EDITOR'S CHOICE

A practical approach for applying best practices in behavioural interventions to injury prevention

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Accepted 29 November 2009

ABSTRACT

Behavioural science when combined with engineering, epidemiology and other disciplines creates a full picture of the often fragmented injury puzzle and informs comprehensive solutions. To assist efforts to include behavioural science in injury prevention strategies, this paper presents a methodological tutorial that aims to introduce best practices in behavioural intervention development and testing to injury professionals new to behavioural science. This tutorial attempts to bridge research to practice through the presentation of a practical, systematic, six-step approach that borrows from established frameworks in health promotion and disease prevention. Central to the approach is the creation of a programme theory that links a theoretically grounded, empirically tested behaviour change model to intervention components and their evaluation. Serving as a compass, a programme theory allows for systematic focusing of resources on the likely most potent behavioural intervention components and directs evaluation of intervention impact and implementation. For illustration, the six-step approach is applied to the creation of a new peer-to-peer campaign, Ride Like a Friend/Drive Like You Care, to promote safe teen driver and passenger behaviours.

INTRODUCTION

Injury remains one of the leading causes of death and acquired disability globally.[1] In the 1990s, the US National Academies recognised the crucial role of interdisciplinary approaches and advised that 'future success of the injury field depends on its ability to broaden its base by recruiting researchers and collaborators from the behavioural and social sciences', but the injury field has adopted 'a general scepticism about behavioural strategies'.[2] In a recent systematic review of the published literature,[3] only 12 studies were found that applied behaviour and social science theory to road traffic injury prevention.

Behavioural scientists, working in concert with engineers and epidemiologists, are necessary to help create a full picture of the often fragmented injury puzzle to provide comprehensive insights into solutions. Injury epidemiologists provide accurate estimates of the magnitude of a hazard, define risk factors for injury, and provide tools (eg, surveillance systems) for identifying hazards and evaluating the effectiveness of interventions. Injury engineers apply laws of physics and other fields to systematically determine injury causation and technology's role in mitigation to inform technological advances (eg, products, safety standards and test procedures). Injury behavioural scientists view the injury within the human and social contexts and answer the question: *why* did the injury occur? Recognising that we can never completely legislate nor engineer out unsafe behaviours, they apply social and psychological theoretical foundations to create behaviour change models. These models guide intervention development aimed at mitigating risk through adoption and consistent performance of safe behaviours and inform methods to assess individual and population level response to risk mitigation strategies (eg, campaigns to educate and change norms).

Other areas of health promotion and disease prevention have embraced behavioural science and its application of empirical methods and behaviour change theories.[4] All of the leading health indicators in the USA[5] rely on promotion of individual health behaviours as strategies; for example, 'practice responsible sexual behaviour' to reduce incidence of HIV; and 'reduce cigarette smoking by adolescents' to reduce tobacco-related deaths. For these health goals, extensive behavioural research fed into the planning of successful behavioural interventions and campaigns. Methods extended beyond traditional risk factor examination to include both qualitative and quantitative methods to create an underlying behaviour change model grounded in biology, communication, psychology and sociology. Thus, effective, research-based and theoretically-driven interventions were created and implemented to target specific risk and protective factors through a systematic approach.[6–10]

As with other health behavioural scientists, injury behavioural scientists focus on mitigating risk factors.[11–18] Paths of influence are captured in theoretically-grounded, evidence-based behaviour change models that involve a progressive narrowing in focus from a broad measurable vision (eg, adoption of a safe behaviour) to smaller addressable component goals (eg, changes in attitudes, skills, behaviours, knowledge or perceived norms that increase the likelihood of the adoption of a safe behaviour).[18–26] Based on this type of model, prevention strategies are created to address these goals and could be aimed at the population (eg, a marketing campaign to change perceived norms about child restraint use), an individual (eg, overcoming individual barriers to access to child safety seats) or both in combination. Without such a model in place, however, it would be difficult to define the strategy or choose among the many possible intervention components.

