

Development of an innovative technology-based youth passenger safety program: An evidence-based approach

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Abstract

Young drivers are overrepresented in motor vehicle crash rates, and their risk increases when carrying similar aged passengers. Graduated Driver Licensing strategies have demonstrated effectiveness in reducing fatalities among young drivers, however complementary approaches may further reduce crash rates.

Previous studies conducted by the researchers have shown that there is considerable potential for a passenger focus in youth road safety interventions, particularly involving the encouragement of young passengers to intervene in their peers' risky driving (Buckley, Chapman, Sheehan & Davidson, 2012). Additionally, this research has shown that technology-based applications may be a promising means of delivering passenger safety messages, particularly as young people are increasingly accessing web-based and mobile technologies. This research describes the participatory design process undertaken to develop a web-based road safety program, and involves feasibility testing of storyboards for a youth passenger safety application.

Storyboards and framework web-based materials were initially developed for a passenger safety program, using the results of previous studies involving online and school-based surveys with young people. Focus groups were then conducted with 8 school staff and 30 senior school students at one public high school in the Australian Capital Territory. Young people were asked about the situations in which passengers may feel unsafe and potential strategies for intervening in their peers' risky driving. Students were also shown the storyboards and framework web-based material and were asked to comment on design and content issues. Teachers were also shown the material and asked about their perceptions of program design and feasibility. The focus group data will be used as part of the participatory design process, in further developing the passenger safety program.

This research describes an evidence-based approach to the development of a web-based application for youth passenger safety. The findings of this research and resulting technology will have important implications for the road safety education of senior high school students.

Key words: Youth road safety; passenger safety; web-based program; participatory program design.

1. Introduction

Motor vehicle crashes (MVCs) are the leading cause of adolescent and young adult death. In Australia during the years 2005-06, 98 per 100,000 young people aged 12 to 17 years were hospitalised for an injury resulting from an MVC (Australian Institute of Health and Welfare, 2008). Young drivers are also overrepresented in MVCs. Data from the US shows that teenage drivers are four times more likely than older drivers to be involved in fatal crashes (Insurance Institute for Highway Safety, 2009). Young driver crash risk increases with the number of similarly aged passengers (Chen, Baker, Braver & Li, 2000). For example, South Australian statistics from 2005 to 2009 reveal that 30% of 16 to 19 year old drivers involved in fatal crashes were carrying two or more passengers, while comparative fatal crash data shows that 19% of 20 to 24 year old drivers and 12% of those aged 25 and over were carrying multiple passengers (South Australian Government Department for Transport,

Energy and Infrastructure, 2012). Passenger injuries are a serious related problem. For example in Queensland in 2009-10, 166 teens aged between 16 and 19 were treated in hospital for serious passenger-related injuries (Queensland Trauma Registry, 2011). Self-report data from Queensland young people aged 13-14 years also shows that 14% report a passenger-related injury in the past 6 months, of which 17% required some form of medical treatment (Chapman & Sheehan, 2005).

The current, effective approach to reducing young driver crashes is Graduated Driver Licensing (GDL). GDL systems involve a three-stage licensing process, which require young novice drivers to progress through stages of supervision and restriction prior to full licensure. A number of restrictions exist under GDL systems and include, for example, the number of passengers that young drivers are permitted to carry at specific times. In Queensland, for example, young novice drivers may only carry one passenger less than 21 years of age, excepting family members, between 11pm and 5am (Queensland Government Department of Transport and Main Roads, 2011).

GDL systems have proven to be effective in reducing young driver crashes, with a systematic review of studies during the years 2002 to 2007 revealing a reduced crash risk of approximately 20 to 40% (Shope, 2007). Additionally, evaluation of specific GDL components has shown that passenger restrictions, among other program components, have had significant effects on young adults' fatality risk (Vanlaar et al., 2009). One recent US study has shown that passenger restrictions have reduced fatal crashes among 16 to 17-year-old drivers by an estimated 9% (Fell et al., 2011).

