

# Complicated and Complex Crime Prevention and the 2 Feedback Loop Law

Dr. Terence Love  
Design Out Crime Research Centre  
SODA, Curtin University, Australia  
IEED, Lancaster University, UK  
IADE/UNIDCOM: The Creative University, Portugal

## Abstract

*This paper reports research from the perspective of complex socio-technical systems that offers insights into improving crime prevention and avoiding crime prevention failures in Design Out Crime, CPTED and other crime prevention planning and strategy making.*

*The research identified two different classes of crime prevention intervention relating to 'complicated' and 'complex' situations. These require different approaches. Historically, the same approach has been applied to both. The research suggested that many crime prevention failures or underperforming interventions result from this problem.*

*The research identified a distinguishing characteristic of '2 feedback loops' that differentiates 'complicated' from 'complex' crime prevention situations and interventions.*

*The research also identified how to address 'complex' of crime prevention situations. Examples are given that illustrate the main issues.*

**Keywords:** Design Out Crime, CPTED, crime prevention, complex socio-technical systems design.

## Introduction

Crime prevention as a field has been marked by characteristic failures and underperforming crime prevention interventions in a variety of circumstances typical of **complex** crime prevention situations (see, for example, Ekblom, 2008; Gill, Rose, Collins, & Hemming, 2006; Holloway, Bennett, & Farrington, 2008; Homel, 2005; Mawby & Jones, 2007; Pelsner, 2007; Scott, 2006; Shipway & Homel, 1999)

This paper addresses this problem of crime prevention failures by research distinguishing between two different types of crime prevention: **complicated** and **complex**. The analyses suggested that only *one* of these, **complicated** crime prevention responds well to the classic approaches of Design out Crime, CPTED and other conventional crime prevention approaches such as evidence-base crime prevention, problem-oriented crime prevention and Policing, situational or place-based crime prevention, and social crime prevention. The same approaches, however, have been used on **complex** crime prevention situations. The analyses suggest this as a core reason for crime prevention failures and underperforming crime prevention interventions because these methods do not work in **complex** crime prevention situations.

The research identified this as a significant reason for the difference between the two groups of crime prevention and the resultant failures. This reason seems to explain all the failures and underperforming crime prevention outcomes that were reviewed. It also points to an approach that will help avoid these crime prevention failures and poor outcomes. As an aside, it goes some way to explain the relative success and failure of current *situational* crime prevention interventions compared to *social* crime prevention interventions. The analyses developed in the research offer an alternative viewpoint to that of Ekblom (2008) on which this research builds in part. They address the same issues Ekblom identified. They suggest, however, that Ekblom's 5Is approach, although very practical, will, in the limit, be insufficient to develop accurate crime prevention interventions in **complex** crime prevention situations.

The outcomes of the analyses reported here comprise contributions to crime prevention theory and practice;

- practical guidance on identifying situations to which conventional Design Out Crime, CPTED and crime prevention approaches apply and which they do not
- guidance on effective approaches for developing crime prevention strategies for the relatively large number of *complex* crime prevention situations to which convention crime prevention planning approaches fail to produce satisfactory outcomes.

## **Background: limitations of thinking**

Human thinking, intuition and feelings are compromised by cognitive biases, biological limitations and fallacies (see, for example, Fernandez-Armesto, 2004; Gilovich, 1993; Klein, 1996; Knight, 1999a, 1999b; Labossiere, 1995; Schacter, 1999; Stroessner & Heuer, 1996; Warren, 1976). These cognitive limitations are grounded in the evolutionary development of human beings (Damasio, 1994, 1999; Fernandez-Armesto, 2004): the result of selection processes from less technological eras. Human cognitive and emotional processes have developed to equip us to respond quickly to direct, simple, causally-obvious challenges in which outcomes are close in time and space and the immediate result of obvious causes (e.g. touch a fire and your finger gets burned). Our brains and emotions have also learned to occasionally adapt to forecasting the outcomes of situations with a **single feedback loop** (someone runs, you chase them, they run faster – or not).

