LETTERS TO THE EDITOR

The risk compensation theory and bicycle helmets

EDITOR,—It has come to our attention that a number of readers have been mystified by our contribution to the debate about bicycle helmets published in the June issue (2001;7:86–91). In particular, those familiar with our previous writings on the subject were puzzled by the claim of the Thompsons and Rivara, in what appeared to be the conclusion, that we agreed with them that "bicycle helmets are effective in decreasing head injuries to cyclists". The confusion was caused by the fact that the responses were published in the wrong order. For those wishing to clear up the mystery, we recommend returning to the published debate and reordering the contributions as follows:

1. Risk compensation theory should be subject to systematic reviews of the scientific evidence (Thompson, Thompson, and Rivara).
2. The risk compensation theory and bicycle helmets (Adams and Hillman).
3. Response from Thompson, Thompson, and Rivara.
4. Response from Adams and Hillman.

It will then be clear that "We did NOT accept that bicycle helmets are effective in reducing head injuries" and, of crucial importance to the debate, why. We regret that the editor has nor seen fit to clear matters up properly by republishing the responses in their logical sequence.

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Safety in numbers? A new dimension to the bicycle helmet controversy

EDITOR,—The recent exchange about risk compensation and bicycle helmets overlooked an important dimension of the issue.[1 2] By reducing cycling and, hence, diluting the effect of "safety in numbers", compulsory helmet laws could have the perverse effect of *increasing* serious injury rates among those who continue to cycle.

Nearly all fatal cycling crashes involve motorists. But there is evidence that the rate of bicycle-motor vehicle crashes declines as the amount of cycling on a road or in a region increases. This "safety in numbers" effect is thought to occur because as cyclists grow more numerous and come to be an expected part of the road environment, motorists become more mindful of their presence and more respectful of their rights.

The implication is that adding cyclists to the road makes it less likely that a motorist will strike an individual cyclist and cause serious injury; and, conversely, removing cyclists from the traffic stream raises the risk to those who continue to cycle. One empirical estimation of this effect, preliminary and site-specific, pointed intriguingly toward a cyclist safety-volume "power law" of approximately 0.6.[3]

According to this relationship, the probability that a motorist will strike an individual cyclist on a particular road declines with the 0.6 power of the number of cyclists on that road. Say the number of cyclists doubles. Then, since two raised to the 0.6 power is 1.52, each cyclist would be able to ride an additional 50% without increasing her probability of being struck. (The same phenomenon can be expressed as a 34% reduction in per cyclist crash risk per doubling in cycling volume, since the reciprocal of 1.52 is 0.66.)

A confident estimate of the precise value of this safety-volume relationship will require further study, but two other studies report similar relationships, one for cyclists[4] and the other for pedestrians.[5] This suggests an important thought experiment regarding compulsory helmet legislation:

Suppose that (i) cyclists currently are split between helmet wearers (one third) and bareheaded cyclists (two thirds); (ii) there is no self selection or other confounding difference between bareheaded and helmeted cyclists as regards their risk of injury-causing accident; (iii) a helmet law provokes one third of the bareheaded cyclists to quit cycling, or slightly less attrition than occurred in Australia when cycling helmets were made compulsory[6]; (iv) all cycling fatalities are motor vehicle related (as is nearly the case); (v) risk compensation does not occur, that is, helmeted cyclists do not ride more adventurously than bareheaded ones; and (vi) helmets are 10% effective in preventing fatalities in the event of crashes, reflecting the modest reduction in severe injury rates found by Rivara *et al* for 3390 cyclist injuries reported from seven Seattle area hospital emergency departments and two county medical examiners' offices.[7]

With these assumptions and the foregoing safety-volume power law, it is easy to show that a compulsory helmet law, far from reducing the rate of cycling fatalities, would *increase* it by 8%. The culprit is the hypothesized 22% decline in cycling volume, which engenders a 16% increase in per cyclist crash risk for *all* cyclists (since 0.78 raised to the 0.6 power equals 0.86, the reciprocal of which is 1.16). This more than offsets the assumed 10% reduction in fatalities per crash among previously bareheaded cyclists.

To be sure, the model is simple, and the assumptions are at best first approximations. If the "safety in numbers" power law constant is in fact 0.6, then a helmet effectiveness rate over 20% in preventing *fatalities* (not just injuries) implies that compulsory helmet laws will reduce fatality rates for those who continue to cycle, as claimed. Of course, those who quit cycling will no longer reap the manifold and extensively documented health benefits.

This thought experiment indicates the need to add another dimension, that of "safety in numbers", to the ongoing debate over helmet promotion and policy. It also makes clear the need for further research to measure the precise value of the safety in numbers effect. It may very well prove to be the case that more cycling is better for reducing cyclist casualties than more helmets.

