. Fear-arousing messages are hence often used in traffic safety campaigns, anti-smoking advertisements, and HIV/AIDS campaigns (Witte and Allen, 2000). However, in contrast to lay beliefs about the effectiveness of fear appeals, several studies suggest that fear arousal may actually result in defensive reactions such as risk denial, biased information processing, and the allocation of less attention to the health information at hand (Kessels et al., 2014; Ruiter et al., 2014). Thus, the effectiveness of the fear appeal in terms of achieving the desired goal (i.e., a change from risk behavior to safe behavior), depends on more than fear arousal alone (Ruiter et al., 2001). Without advice on how to avert the consequences of the fear-arousing message, the possibility of counter-effective responses is all too real. The use of confrontational messages is often requested by those who are on the receiving end (e.g., the smokers, the risky drivers, thos practicing unsafe sex), but these individuals are not really experts on the effectiveness of such messages (Hastings and MacFadyen, 2002; Peters et al., 2014; Ruiter et al., 2014 ; Kok et al., 2004; Ten Hoor et al., 2012): "current evidence shows that information about the severity of possible negative consequences from risk behavior may prompt defensive responses. These counterproductive responses may be avoided by providing instruction on how to successfully implement the recommended actions as well as convincing people that they are personally susceptible to the threat."(Ruiter et al., 2014, pp. 68).

Furthermore, the traffic informer program was probably insufficiently tailored to the desires and motives of the students. Since the goal of the program is to influence adolescents' current traffic behavior, it would have made much more sense to show videos of bicycle (or pedestrian) accidents, and to select TIs that would be able to talk about bicycle accident scenarios. In light of the fact that these participants were about 15 years old, i.e., three years below the legal car driving age in The Netherlands, it could be argued that investigating the risky car driving intentions of participants was not particularly useful. The idea that confronting 15-year olds with car accidents will lead to safer bicycle riding behavior is questionable; these participants will not easily identify with the TI as a person and also not with the described behavior of the TI (Bartholomew et al., 2011; McAlister et al., 2008). As mentioned earlier, participants may not experience personal susceptibility or feel confident about how to avoid or prevent accidents in their own situation.

This study has some limitations. First and foremost, because the program itself was not based on theoretical frameworks underlying health behavior or empirical evidence, a systematic evaluation closely geared toward the objectives of the program was practically impossible. However, the evaluation was performed as scientifically as possible given the natural setting. Second, because there is a lack of empirical data on specific behaviors that directly increase the risk of an accident in traffic, the variables used to predict behavior and intentions were not measured on the same level as the behavior itself, thus neglecting the correspondence principle (Fishbein and Ajzen, 1975). Third, as yet, few theories have addressed the risky traffic behavior of cyclists. Many explanations have been put forward as to why adolescents show more risky behaviors, in general and more specifically in traffic (Reyna and Farley, 2006; Dahl, 2008; Keating and Halpern-Felsher, 2008; Shope and Bingham, 2008). However, theory-driven tools for evaluating behavioral interventions to promote safe traffic behavior are somewhat lacking. In this study, the theory of planned behavior was used, but there are several ways in which the research could be extended. For example it remains unclear which risky cycling behaviors are planned and which are not. Moreover, it remains to be seen which cognitive factors drive these behaviors, and, for e.g., in what way unconscious or automatic processes might influence these behaviors. Fourth, shortcomings in the available data made it impossible to use multilevel analyses, even though the design was nested (student within class, class within TI, and class within school). By not accounting for the nested nature of this design, group differences may have been weakened or masked entirely. Finally, quasi-experiments in natural settings are hard to evaluate, since many factors that can potentially influence the outcome cannot be controlled, as they can be in an experimental setting. These issues affected the evaluation of the traffic informer program, including the choice of analysis methods. However, the large number of students participating in this study should have at least revealed sturdy effects, if there were any.

As a first step in the development of theory- and evidence-based behavioral interventions (Bartholomew et al., 2011), a clear insight into what exactly constitutes the risky behaviors of adolescent cyclists (and moped riders) is essential. When specific behaviors that contribute to an increased risk in traffic are identified, the personal and external determinants of these specific behaviors must also be identified. Only then can interventions be designed to target those determinants in order to change the risky behavior into the desired safe behavior. As epidemiological data about the specific risky behaviors of cyclists is unavailable, there is a need for future research in this field.

In conclusion, the traffic informer program does not seem to have the desired effect (i.e., it does not appear to promote a change in behavior in a safe direction). Luckily, the evidence pointing in the direction of any negative consequences of the program is minor. For the development of future interventions and programs targeting adolescents in traffic, more research is needed. This should focus on finding effective behavioral change techniques for the promotion of safe traffic behavior, and the translation of these techniques into effective educational programs that do not use confrontational and fear-invoking messages.

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Conflict of interest

None of the authors have any conflict of interest.

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