DINOSAURS, THE FLAT EARTH, AND ROAD SAFETY RESEARCH IN AUSTRALIA

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ABSTRACT

This paper explores aspects of the development of scientific knowledge in Australian road safety research. It argues that road safety research in Australia has generally focused on the development of analytic and evaluative methods, and the collection of data concerning crash and injury problems and the outcomes of various interventions. There has been little interest in developing an understanding of the factors that underlie either crashes and injuries, or the effects of road safety programs. This issue is discussed in the context of scientific progress in general and a three-dimensional model of scientific knowledge. The paper also draws attention to the short term benefits and long term disbenefits of the current situation by drawing on recent road safety research projects.

INTRODUCTION

In an short, amusing article, King (2000) presents an argument that current science is failing to meet the demands of a three-dimensional model of scientific endeavour. His view, in summary, is that good science requires effort in three areas and that current science is not meeting the demands of one of these. King's view is directly relevant to road safety, and while we might have a certain warm feeling that our work is similar to the work of real scientists, it is clear that King's concerns are becoming an overwhelming issue in some research areas in the safety field. In road safety research the concerns are greater because, unlike real science, we do not have a long history of development and effort in all three areas to counter the current weakness in one

This paper started life as a response to King's (2000) concerns. It commences with an analysis of these concerns and a discussion of the three-dimensional model he proposes. This model is then applied to road safety research. The paper then addresses some general issues surrounding science and road safety research, and finally draws the general conclusion that there is far too little science happening in road safety research activity in Australia.

SCIENCE IN 3-D

King (2000) suggests a three-dimensional model of science, which is presented here in Figure 1. He suggests that progress in science is unlikely to occur without progress in each of the three dimensions. Progress in the Knowledge area represents the accumulation of data – clearly a key area of endeavour in science, but not much more than counting without the other areas.

The Techniques area incorporates the full range of techniques designed to collect sophisticated data or to extract useful information from the data. In some science areas techniques might have a technical flavour, in others the techniques are related more strongly to the analysis of the data. In general, techniques also include the thorough application of the hypothetico-deductive logic of the scientific method, which in many ways remains the basis for good science. This issue is addressed in more detail below as it is another specific concern in the road safety area.

Excluding the application of the scientific method, the first two areas, combined, amount to sophisticated counting rather than simple counting. This is an improvement over the collection of data alone, but it still does not make for good science.

The third dimension of scientific effort for King (2000) is Understanding. He suggests that the application of reasoning to the information arising from work in the other two dimensions to produce Understanding is critical for the advancement of science. Understanding can take the form of hypotheses based on other work and the development of theories to account for information and to predict new findings and applications.

King is quite negative about the current state of science in this dimension, although in general it is probably fair to conclude (as King suggests) that this is a relatively recent problem based on the growth

of phenomena such as economic rationalism, commercial research, and funding cuts in science. In a historical sense, most areas of traditional science have a strong focus on the Understanding dimension, with quite sophisticated theoretical development in areas such as the physical and chemical sciences. It may be the case that this historical sense of the importance of the scientific method and Understanding will ensure at least some ongoing focus on this dimension.

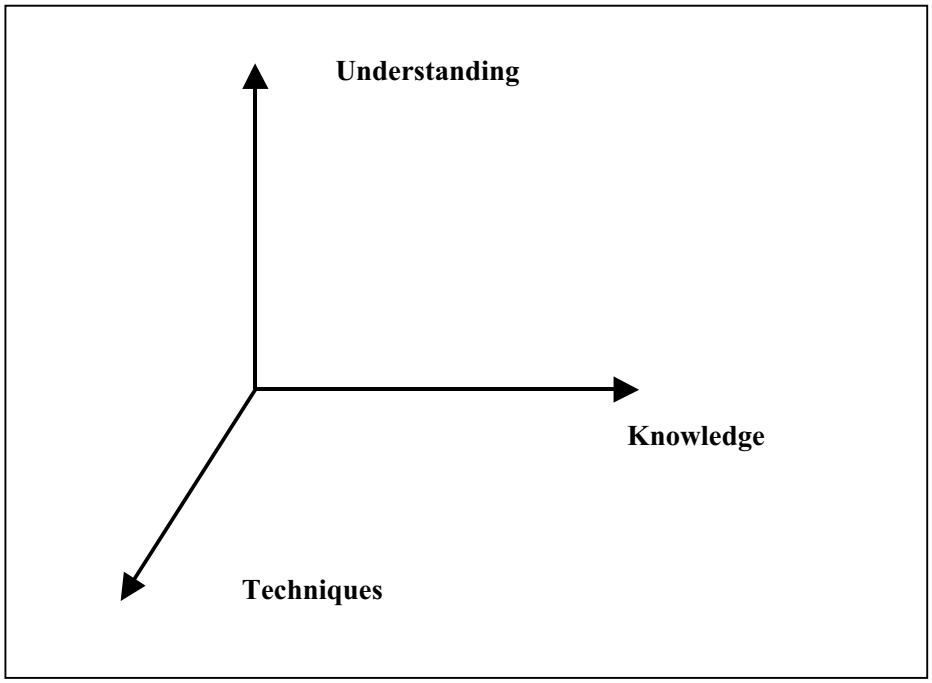

Figure 1: A 3-D model of scientific endeavour

ROAD SAFETY RESEARCH IN 3-D

The development or application of theory in Australian road safety research is unusual, and a review of research emanating from road safety research organisations in Australia suggests that the terrain defined by the 3-D model in Figure 1 is quite flat with a hill or two rather than the mountainous terrain that might provide more promise for the development of new initiatives.

Road safety research in recent years has become increasingly concerned with the collection of data (knowledge) and the development of statistical tools to mine those data for information. In some ways, the application of the scientific method has been a victim of this development as statistical techniques have become more focused on finding results (assuming results are there to be found) and less focused on testing predictions (with an initial assumption that the prediction is false). The continuing development of statistical techniques, and the mining of data sets such as crash data files, does little to improve our understanding of the resulting information and, in some cases, may serve to confuse the picture as less and less meaningful results are generated, and as those results are apparently less and less stable under different analysis methods.

A number of specific research areas are interesting examples of the current status of road safety research.

Enforcement

Enforcement has been a key component of road safety programs in Australia and New Zealand. Most jurisdictions have targeted safety-related offences such as speeding and drink-driving with high levels of enforcement activity, and most published evaluations of enforcement programs claim that the program had the desired effect on the outcome measures.

Enforcement-related research and programs have generally relied strongly on Homel's (eg. 1988) early attempt to apply a criminological view of drink driving and enforcement. Apart from a few small attempts to incorporate other psychological theories into the drink-driving and speeding area, the only other large hill on the enforcement terrain has been my attempt to apply modern decision-making theories to drink driving, speeding, and enforcement effects (see my paper at this conference: *Drink driving in rural areas: Recommendations for enforcement and public education based on surveys of hotel patrons*).

While not surprising, the lack of interest in understanding the effects of enforcement on behaviour is concerning and may hinder future efforts to influence driver behaviour. Evaluations of enforcement programs are generally silent on why the particular results might have occurred, apparently assuming that the early deterrence and rational decision making approach of Homel is sufficient to explain any enforcement effects. Increasing our understanding of why behaviour is influenced by various enforcement styles and programs would make it possible to predict the outcomes of new enforcement initiatives more successfully and might also provide the information needed to improve the effectiveness of current programs.

There are a number of specific issues that need to be addressed under the Understanding dimension. The implicit assumption of many evaluations (that increased enforcement activity leads to awareness of enforcement which then leads to an increase in the perceived risk of detection which then influences the target behaviour which then results in a reduced level of crash risk) needs to be re-assessed as there is an increasing body of evidence that suggests this may be an overly simplistic view. There is a need to further explore the psychological and decision-making aspects of the link between enforcement and behaviour, and more generally the decision-making processes that result in unsafe driving behaviour. It may be difficult to make long-lasting changes in behaviour without understanding the underlying processes that lead to the behaviour itself.

Public Education

Public education or advertising programs are widely used throughout Australia and New Zealand, both as a direct method of behaviour or attitude change and as a method to provide support to other programs such as enforcement. Their success is usually evaluated in one of two ways. The most common technique is to use awareness or recall as measures of the advertising program's success. This approach assumes either that awareness of an advertisement is a surrogate for measurements of behaviour change, or that awareness of an advertisement at the time of a survey is a prerequisite for behaviour change. The first assumption is clearly unreasonable, and the second assumption has not been assessed.

The latter point is important and represents one example of the flat scientific terrain in the public education area. There is widespread acceptance that many aspects of driving behaviour are largely automated. It is possible that decisions about speed and other unsafe behaviours are also largely automated and, therefore, outside conscious control under normal circumstances. This means that drivers may not be consciously aware of the processes underlying many driving behaviours, and that advertising material may act at the time it is viewed to influence underlying processes without a requirement for conscious awareness of the material at a later time.

The second method used to assess the effectiveness of advertising programs involves statistical methods and large data sets to demonstrate a relationship between, say, advertising intensity and crash involvement. While this type of evaluation method does provide some information about a relationship, it does nothing to add to our understanding of why there might be a relationship between advertising and crash outcomes. This type of assessment gives the impression of good science, but its failure to increase understanding and (perhaps more importantly) its failure to assess causality limits its effectiveness as science.

There are many issues yet to be investigated in the publicity area. Why, for example, does the high level of advertising in some jurisdictions not have a cumulative effect on crash outcomes, but rather seems to have an effect at the time it is aired only. This question could equally be asked of enforcement programs, given the plateau in crashes over the last few years. At a more basic level, it would help the development of advertising programs if we understood the mechanisms by which material in the media influenced behaviour, and what characteristics of this material were important for this influence. There are also a number of potential approaches to road safety advertising that have not been tested in Australia or New Zealand but which are likely to influence unconscious behaviour

control mechanisms. These approaches are based on recent developments in psychology and might be worth pursuing, with any outcomes adding to our understanding of the processes that underlie advertising effects.

ITS Technologies

Intelligent transport systems are an important potential road safety measure. ITS technologies are a Technique based on Knowledge from a number of sources ranging from analyses of crash data through to the physical sciences. They serve as an example of a technology that is being applied to the road safety problem with very little understanding of the type of effect it is likely to have or of the mechanisms by which that effect might occur. As King (2000) suggested, the focus on data and technology (and therefore an outcome) has overwhelmed any interest in understanding the effects or their causes.

The particular problem with the lack of understanding in this area is that there are some reasons to expect both negative reactions to the technology on the part of drivers, and negative effects of the technology on safety for some drivers in some situations. ITS technologies show considerable promise, but the lack of emphasis on understanding their effect is concerning.

Issues that remain to be addressed in this area include understanding how drivers will respond to ITS technologies that are likely to be perceived as taking some aspects of vehicle control away from them; the actual (rather than predicted) safety benefits and disbenefits that are likely to occur as these technologies become widespread in the vehicle fleet; and the mechanisms by which these effects occur. The latter issue is particularly important as understanding these mechanisms will help in the development of more effective technologies in future.

SCIENCE, ITS METHOD, AND ROAD SAFETY RESEARCH

Although it is not reasonable to be too definite about the scientific method, science generally proceeds based on a cycle of activities and some general principles. The extent to which these have parallels in road safety research is an issue worth investigating.

The cycle of the scientific method starts with developing a tentative theory about some event, testing the theory's predictions with experiments or further observations, modifying the theory in light of the data, and then making new predictions for testing and so on. This method, given the analysis above, ensures development in the Understanding dimension while simultaneously gathering data and developing techniques.

Theory plays an important role in the scientific method. A theory is an attempt to explain some aspect of data (ie, a way to understand the data) and is used as the basis for making predictions. Theories are generally best if falsifiable, because best practice in science generally involves attempting to falsify the theory generated by the researcher. This is partly a way to control the already impressive egos of scientists. The only other point worth making in this context is that scientific understanding is a changing phenomenon – theories rarely survive testing perfectly intact, and it is this ongoing process of testing and revising that leads to better understanding of the world and better predictions about how things work.

Road safety research performs quite poorly as scientific endeavour. A number of features of road safety research in Australia are worth noting in this context:

- The pressures of evaluative research conducted in a commercial research environment allow little opportunity to apply the cyclic nature of the scientific method to research, or to develop a program of research that would allow this approach;
- As noted above, there seems to be only marginal interest in developing theories about results and then making testable predictions based on those theories;
- There is generally little interest in applying new developments in areas outside road safety to road safety. This is particularly apparent in the area of psychology, where recent developments in a range of areas as diverse as learning theory, decision making, psychotherapy, and cognitive psychology could potentially help develop new Understanding in road safety and ultimately new safety measures.

- When theories are challenged by the results of studies or evidence from research conducted elsewhere, there seems to be a general reluctance in some road safety areas to let go of the theory. This has been apparent in some areas of evaluation research, where the expectation that some program will have an effect has not been supported by the data. Rather than questioning the expectation, the data are sometimes treated as suspect or further analyses are carried out to find a result. This would be appropriate if the opposite also occurred – but there seem to be very few circumstances where an expected outcome in an evaluation has led the researcher to question the data or conduct further analyses.

The problem with this for road safety practice is that the development of new and more effective road safety measures to deal with the ongoing (or even increasing) road safety problem relies almost entirely on the development of new knowledge. Without an emphasis on the development of this knowledge in the context of the scientific method, there is less certainty about the validity of the theories that are used to develop and predict the effects of new measures.

DINOSAURS AND THE EMERGING MAMMALS

Road safety has a long history now of failing to develop in the third dimension of King's (2000) model. The strong focus on the development of techniques and the collection of data, particularly in recent years, has added much to our store of information but little to our understanding of why road users behave the way they do or why some measures work some of the time with some road users.

The cost now and in the short term is that developing new measures is likely to be difficult, and recommendations for programs are unlikely to go far beyond recommending more of the same in spite of some evidence that some drivers are immune to current programs. The most effective solution to this problem is likely to be a shift in the way we think about and do research in road safety, with a stronger emphasis on developing theoretical understanding of the events and effects that are investigated in our research, within the context of a sound scientific method.

A shift of this type is, in a sense, evolutionary. Thus the title of the current paper - fearful of mixing metaphors, but proceeding regardless, the continued creation of information without detailed or deep understanding is the province of road safety dinosaurs living on a flat earth. The emergence of a new way of thinking about road safety research as science, and the consequent increase in the hilliness of the road safety terrain, will do much to generate the new ideas that appear to be necessary at the moment.

The challenge for both road safety researchers and their funders is to find a consultation model that allows the opportunity for the development of King's third dimension while still meeting the shorter-term needs of policy development.

REFERENCES

King, N, (2000). Reading between the lines. *Australasian Science, 21*, 18-19.