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1 Thompson DC, Thompson RS, Rivara FP. Risk compensation theory should be subject to systematic reviews of the scientific evidence. *Inj Prev* 2001;7:86–8.
2 Adams J, Hillman M. The risk compensation theory and bicycle helmets. *Inj Prev* 2001;**7**:89–91.
3 Leden L, Garder P, Pulkkinen U. An expert judgment model applied to estimating the safety effect of a bicycle facility. *Accid Anal Prev* 2000;**32**:589–99.
4 Ekman L. *On the treatment of flow in traffic safety analysis: a non-parametric approach applied on vulnerable road users*. Lund, Sweden: Department of Traffic Planning and Engineering, University of Lund, bulletin 136, 1996.
5 Leden L. Pedestrian risk decrease with pedestrian flow: a case study based on data from signalized intersections in Hamilton, Ontario. *Accid Anal Prev* (in press).
6 Robinson DL. Head injuries and bicycle helmet laws. *Accid Anal Prev* 1996;**28**:463–75.
7 Rivara FP, Thompson DC, Thompson RS. Epidemiology of bicycle injuries and risk factors for serious injury. *Inj Prev* 1997;**3**:110–4.

CALENDAR

1st Asian Regional Safe Community Conference

25–27 February 2002, Suwong, South Korea. *Further information*: Ms Hyun Jong Song, Department of Emergency Medicine, Ajou University School of Medicine, Wonchon-dong 5, Paldal-gu Suwon 442-721, South Korea (tel: +82 31 219 6007, fax: +82 31 219 4568, email: ajemc@madang.ajou.ac.kr, web site: www.safesuwon.or.kr).

5th International Conference on Fatigue in Transportation. Coping with the 24 hour society

11–15 March 2002, Fremantle, WA, Australia. The conference is on non-prescriptive approaches to managing fatigue in transportation. *Further information and abstracts* (by 1 February 2002): Laurence Hartley, Conference Convenor, Institute for Research in Safety & Transport, Psychology, Murdoch University, Western Australia 6150 (fax: +61 8 9360 6492, hartley@socs.murdoch.edu.au).

4th Fourth International Symposium on Safety in Ice Hockey

5–6 May 2002, Pittsburgh, PA, USA. The objective of the symposium is to review the current state of the art and science of prevention of ice hockey injuries. One session will be devoted to in-line or roller hockey injuries. The meeting will cover new and old protective equipment, coaching techniques to decrease the risk for injuries, playing rule changes to decrease the risk for injuries; and awareness programs for players, parents, coaches, referees, and administrators. *Further information*: Symposium Co-Chairmen: Alan B Ashare, St Elizabeth's Medical Center, Boston, MA, USA (tel: +1 617 789 2828, aashare@semc.org) and David J Pearsall,

McGill University, Montreal, Quebec, Canada (tel: +1 514 398 4184, ext 0488, david.pearsall@mcgill.ca).

11th International Conference on Safe Communities

7–9 May 2002, Rainy River Valley, Ontario, Canada. *Further information*: Jeannette Cawston, 2002 WHO Safe Communities Conference Coordinator, 400 Scott Street, Fort Frances, Ontario, Canada P9A 1H2 (tel: (toll free) +1 800 465 8502, email: info@who2002.com; preliminary program at: www.who2002.com).

6th World Conference on Injury Prevention and Control

12–15 May 2002, Montreal, PQ, Canada. The theme is "Injuries, Suicide and Violence: Building Knowledge, Policies and Strategies to Promote a Safer World". *Further information*: www.trauma2002.com, tel: +1 514 848 1133, fax: +1 514 288 6469.

XVI World Congress on Safety and Health at Work

26–31 May 2002, Vienna, Austria. *Further information*: AUVA, Kongressbüro, Adalbert-Stifter Strasse 65, A-1200 Vienna, Austria (fax: +43 1 33 111 469, email: safety2000@auva.sozvers.at, website www.safety2002.at).

World Congress on Drowning

26–28 June 2002, Amsterdam, The Netherlands. The congress will seek to reduce drowning throughout the world by creating a forum for prevention, treatment and rescue. *Further information:* Congress Secretariat, World Congress on Drowning 2002, Consumer Safety Institute, PO Box 75 169, 1070 Amsterdam, The Netherlands (fax: +31 20 511 4510, email: secretariat@drowning.nl, website: www.drowning.nl).

Thanks to reviewers

Journals cannot function properly without the generous help of reviewers. In the past year we have called on a record number of experts to guide us in making the right decisions. Being listed in this manner is insufficient thanks for the time and effort involved but it is the best we can do. In addition to those listed, every member of the editorial board has reviewed several papers for the journal in the past year. To all of you go my sincere thanks—and, I trust, those of the authors whose papers you reviewed.

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