Gielen *et al* highlight the most frequently used behaviour change theories and effectively review many of these efforts.[27] Despite notable successes in the creation of empirically- and theoretically-grounded

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behavioural interventions[27] for injury prevention, efforts to apply behavioural science to injury prevention lag behind those that apply engineering and epidemiology.

To assist efforts to promote injury behavioural science and its inclusion in injury prevention strategies, this paper presents a methodological tutorial that aims to introduce best practices in behavioural intervention development and testing to injury professionals new to behavioural science. This tutorial attempts to bridge research to practice through the presentation of a practical, systematic, six-step approach to guide interventions aimed at promoting behaviours to reduce injury occurrence and severity (herein called 'the six-step approach'). The six-step approach begins with stating a clearly articulated vision or key outcome and progressively narrows the vision to specific goals. The result is a framework, known as the intervention's programme theory, which integrates the key outcomes, behavioural objectives, and target constructs into a clear actionable plan which is theoretically-grounded and evidence-based. This plan serves as a compass to guide the development of the intervention content and evaluation plans. The approach is grounded in behavioural science theory and borrows from established frameworks in health promotion and disease prevention and the current efforts in injury behavioural science.[5 11 14 15 17 20–22 28 29] A table of definitions of commonly used terms in behavioural science may aid the reader of the tutorial (see table 1).

For illustrative purposes, we applied the six-step approach to respond to a specific challenge: create a teen peer-to-peer campaign to promote safe driving for National Teen Driver Safety Week (NTDSW) 2008. NTDSW, promoted by State Farm Insurance Companies and The Children's Hospital of Philadelphia, was adopted as a US Congressional resolution in 2007; it is an annual event during the third week in October to raise national awareness of the issues around teen driving and ultimately to improve driving safety through behaviour change.

Table 1 Definitions of key terms in behavioural science as used in the tutorial

Behaviour: a specific action taken by a specific person at a specific time/context.
Behaviour change model: hypothesised causal paths that draw on a number of behaviour change theories to link specific target constructs with specific behavioural objectives.
Behavioural objective: clear, explicit behaviours that if adopted and performed are directly and strongly related to reduction in the incidence or severity of an injury.
Behaviour change theory: abstract, hypothesised mechanisms by which types of events or situations mediate, moderate or otherwise influence outcomes. They comprise a set of concepts (also known as theoretical constructs) and define the ordered relationships among these concepts as they might apply to a broad array of situations.
Elicitation research: Research that is guided by theory about categories of determinants of risk and preventive behaviours and conducted with a sample of a target population to help to identify target constructs; subsequent research assesses pre-intervention levels of target constructs.
Evaluation: research designed to assess whether and how well the intervention achieves the goals as articulated in the programme theory and its associated behaviour change model.
Formative research: research conducted in advance of intervention design and development with a sample of the target population, most often to understand their current behaviours and perceptions.
Key outcome: the 'grand prize' or long term vision (eg, reduction in severity and frequency of road traffic injuries).
Programme theory: a clear actionable plan that integrates key outcomes, behavioural objectives, and target constructs and guides the development of the intervention content and evaluation plans and describes the path of influence through which the intervention is intended to work.
Stakeholders: those with practical expertise about, contact with, and/or influence on the target population and a strong interest in injury mitigation.
Target constructs: theoretical concepts (eg, knowledge, self-efficacy beliefs, normative beliefs) developed or adopted for use in a particular programme theory and its underlying behaviour change model.

DEVELOPING AND APPLYING A PROGRAMME THEORY TO GUIDE INTERVENTIONS: A SIX-STEP APPROACH

The six-step approach systematically presented in this paper takes the reader from defining a clearly articulated vision with goals for a new behavioural intervention through to development and testing of the success of the intervention's components in addressing the goals. The first three steps develop the intervention's programme theory, capturing the relationships between intervention components and goals and the vision through defined paths of influence, while the remaining three steps utilise the programme theory for intervention development and evaluation.