Biologically, these cognitive processes do NOT equip us to envisage, understand or predict behaviours of situations where causes of outcomes are:

- Complex
- Multiple
- Hidden
- Remote in time
- Remote in location

Our basic human biological processes delude us into erroneous understanding and faulty judgments.

The absolute limit of human thinking and intuition seems to be biologically limited to understanding the behaviour of situations with **less than two feedback loops**. These biological limitations of human thinking, intuition, feeling and understanding apply to EVERYONE.

**Quick Test:** Mike has \$1.10 and buys two items. The first item costs \$1 more. How much is the second item? Most people answer 10 cents. This is a very simple uncluttered single feedback loop problem shaped in arithmetic. The answer is \$1.05 and 5 cents. To test if one can easily predict the behaviours of a simple **double feedback loop** situation try <http://web.mit.edu/jsterman/www/Bathtub.pdf>.

Whether a situation has 2 or more interlinked feedback loops is a 'line' that separates situations whose behaviour can be understood using normal thinking and those that cannot be understood without modelling.

This is the LINE:

Humans unaided **CAN** predict behaviour of simple situations  
with **less than 2 feedback loops**

=====

Humans unaided **CANNOT** predict behaviour of complex situations  
with **2 or more feedback loops**

Figure 1: The 'Line' - 2 feedback loop measure separates simple and complex situations

## Conventional crime prevention

In this context, it is a problem that conventional crime prevention approaches assume and are developed for crime situations with less than 2 feedback loops.

This is unsurprising because until recently crime prevention has been focused primarily on crime situations that are merely *complicated* and have lots of factors but without feedback loops. These situations can be thought through and understood. Appropriate tools in these *complicated* crime prevention situations include:

- Crime data
- Crime trend data
- GIS crime hot spot maps
- Stakeholder participation in crime prevention
- Evidence-based crime prevention
- Classic Design Out Crime
- Classic CPTED
- Problem-oriented crime prevention
- Collaborative interagency meetings and strategy making]
- Scenario-building
- Environmental scanning
- Expert crime prevention think tanks
- Emerging crime issues analysis
- Headline crime indicator analysis

These approaches help address the *complication* of having multiple factors in a crime prevention situation. They work because *simple* and *complicated* crime prevention situations with less than 2 feedback loops can be thought through.

They are different from *complex* crime prevention situations that have multiple feedback loops because *complex* crime prevention situations **cannot** be thought through because humans are not biologically developed to understand and predict the dynamic behaviour of multiple feedback loop situations. Our knowledge of them and our ability to deal with them comes from the use of mathematical models. This can be tested in a trivial way by asking people to predict the behaviour of multiple feedback loop situations. Every time I have done this, I have found that the respondee will try to give me a single 'snapshot in time' answer. This illustrates the lack of understanding because the crucial thing about multiple feedback situations is that the outcomes change dynamically over time and this is both a problem for understanding them and identifying crime prevention responses, and a reason for the failure of conventional crime prevention approaches that assume that a crime prevention intervention has a single outcome in time.

## Crime prevention situations with less than 2 feedback loops

The simplest model of crime prevention is primitively one of force and direct action. An example is the 'reducing crime opportunities' approach of Felson and Clarke (1998) and others.



Figure 2: Direct action model of crime prevention – zero feedback loops

The most common underlying model of crime prevention interventions comprises a *single feedback loop model* as shown in Figure 3 below.