GDL systems have significantly impacted on young driver crash risk, however complementary strategies may further reduce crash rates. To date, for example, the potential for peer and passenger-focused strategies has been largely overlooked (Williams, 2006). Developmental research has shown that peer groups become increasingly important throughout adolescence and that peers may act to shape young adults' behaviour. Although peer influence has commonly been considered as a risk factor for young peoples' risky driving, more recent research has suggested that peers exert protective effects on other young people through intervening behaviour. A study conducted with 509 college students in the US showed that over half of the participants (57%) reported having driven or walked home someone who had been drinking in the previous two months. Recent research by the authors also showed that approximately half (46%) of a sample of 393 young females (17 to 25 years) had a recent experience of intervening with a friend who was going to drive after drinking, and that this was more often considered effective than not (Buckley et al., 2012).

Young driver education and behaviour change programs may be combined with GDL to further contribute to reductions in young driver crash rates (Williams, 2006). Programs may attempt to increase the likelihood that young people will protect their peers in risky driving situations, and web-based strategies may be an important means of targeting this change. Recently, research has shown that web-based programs are a promising means of delivering health behaviour change messages, particularly as young people are increasingly accessing the Internet and mobile technologies. Previous research by the authors has shown that, among a sample of 72 Grade 12 students in a low socio-economic area of Queensland, 100% reported Internet access at home or school, and 74% had searched for road safety information (Chapman, Buckley & Sheehan, 2009). Of these young people, 87% said that they would visit an interactive, educational passenger safety website, suggesting the potential for web-based methods of road safety program delivery (Chapman, Buckley & Sheehan, 2009). A number of web-based programs have in the past been developed and evaluated for changes in young adults' health risk behaviours including smoking, violence and alcohol use, with some promising results showing success in changing knowledge of and attitudes to risk behaviours, or the behaviour itself (e.g., Escoffery, McCormick & Bateman, 2004; Schinke, Noia & Glassman, 2004; Wall, 2007).

Web-based programs have a number of advantages over traditional means of health information delivery, including novelty and appeal, flexibility, interactivity, as well as the opportunity for individually tailored information and the facilitation of interaction and social support (Ferney & Marshall, 2006). Web-based strategies also provide a critical medium that has the potential to be incorporated in classroom-delivered safety promotion messages that can then also extend beyond the classroom. Despite their advantages, however, web-based programs have to date been limited by poor participant adherence and engagement (Leslie et al., 2005). In order to address this issue, user-centred or participatory design methods have been proposed, whereby the target participants are consulted throughout the development process in order to ensure their preferences for website functions, content and design are understood (Corry, Frick & Hansen, 1997).

1.1. Research aim

The aim of the current research was to describe the participatory design process undertaken to develop a web-based road and passenger safety program for senior school students. Specifically, this research tested the feasibility of storyboards and the initial design of a web-based module for youth passenger safety and peer protection in risky driving situations.

1.2. Current program

Framework content and design for the web-based program was based on previous focus group research with young people in Queensland state high schools. This previous research examined risky driving situations, intervening behaviours and factors influencing intervention, as well as Internet usage for road safety information, and perceptions of key components of youth road safety sites.

Three scenarios were developed based on students' indications of risky driving situations, upon which activities were based. The text for these scenarios was based on the following:

1. Character driving a group of friends to a party after a fight with his girlfriend. Driver was emotional, texting his girlfriend and driving too fast. A crash ensued.
2. Character driving a group of friends on back roads late at night; speeding down hills. Lost control on a steep hill. A crash ensued.
3. Character assigned as designated driver but had a few drinks. Insisted on still driving, and was changing music on his iPod. A crash ensued.

Activities were developed, based on key components of sites as indicated in the earlier research, which related to the three scenarios. These activities included:

- Identifying factors that contributed to the crash
- Assessing benefits and costs relating to protective strategies (driver and passenger); and identifying own strategies for each scenario
- Choosing the best protective prevention method, and identifying reasons for choice.

Several activities were also designed to be independent of the scenario-based exercises. These included:

- Identifying safety levels within risky passenger situations and self-assessing confidence to intervene
- Identifying verbal and active intervention strategies within a drink driving situation
- Learning first aid techniques for dealing with MVC-related injuries, and considering prevention strategies to avoid injury.

Each of the scenarios and related and independent activities were designed to be interactive and to encourage an understanding of cognitions and behaviour. A web developer translated them into web-based format, and incorporated design elements (e.g. colour, font, pictures) to be visually appealing and engaging for young people. Each of the scenarios and activities

was designed to be accessible from a homepage, which outlined the aim of the website and provided the developers' contact details.

2. Method

2.1. Participants

One high school in the Australian Capital Territory was recruited for the current research. While there are limitations associated with a small sample restricted to one school, this data was collected in the context of a wider developmental research program involving additional focus groups in Queensland high schools, informing the web design process. Practical constraints limited wider sampling for this component of the research.

Parental consent to participate was obtained for N=30 senior students (aged 16 to 17 years) from one class. Additionally, N=8 school staff were recruited at that same school. These staff members were from different teaching departments throughout the school, and were approached by the Pastoral Care Coordinator to participate.

2.2. Materials

A detailed focus group protocol was developed for both the student and teacher discussions. Students were asked questions relating to the situations in which passengers may feel unsafe and potential strategies for intervening in their peers' risky driving. The groups of students were also shown the storyboards and framework web-based material and were asked to comment on design and content issues. Teachers were also shown the material and asked about their perceptions of program design and content. Teachers were asked questions relating to the feasibility within the school context. Example questions for the student and teacher focus groups are shown in Table 1.

Table 1. Example focus group questions

Topic (<i>Group asked</i>)	Example questions
Passenger safety and intervention (<i>Students</i>)	What situations might make a passenger feel unsafe? (<i>After introducing various risky driving scenarios</i>) What things can passengers do in this situation?
Web-based program design (<i>Students & Teachers</i>)	What is your first impression? Prompt on: Design/Layout, Colour, Fonts What do you like about it? What do you dislike about it?
Web-based program content (<i>Students & Teachers</i>)	(<i>After presenting risky driving scenarios in web program</i>) How realistic are these stories? What sorts of things would you like to see as activities?
Web-based program feasibility (<i>Teachers</i>)	What, technically, is feasible to incorporate into classroom web-based programs? How would you facilitate interaction and discussion with a classroom web-based program?

2.3. Procedure

Approval to conduct this research was initially obtained from the school principal as per the ACT Department of Education and Training and the university (QUT) research protocol. Parental consent was obtained prior to the students' participation by sending an information sheet and consent form home about the focus groups. Students were only able to participate with written parental consent. Teachers and students were also provided with information

sheets and consent forms prior to the focus groups, and gave their own written consent before participating.

All of the focus groups were held during school time. Two facilitators conducted two groups with students over approximately 45 minutes, during one class period. A single teacher focus group was conducted over lunch, and teachers were provided sandwiches to thank them for their participation. Each of the focus groups was audio recorded with the participants' permission, and later transcribed.

2.4. Data analysis

The qualitative data was analysed using thematic analysis. The first author firstly read all data repeatedly for immersion. No notes were taken during this time. Following repeated readings, the coding process was conducted using an inductive approach to identify codes and themes progressively throughout analysis (Hsieh & Shannon, 2005). The coding process involved examining and categorising data based on words and phrases used across participants and throughout data items, and tagging and labelling data extracts. The labelled codes were then grouped according to the common underlying theme that they expressed. The first author undertook the analysis, however to ensure reliability and validity of the coding process and to form a complete understanding of the data, frequent consultations were held with the other authors. During these consultations, transcripts were re-read, interpretations were discussed and clarified, and themes were agreed upon.

3. Results

3.1. Passenger safety and intervention

Results relating to passenger safety and intervention came from the student focus groups. Responses to these issues related to two themes: risky driving situations in which young people feel unsafe, and strategies for intervention.

3.1.1. *Situations in which students feel unsafe*

Students mentioned both general and specific situations in which they would feel unsafe in a car. Generally, students mentioned the risky behaviour of the driver, for example *'if they were being irresponsible or stupid while driving'*, *'just being dangerous in general'*, and *'if they're not cautious on the road'*.

Specifically, students primarily mentioned *'drink driving'* as a situation in which they would feel unsafe, as well as when the driver is *'not bothering about seatbelts or speed'*.

3.1.2. *Intervention strategies*

Overall, students indicated that they would intervene in the risky driving behaviour of their friends, and that they think about protecting their peers. They suggested that they try to act responsibly toward their friends (*'you want to do the right thing'*, and *'you want to make sure your friends are okay'*.) In regards to protecting their friends, one student said, *'you plan to keep an eye out for people'*, although as another followed on, *'but you're not like being their mother the whole time'*. Students described the protection of their friends as an instinctive process, although they do sometimes think and plan for this before an event. For example, one student said that looking out for their friends would be a *'bit of instinct'* and another said *'you would probably plan'*. Another student suggested that *'it would be a bit of both'*.

Students discussed intervention strategies in the context of drink driving friends, as well as a driver who has had a fight with his girlfriend and is texting her on a mobile phone as he drives. Regarding the friend who is texting while driving, students initially discussed an active intervention, such as *'rip the phone off him, throw it out the window'*, however this was then discussed by the group as potentially having more negative consequences (*'that would make*

him more angry'). One student suggested that they would *'just like politely...like tell him about it and ask him to stop and not make him angry'*. The group of students also suggested strategies prior to getting in the car, such as *'ask him how he is'*, *'wait and calm them down, and then drive'*, and *'offer to drive instead'*, however they also indicated that this depends on their capacity as a passenger, for example, *'depends on your state of mind, if you've been drinking'*, and *'you have to be fine as well, if you're a passenger'*. One student indicated that passengers also hold a position of responsibility in the car, suggesting that *'you could get in, but you have to act as like a second eye on the road as well, so like point out things that he might not see'*. In the context of a drink driving friend, students also indicated their responsibility as potential passengers (*'it is our responsibility; you have to be grown up about it'*). Many of the responses relating to the drink driving situations related to actions prior to getting into the car, such as *'do something at the party, before you get in the car'*.

Students were also asked about their confidence regarding attempts to intervene in friends' risky driving. The students were unanimous that they would intervene with a good friend (*'if it's a good friend, yeah'*), however had mixed responses regarding acquaintances or strangers. Some said that they would not actively intervene (*'I wouldn't think so, not if I didn't know them'*), but would avoid the situation, for example, by seeking another means of transport (*'walk'*). Others, though, suggested that they *'would still say, even if I didn't know them that well'*, because *'they're putting you in danger'*.

3.2. Program design and content

Three major themes emerged from both students and teachers within the topic of program design and content, relating to 'visual appeal', 'interactivity' and basing the site on 'real life situations and solutions'. Recommendations for program design and content as raised by the student and teacher participants are summarised in Table 2, and presented in more detail in the following sections.

Table 2. Recommendations for design and content of a passenger safety website for young people

Theme	Recommendation
Visual appeal	<p>Include pictures and animation, and not too much text</p> <p>Colours that 'work together'</p> <p>Have the right 'look' for the target age group</p>
Interactivity	<p>Incorporation of feedback mechanisms</p> <p>Games and quizzes</p> <p>Videos and opportunities for practice in class</p>
Real life situations and solutions	<p>Base on scenarios that are realistic for target group</p> <p>Ideas and strategies for real life risky situations</p> <p>Accounts of peers</p>

3.2.1. Visual appeal

Students and teachers agreed that the website should incorporate pictures and animation and not rely heavily on text. For students, too much text makes a site *'boring'* and *'plain'*, and would make them want to navigate away from the page. The students indicated that a web-based program would *'need pictures'*, although did indicate that the pictures included in the framework material were *'cool'* – the site just needed more of them. Specifically, the students suggested that the site *'needs something that catches the eye first, and then bring it in to the information'*.

Teachers also suggested that *'boys like animation'*, and that *'cartoony stuff is definitely something that they relate to...it's the drill-in point for them, so they don't go, oh here we go, it's another bit of education'*. Some teachers also indicated that pictures and graphics are a *'visual language'* students are *'comfortable and familiar with'*. Several of the teachers also suggested that the initial, framework version of the web-based program looked *'very much like a test'*, and that this *'would probably turn kids off pretty quickly'*, indicating that a *'more graphic interface'* was needed.

Students were the only group to comment on the colours used on the site, and suggested that it needed to make use of *'colours that work together more'*. They commented that the colours used within the framework material looked *'weird together'*. The students also mentioned that the program *'kind of looks like it's for children'* and that it needed to be made to *'look a bit older, like for older people'*. The colours and graphics were suggested as means of making the program *'look'* like it was targeted toward their age group.

3.2.2. Interactivity

Both the students and teachers indicated that the web-based program should incorporate interactive activities. Teachers indicated that feedback mechanisms within interactive website activities were *'critical'* for maintaining students interest; *'where they see a feedback mechanism is where they will want to engage and then continue'*. This individualised feedback was suggested by teachers as being incorporated into interactive game activities, with one teacher suggesting *'avatars'*; for example, *'an avatar who they'd have to safely navigate through various scenarios and see if they survive'*. They saw this as potentially transferring to their own decisions within risky situations; for example, *'that might give them a sense of reason for why you make those decisions....what if that's actually me at the party having to make these choices'*.

Students also mentioned that they would like interactive activities, like *'a car game'* or *'quizzes'*. A pair of students talked about a quiz that had recently been conducted in class, where the teacher *'had a projector, she put up questions. And we had like teams and all that, and we had to get points, and the team that got the most points won'*. Other students agreed with the idea of quizzes; *'yeah I reckon quizzes would be best, where the teacher and the whole class can work through it'*, and *'maybe quizzes of varying difficulty'*.

The students also mentioned that they would like videos that demonstrated practical skills (*'yeah maybe like videos or something, on like what you should do'*), and that videos would enable them to learn at their own pace (*'so you can pause and start again', 'step by step'*). One student did however suggest that practice would need to take place within the class context as well (*'online it's a bit difficult, you can't like practice it'*). The students also did acknowledge that videos might not be possible in all cases, and that an alternative may be *'those cartoon things from before'*.

Of note, both students and teachers indicated that a web-based program needed a *'combination of activities that took place both online and within the actual classroom context'*. For example, one teacher suggested that *'I wouldn't just make it game, game, game...there's a balance between reading, feedback, interactivity, you know, breakout teacher-based things. It's the combination of all those things that will touch on different levels of people's learning'*.

3.2.3. Real life situations and solutions

The participating students indicated that each of the scenarios included within the framework materials was realistic for their age group (*'it could be anyone; especially when people have drunk alcohol'*). The teachers agreed that the web program should include *'scenario-based stuff'*, and also suggested that it should give examples of solutions or strategies that young people can use in risky driving situations (for example, *'a script, a set of fall-back scripts that they can use'*). The students also saw example strategies as useful, and suggested that the

web-based program should include *'a page for what to do if...'*, and *'solutions for if you're in bad circumstances'*. Several students also indicated that examples are useful; however that the program should also enable students to generate own strategies that are individually relevant.

A further suggestion arising from the teacher group was the inclusion of real life accounts from young people or peers. One teacher indicated that when they taught sex education in class, *'when they really started engaging was actually a website that had accounts of peers from their own group'*. The teachers saw real life scenarios and accounts as being a *'hook in'*, that would engage students. For example, one teacher suggested that *'a lot of...distracted students engage in things that are, hey this isn't school, this is life, and they suddenly focus'*.

3.3 Program feasibility

Results relating to program feasibility came from the teacher focus groups. The teachers indicated that web-based programs are able to be run in classes, particularly in lab rooms where computers are available, and suggested that potential difficulties, such as for example, audio-based web activities are able to be overcome. For example, in a discussion of narrated online content on individual computers, teachers suggested that *'it's probably just more like classroom management and setup; you can arrange those things to suit. Turn it down, put some headphones on, work in a group, so not just have one each...So you wouldn't necessarily compete with 27 different sound things happening at once'*.

The teachers did however indicate that students would require a large degree of direction in their use of the web-based program in class, and that without the teacher's presence and direction, they would not complete the program activities. For example, one teacher who had previously taught an online curriculum indicated that *'kids don't drill into that unless the teacher is the catalyst to it, and you've got to be the animated person at the front drawing things, showing them some things on the website, and they will read it, but they won't read it to the level you'd think they would...you'd think that's their world, because there's this perception where adults and school boards and principals go, that's the future of education, and you talk to the students and they go, I wouldn't do it if you weren't showing me how to do it'*. The teachers suggested that a program must incorporate interaction with teachers as the *'motivating factor'* that would encourage their completion of the web-based content.

4. Discussion

Web-based behaviour change programs are becoming increasingly used within public health practice, however to date have been limited by poor participant adherence and engagement (Leslie et al., 2005). A user-centred or participatory approach to program design can enhance the usability and appeal of intervention programs (Ferney & Marshall, 2006). This research has described the participatory design process undertaken to develop a web-based road and passenger safety program for senior school students.

The findings of this research provide informative recommendations and strategies for program design and content. For example, the driving and passenger-related situations described as unsafe by student participants may be used to further develop the real life scenarios on which the program activities are based. Student participants mentioned drink driving and speeding as unsafe, and also discussed the scenarios developed for the initial web-based program as realistic for young people their age. Such feedback is critical in the design phase of the program, prior to widespread implementation throughout schools.

The strategies that students suggest for intervening in risky driving behaviour can also be used to further inform program content. For example, students indicated that, at times, they plan to look out for their friends, while at other times this is more instinctive and immediate. Having a plan to watch out for friends could therefore be further encouraged through web-based program content. The suggestions that students had for intervening in their friends' risky driving behaviour can also be used as example strategies for future participants in

program activities. Students also varied in their confidence to intervene with drivers who are not close friends. Confidence to intervene with different groups of risky drivers may therefore be an important factor to target through the web-based program.

Both the student and teacher participants provided insight into preferred program design and content. Both groups of participants indicated that visual appeal and interactivity are particularly important in terms of engagement and continued use of a program. In particular, students mentioned the need for pictures and less text, and teachers agreed with this perception, indicating that text needs to be used supplementary to graphics in an online curriculum. Teachers also mentioned that individualised feedback is particularly important, and students provided ideas of how this may be implemented through a web-based program; for example through interactive class quizzes with group prizes.

Students indicated that aspects of the framework web-based materials were appealing, particularly the pictures that had been drawn to illustrate the different scenarios. They did however suggest that the rest of the program was at that stage too basic and more appropriate for earlier teens. It was suggested that the colours and graphics used throughout the pages gave the impression of being for a younger audience. Such feedback is particularly important in the design phase of the web-based program, and can be used to tailor the website to appeal to the age group and developmental period it is intended for.

Interestingly, both teachers and students suggested the need for varied content, and to integrate web-based material with interactive classroom activities. Most students mentioned this in terms of the ability to 'practice' skills, while teachers recommended this as a means of sustaining engagement and motivating students for continued participation in the online content (similarly, some students noted attention would be achieved with varied content and engagement with teachers). This finding has important implications for the design of the web-based program, in that activities should be designed to incorporate classroom interactivity and teacher-student engagement.

Grounding the web-based activities in real life scenarios was considered important, and students indicated that the scenarios developed for the initial program were realistic for their age group. Teachers and students also gave additional recommendations for enhancing the 'real life' elements of the program content, for example, by including pages of strategies for dealing with risky situations, and by incorporating peer accounts of risky situations and their own outcomes and solutions. Such suggestions may be incorporated into future iterations of the web-based program.

The findings from this research provide a number of suggestions that can assist in the development of the web-based road and passenger safety program; however, future program design needs to take into account the sustainability, cost-effectiveness and potential efficacy of the suggested elements (Ferney & Marshall, 2006). For example, several students suggested that they would like videos to be included; however, videos are costly to produce and may 'age' quickly, requiring frequent updates. Additional program elements therefore need to be carefully assessed in terms of their addition to program efficacy in relation to their sustainability and cost-effectiveness, prior to inclusion in program content.

5. Conclusion

A web-based program for senior high school students appears to be a feasible means of delivery for road and passenger safety messages within the school context. The current research reveals the importance of a participatory, evidence-based approach to web-based program design, in order to ensure future acceptance and use of the program by target participants. The findings of this research have important implications for the further development of the web-based passenger safety program and to the road safety education of senior high school students.

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