The six steps are:

1. Set a key health outcome (a clear, measurable, long-term vision related to injury reduction).
2. Identify behavioural objectives linked to the key health outcome.
3. Identify target constructs and their influence on the behavioural objectives.
4. Design and develop intervention content to address constructs.
5. Evaluate effectiveness of interventions.
6. Refine interventions and behaviour change model, when needed.

STEP 1: SET A KEY HEALTH OUTCOME (A CLEAR, MEASURABLE, LONG-TERM VISION RELATED TO INJURY REDUCTION)

The key outcome is the desired distal result which the intervention seeks to effect. In other words, the key outcome is the 'grand prize' or long term vision (eg, reduction in severity and frequency of road traffic injuries). The vision should be sufficiently broad to remain stable for a reasonable period but should be monitored to measure change and ensure continued relevance. It can be useful to involve stakeholders (those with practical expertise about, contact with, and/or influence on the target population and a strong interest in injury mitigation) in the vision-setting process. This can help to build buy-in for a new intervention from the start and allows a project to benefit from stakeholders' real-world experience, as applicable.

Application of step 1

Although a range of factors affect teen crash incidence and severity,[30–33] a specific outcome was chosen for this intervention: to reduce crashes and their associated injuries and deaths to teen drivers and their passengers with a focus on the risk factor of 'teen passengers' in crash causation.[34] Teen drivers who carry peer passengers have a higher relative risk of being in a fatal car crash than teens who ride without peer passengers, and this risk increases with each additional passenger.[31 35] Combined with driver inexperience, teen passengers can have a detrimental impact on teen driving by creating distractions and influencing the driver to engage in risky behaviour.[36]

STEP 2: IDENTIFY BEHAVIOURAL OBJECTIVES LINKED TO THE KEY HEALTH OUTCOME

Each behavioural objective should be clear and explicit, targeted for an identified population that will perform specific actions within a given context. The selection of the behavioural objectives should be based on a clear understanding of the associated risk and protective factors for the specified health outcome, as well as the social and developmental context in which the

behaviours are performed. Each behavioural objective (eg, consistent seat belt use) must be directly and strongly related to the key outcome (eg, reduction in severity and frequency of road traffic injuries). If insufficient evidence supports the choice of a behavioural objective, research will be needed. This could involve data collection and analysis and involvement of both a representative sample of the target population and expert consensus among key stakeholders.

It is important to note that a key outcome may be influenced by a number of behavioural objectives. When this occurs, additional work is needed to prioritise the behavioural objectives according to the strength of their influence on the key outcome. In addition, different populations also will likely have different behavioural objectives for a shared key outcome (eg, for teens: wear safety belts on every trip; for their parents: set rules for and monitor use of safety belts by their teens for every trip).

Application of step 2

Scientific literature was reviewed for both driver and passenger behaviours that influence crash occurrence and the strength of the considered behaviours' protective effect.[33 34 37–42] To reduce passenger-related teen crash risk, the existing research pointed to a no-passenger restriction during the first 6–12 months of driving as the optimal behavioural objective.

To test the acceptability and potential of this behavioural objective with teens, we conducted formative research regarding teen passengers and teen drivers' interaction with them. Focus groups and an online survey with teens allowed for a better understanding of teen perceptions about driver and passenger behaviours and their reactions to imposing passenger restrictions. The research instruments were informed by elicitation research and behaviour change theory[11 12 14 17 28 29 43] and results from the National Young Driver Survey.[44]

The formative research identified a conflict between the behavioural objective from the scientific literature (passenger restriction) and the teen view of this behaviour (their rejection of it). Based on formative research evidence, restricting passengers for teen drivers was identified as a behavioural objective for interventions targeted at parents (who should set and enforce passenger restriction rules with their teen drivers) and not a behavioural objective for the teen-focused intervention.

The formative research results also highlighted teen drivers' perception of their teen passengers as a distraction or annoyance; passengers' perception of their role in the vehicle as meaningless or irrelevant; and the importance of friendship, respect for friends, and the social nature of teen driving. These findings guided the direction of the behavioural objectives for a school-based teen peer-to-peer intervention. For example, the driver–passenger relationship could be cultivated to promote safe interaction and minimise passenger distractions. Drivers could be empowered to 'own' the space in the car, to set passenger rules for that space, and to communicate with distracting passengers without sacrificing their friendship. Passengers could be given a substantive safety role by following the driver's rules and helping the driver when asked.

From these broader themes, more specific behavioural objectives were formulated to directly correspond to the key outcome (see figure 1). The specific behavioural objectives for the teen passenger were: (1) always wear a seat belt; (2) show driver respect (by keeping the music and conversation volume low); and (3) help with driving task, when asked (by watching the road or assisting with directions via GPS or map). The behavioural objectives for the teen driver centred on establishing their role in relationship to their passengers: (1) set expectations for safe passenger behaviour in the car; (2) ask passenger(s) for help, when needed; and (3) expect respect.

Discrete behaviours were selected for each audience, to paint a picture of what it looks like for a passenger to be a good friend in the car, and what it means to be a driver who cares about his or her peer passengers.

STEP 3: IDENTIFY TARGET CONSTRUCTS AND THEIR INFLUENCE ON THE BEHAVIOURAL OBJECTIVES

Background research and literature reviews are used to identify potential target constructs (ie, concepts such as knowledge, beliefs, attitudes, norms and skills) that influence adoption and performance of the behavioural objective. Three criteria guide selection of potential target constructs[14 15 21]: each must (1) have a strong association with the behavioural objectives; (2) be susceptible to change through intervention (eg, gender as a risk factor may help define the population but would not be a target construct); and (3) have 'room' to change (eg, knowledge would not be selected as a target construct for seat belt promotion if the population already possesses sufficient knowledge about the laws and safety benefits of seat belts). Just as the behavioural objectives are specified for the identified populations, so too are the target constructs—different target constructs might need to be defined for each population (eg, to promote teen seat belt use, synergistic effects might be achieved with concurrent interventions: for parents, improve self-efficacy around enforcing rules around seat belt wearing by their teens; for teens, change their perception to promote universal, consistent seat belt wearing as a normative behaviour).

One result of steps 1–3 is an integrated, theoretically-grounded, empirically tested behaviour change model that links how target constructs will promote adoption of the behavioural objectives through hypothesised paths of influence (eg, as moderators, mediators). This model will then form the basis of

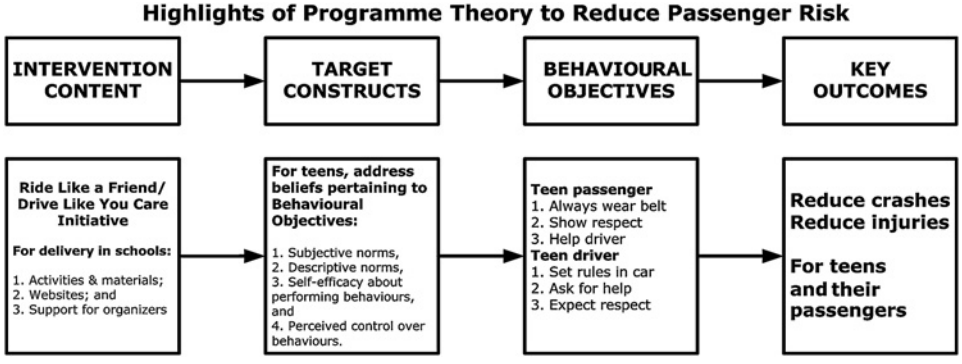

Figure 1 Schematic highlights of programme theory to reduce passenger risk.

a programme theory to guide interventions by linking each proposed intervention component to target constructs.

Application of step 3

Based on the above described formative research, chosen target constructs included specific beliefs underlying teens' (a) subjective norms, (b) descriptive norms, (c) self-efficacy about, and (d) perceived control over the behavioural objectives. The paths linking the target constructs to the behavioural objectives further built the underlying behavioural change model with each target construct becoming essentially an intervention goal. For example, changing teens' subjective norms involved developing the belief that the people important to them approve of safe driver and passenger behaviours such as asking passengers for help when needed and always wearing a seat belt, respectively. Changing teens' descriptive norms required establishing the belief that the majority of a teen's peers engage in these recommended behaviours.

Similarly, additional intervention content could address other target constructs by aiming to improve teens' self-efficacy, enhancing their belief that they have the necessary ability to perform the recommended behaviours. Specifically, one target construct was to establish the driver's belief that he or she could successfully ask a teen passenger/friend to calm down and be less noisy as one way to effectively reduce distractions. Establishing a teen's confidence to effectively handle this situation with the friendship intact was accordingly a goal of campaign messages.

STEP 4: DESIGN AND DEVELOP INTERVENTION CONTENT TO ADDRESS THE TARGET CONSTRUCTS

Using the programme theory as a guide, intervention content should draw directly from, and be designed to address, the identified target constructs for each of the identified populations of interest. As in Step 1, this step should involve input from stakeholders who influence and interact with the populations to guide content delivery in terms of usability, format, messages and language. Most importantly, the intervention content and design should be tested with the targeted populations, taking into account their perspective, characteristics (eg, developmental level, disabilities, cultural considerations), and communication style, exploring natural contexts, channels and modalities for intervention delivery. Intervention components often undergo iterative cycles of testing and revision to ensure that the target constructs are effectively addressed (often called 'pre-testing'). Such theory-informed pre-testing has been applied to injury prevention interventions.[45] At the conclusion of step 4, the intervention's initial programme theory should be finalised and the intervention components tested; the intervention is then ready for initial implementation and evaluation.

Application of Step 4

Because changing norms about teen passenger and driver behaviours was central to the intervention, a campaign aimed at a population (rather than an intervention aimed at individuals) was chosen with delivery at the primary site for teen peer interaction, the school. Targeting teen drivers and passengers, the campaign came to be called by the central taglines that were ultimately developed and tested with teens as part of the creative materials, 'Ride Like A Friend. Drive Like You Care' (RLAF). School-based materials and experiential activities were developed in alignment with the target constructs; these creative materials included posters, postcards, stickers and t-shirts, which were posted, distributed or worn in schools. To ensure high levels of exposure, a variety of materials and activities were used in a range of locations during multiple times of the day.

Previous research with teens [46–51] has shown that peer approval is a tremendous influence in shaping teen health behaviours. Our own formative research confirmed that peer approval was important in the adoption of safe behaviours involving teen driving with peer passengers. Therefore, beliefs underlying subjective norms became a target construct, and including intervention content to address beliefs that friends and peers approve of the recommended pro-safety passenger and driver behaviours became a priority. To this end, the week-long RLAF intervention included daily student-run polls with multiple choice questions on drivers and passengers (eg, What do you think makes an ideal passenger?) in which all responses were correct; the goal was to show that the desirable characteristics described in the responses were socially acceptable, common and endorsed by the teen peer group. Poll 'results' were displayed on student-made posters or banners hung in cafeterias or hallways, and were often broadcast in the next day's morning announcements so that all students could hear and/or see their peers approving these behaviours.

The RLAF intervention content used peer-accepted and pre-tested language throughout its materials, including those intended to address the target construct of driver self-efficacy by helping teen drivers more confidently communicate with distracting or annoying teen passengers. For example, one poster depicts a passenger in animated loud talk and a driver reaching for a big red 'Just Chill' button on the car dashboard; the poster asks, 'Ever wish your car had one more button?'. In this way, both drivers and passengers were exposed to the language in a non-threatening, humorous way.

RLAF was supported by a website (www.ridelikeafriend.com) with three portals: one for teens, one for parents, and one for initiative organisers. The teen portal offered online activities and a Facebook application; the parent portal provided informational resources; and the organiser portal served as the primary online component of the initiative, with downloadable guides, resources and materials to facilitate implementation of the initiative.

Implementation of the RLAF initiative occurred during National Teen Driver Safety Week in October 2008. For large-scale campaigns, the dissemination and implementation process constitutes its own complete step, beyond the scope of this article.

STEP 5: EVALUATE EFFECTIVENESS OF INTERVENTIONS TO ADDRESS THE TARGET CONSTRUCTS AND BEHAVIOURS

Although all steps involve testing, the term 'evaluation' is reserved to assess whether the intervention achieves the goals as articulated in the programme theory and its associated behaviour change model. Evaluation is central to the systematic approach proposed here, providing concrete evidence for an intervention's success, as well as any potential flaws in the behaviour change model.[18] If an initiative is effective, the evaluation will clearly show the path of connections in the behaviour change model. Strong evaluations also assess whether the implementation of the intervention was successful. For example, such a 'process evaluation' might determine the extent to which participants received and were engaged in the intervention materials and services and whether this exposure and/or involvement was associated with addressing the target constructs and performance of the defined behaviour. In addition, a thorough evaluation can reveal the most potent

intervention component that leads to behaviour change and allows for efficient pruning of the intervention to the most parsimonious set of components for future versions of the intervention. Several references exist regarding outcome[18 23–25 52–54] and process evaluation methods.[55]

Application of step 5

Outcome evaluation to determine the effects of intervention content on the target population involved pre- and post-initiative surveys. Instruments were designed to specifically measure the target constructs and behavioural objectives explicated in the model (eg, teen subjective norms around safe passenger behaviour and actual engagement in driver and passenger behaviours recommended in the intervention content). In addition, the post-survey captured exposure to and involvement in the initiative as well as teen awareness and evaluation of the initiative taglines. This combination of questions allowed for the association among the amount of exposure to the RLAF initiative components and teen outcomes as well as a way to determine how the various RLAF components were received by the teens.

Process evaluation involved: (a) questionnaires and focus groups with student organisers; (b) key informant interviews with school personnel; (c) observational notes by study staff who were facilitating implementation; and (d) website tracking to see how the online resources were used.

STEP 6: REFINE INTERVENTIONS AND BEHAVIOUR CHANGE MODEL WITH KNOWLEDGE GAINED FROM INTERVENTION EVALUATION

If interventions prove unsuccessful or produce unfavourable outcomes, the underlying behaviour change model, the programme theory, and/or the intervention content and its implementation may need to be modified. Findings from the intervention evaluation can be used to inform this process and the preceding steps should be repeated until positive results are achieved. If the evaluation proves the intervention successful, dissemination and distribution are the next steps. This step also requires strategies as distribution may require stakeholders to adopt and deliver the intervention. Steps 1–5 can be used to develop and evaluate a dissemination strategy while continuing to evaluate the original intervention in broader populations.

It is important to note that the six-step approach is not necessarily linear, but rather may require iteration and looping back to earlier steps based on negative findings or new information. All six steps in this process require periodic review to take into account new scientific knowledge and other changes that may occur, either on their own or as a result of the intervention (eg, if a relevant law is passed, normative behaviour may change and changing norms may no longer remain an important target construct). It is important to remember that thoughtful planning and pre-testing is necessary if the intervention is to be delivered to a population that differs in key characteristics from the original population (eg, in another country).

Depending on the target behaviour and constructs, multiple behavioural science frameworks can be applied to inform the behaviour change paths. Widely used models are presented within an injury context by Gielen *et al*;[27] and include: the integrative model of behaviour change,[15] a well-established theoretical framework that incorporates concepts from the theory of reasoned action[14]; the theory of planned behaviour[29]; and social cognitive theory.[12]

Application of step 6

At the time of this writing, the process and outcome evaluations of the RLAF 2008 pilot are underway. Lessons learned from these evaluations will be used to inform revisions to the initiative components and their delivery before the initiative is disseminated broadly. If the initiative is found ineffective, further revision and piloting will be necessary. In addition, the evaluations will inform the underlying behavioural change model and programme theory on which the initiative was designed.

SUMMARY

Drawing from scientific foundations in promotion of health and injury prevention behaviours, this tutorial presented a proposed, practical six-step approach to inform injury prevention interventions and campaigns. An example illustrated how this approach led to a programme theory and behaviour change model that guided the design and evaluation of a peer-to-peer initiative to promote safe teen passenger behaviours.

The tutorial underscores that a well articulated model ties together theory and practice and maps out the path of influence from intervention components to intended outcomes. In sum, all strategies considered, messages designed, and activities implemented ideally should be aligned with a pre-set theory and projected model of effects.

LIMITATIONS TO THIS TUTORIAL

This paper was meant to show one approach to applying best practice in behavioural science to intervention development rather than to prescribe any approach or specific interventions. The illustrative example, RLAF, is currently under evaluation. It is important to note that in applying this work in other settings or at other times, a review of existing research is required and new formative research is likely to be necessary. At the time of writing of this paper, for example, young crash victims in the USA were principally drivers and passengers, not vulnerable road users (eg, pedestrians and bicyclists), as in low- and middle-income countries. Even evidence-based approaches and interventions that have been successful in the US context must be adapted to address the needs in the unique local contexts worldwide. Further, this paper builds on a growing body of behavioural science work in injury prevention and in teen driver safety specifically,[27] but it was beyond the scope of this paper to review this important literature. Also, for large-scale behaviour change campaigns, additional steps focused on dissemination and implementation are critical but beyond the scope of this paper.

This paper focuses on behaviour change interventions, only one important piece of a comprehensive strategy. Consistent with our Center's advocacy for a multi-pronged approach, behaviour change interventions should be accompanied by improvements in vehicle safety, road and environmental conditions, evidence-based policies, and enforcement of strong laws.

Finally, this approach can add upfront costs associated with planning, pre-testing, revision and evaluation. However, these costs likely will be counterbalanced by the ability to better focus efforts, thereby limiting potentially costly, ineffective components, and to demonstrate effects, which will both aid in future support for efforts and advance the field.

CONCLUSION

Integration of behavioural science into comprehensive injury prevention strategies promises to advance the field. A

programme theory can systematically focus resources on the likely most potent behavioural intervention components and direct evaluations of their implementation. Such an approach can build a bridge between behavioural science research and injury prevention practice.

Acknowledgements This paper was written as part of the Young Driver Research Initiative (YDRI), a collaborative research programme between the Center for Injury Research and Prevention at The Children's Hospital of Philadelphia and State Farm Insurance Companies. State Farm provided financial and research support for the conduct of the research. The opinions expressed are not necessarily those of State Farm. The authors thank the behavioural scientists, outreach specialists, and others at the Center and many colleagues in the field and at State Farm for their intellectual contributions, including, but not limited to: teaching us; helping us to formulate our approach; creating, promoting, and evaluating the Ride Like a Friend Initiative; and assistance in drafting, editing or reviewing this manuscript. In particular, the authors thank Laurie Bach, Ewa Kalicka, Danielle Erkoboni and Christine Norris for their support.

Funding State Farm Insurance Companies.

Competing interests None.

Contributors The authors would like to thank Nancy Kassam-Adams for her review and guidance.

Provenance and peer review Not commissioned; externally peer reviewed.

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