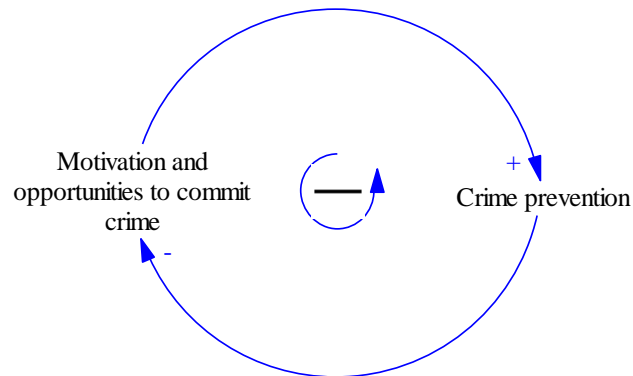


Figure 3: Single feedback loop model of crime prevention

To describe the action of the above single feedback loop model:

‘MOTIVATION AND OPPORTUNITIES TO COMMIT CRIMES results in *increased* CRIME PREVENTION which results in *reduced* MOTIVATION AND OPPORTUNITIES TO COMMIT CRIMES which results in *reduced* need for CRIME PREVENTION....’

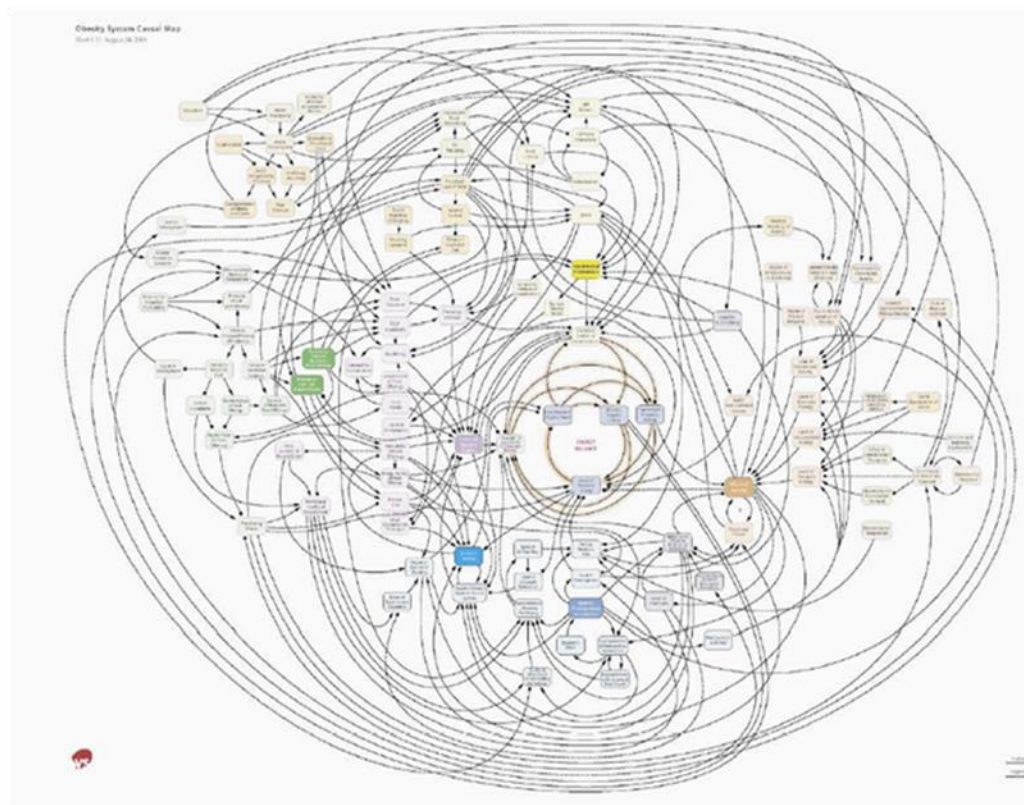
Most crime prevention interventions assume one of the above two models in Figures 2 and 3. Design Out Crime, CPTED and most crime prevention models operate on the basis of Figure 3 with crime prevention occurring as a result of a single stabilising feedback loop approach to controlling crime levels.

### **Complex Crime prevention situations with 2 or more feedback loops**

Many crime prevention situations are *complex*, however, and have multiple relationships between significant factors that form multiple feedback loops that over time influence each other and result in a dynamically changing.

As these crime prevention situations are beyond the 2 feedback loop line, their behaviour is *beyond* unaided human thinking and understanding. Conventional approaches to developing crime prevention interventions, as listed above, no longer apply because they assume that it is possible to think through the situations and understand them and their behaviour.

Many common complex crime prevention situations have dozens or hundreds of feedback loops. Figure 4 below is a diagram of a multi-feedback situation of addiction control intervention. The diagram shows the effects on each other of the main factors and the many feedback loops that these cause.



Design of obesity reduction: simplified model of multiple interrelated feedback loops  
<http://www.foresight.gov.uk/Obesity/12.pdf>

Figure 4: Complex multiple feedback loop model typical of addiction reduction management

The kind of situation illustrated by the causal loop diagram in Figure 4 is typical of complex crime prevention situations (e.g. anti-terrorism, anti-social behaviour, mixed crime in lower socio-economic areas). In these situations it is impossible to think through the situations and the effects of the interventions – hence levels of failure and poorly performing interventions is high as shown in the literature. A side effect is that the complex nature of these situations naturally leads professionals and public at the crime prevention ‘coal face’, and above, to be critical of the interventions and as a result this is often echoed in failures of implementation or blocking of implementation.

*This, in part, explains the apparent failure of socially-based crime prevention approaches compared to spatially-based crime prevention (see, for example, Frank, 2003).*

A couple of recent simple examples of problems from assuming crime prevention situations with 2 or more feedback loops have only 1 feedback loop are:

- Failure of Passport telephone-based identity checks provides opportunity for identity theft.
- Territoriality issue in Public pedestrian access ways (PAWs)

### **Blindness to the 2 Feedback Loop problem**

One of the key questions is ‘why has this distinction between these two types of crime prevention situations not been more obvious?’

For complex crime prevention situations with more than 2 feedback loops there are four problems with blindness to this issue:

1. The lack of ability to unaided understand the behaviour of situations with 2 or more interlinked feedback loops applies to EVERYONE. Yet, individuals believe that it does not apply to themselves and that if they think harder they will understand - not that they cannot understand!

2. Humans' lack of ability to think or intuit situations with 2 or more feedback loops leads to a delusion in which individuals feel and think that they understand the situation ( a similar issue is the confidence in false memories of witnesses)
3. Discussions involving multiple stakeholders fail because in them *no one understands the crime situation* where it involves more than 2 feedback loops. The nature of the group does not help. The primary outcome is of 'group think' in which the group members persuade each other to feel good that at least they will all be making the same mistake.
4. There is a strong temptation to ignore feedback loops (that are the core of the behaviour) to simplify complex crime prevention situations into merely complicated situations in order that they can apparently be thought about. This typically results in interventions that fail from just after the start.

The latter is echoed in the literature, crime prevention professionals have consistently attempted to deal with complex crime prevention situations by ignoring the feedback issues and attempting to re-envision them as simple linear or single feedback situations. All contemporary crime prevention theory follows this route. The outcome naturally is crime prevention failures and poorly performing crime prevention interventions

Experience has shown that when people try to create interventions to manage complex situations and use tools only suited to simple situations then many will produce results *opposite* to those intended. Humorist Henry Mencken is quoted as saying,

*'For every complex problem, there is a solution that is simple, neat and wrong.'*

The usual approaches of intuition, visualizing and feeling one's way round a crime prevention solution do not help when it is **not possible** to understand the behaviour of the situation due to human limitations of cognition for situations with 2 or more feedback loop crime situations.

Evidence shows that people intuit the wrong answer whilst believing absolutely (on the basis of their feelings and mental comfort) that they are correct. Meadows (1999) a key author of 'Limits to Growth' (D. H. Meadows, Meadows, Randers, & Behrens III, 1972) quoted Forrester,

*'Time after time I've done an analysis of a company, and I've figured out a leverage point [the location of the most effective design intervention] - in inventory policy, maybe, or in the relationship between the sales force and productive force, or in personnel policy. Then I've gone to the company and discovered there is already a lot of attention to that point. