# Collaborative Sciences Center for Road Safety

## PROCEEDINGS from “Systemic Change and Systematic Change: Using Systems Science Tools to Communicate Complex Concepts”

## Steve Marshall

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Steve Marshall is a Professor of Epidemiology at the Gillings School of Global Public Health and the Director of the Injury Prevention Research Center. He is a quantitative epidemiologist with more than 25 years of experience in injury prevention, including road and transportation safety.

Marshall argues that as individuals, humans are highly intelligent and capable of understanding complexity. However, humans are not very smart as a collective. We are a contradiction: highly social, but also highly competitive, and not known for acting cohesively or strategically as a group. As a collective we may be *less* than the sum of our parts, unlike bees who alone are cogs in a greater hive but together form something *greater* than the sum of their parts. Marshall says that this is reflected in our political process, where we reveal that we are poor at planning for change. An example of this is Social Security in the United States—we have known it will go bankrupt for decades, but we are unable to fix it or allow processes to fix it.

The main premise of Marshall’s talk with the Collaborative Sciences Center for Road Safety is that scientists and researchers haven’t been good about communicating the need for change or encouraging people to think about the ‘big picture.’ He explains that this is why scientific communication often fails—for example, research on seatbelt or child car seat efficacy only goes so far, and larger systemic interventions are needed before we can have population-level impacts. In Marshall’s opinion, climate change is the greatest failure in science because scientists have been unable to communicate the results of climate models, and the discourse centers who is to blame rather than the fact that it is happening (as Marshall quips, “It’s time to stop building condos in Florida”).

Marshall presents three papers that illustrate these concepts and provide suggestions for how we might encourage people to think systemically. The first is a paper from Nevada [1]. The author, Stave, constructed a model of Las Vegas’s water system. They then used the model and its outputs in the community and allowed people to adjust inputs to see the changes in the outputs for themselves. The results were counter-intuitive and allowed people to see for themselves that outdoor residential use was the biggest water user, with 40% of the city’s consumption. Most people pointed to the casinos and hotels as the biggest user at first. This study worked because it used a model to demonstrate counterintuitive results, it showed how the water system has positive feedback loops (residential indoor water gets reclaimed), and showed how part of the water system has no feedback loop. The discussion shifted from who was to blame to how to solve the problems in the system.

The second paper Marshall presents is from Auckland [2]. They used system dynamics to model travel in Auckland and evaluate different build-out scenarios of vehicle lanes and bicycle networks. The researchers demonstrated with the model that the biggest investment in the road infrastructure to support non-automobile modes created the biggest returns for traffic congestion and safety. Although establishing causality is challenging for researchers, the demonstration of the impacts of various policy options can help decision-makers understand the return-on-investment of different choices.

The third paper is from the CDC and lays out how scientific communication could become more effective at creating social change by becoming more like community organizing [3]. Community organizing involves building local capacity, creating linkages, recruiting local organizations, lifting up their messages, and supporting local advocates with information to advocate for community change. As Marshall says, “It’s about making those things disappear as scientific disciplines by embedding their rationale into the fabric of society.”

Marshall engaged with the Coffee & Conversations audience, who had a few questions about the efficacy of the rational decision-making model, how approaching scientific communication in a systemic way dovetails with current public engagement approaches in the planning field, and how to deal with acceptable risk in models particularly when industry is involved. Despite knowing that humans do not always behave rationally, Marshall believes that bringing information into the community and getting input from stakeholders improved the decision-making process. He notes that community engagement worked particularly well in the Las Vegas example because water is very tangible for the stakeholders and the system operates in an ongoing manner versus a one-time decision. On the question of industry involvement, Marshall makes the point that industry can’t sell a product that is killing people in regular numbers, and so industry can also harness the power of systemic models to better understand their impacts. Marshall argues that while we should try to get the models right, the focus should be to use them to empower community groups.

**Resources**

[1] K. A. Stave, “A system dynamics model to facilitate public understanding of water management options in Las Vegas, Nevada.,” *J. Environ. Manage.*, vol. 67, no. 4, pp. 303–313, Apr. 2003.

[2] A. Macmillan, J. Connor, K. Witten, R. Kearns, D. Rees, and A. Woodward, “The Societal Costs and Benefits of Commuter Bicycling: Simulating the Effects of Specific Policies Using System Dynamics Modeling,” *Environ. Health Perspect.*, Feb. 2014.

[3] R. J. McClure, K. Mack, N. Wilkins, and T. M. Davey, “Injury prevention as social change,” *Inj. Prev.*, vol. 22, no. 3, pp. 226–229, Jun. 2016.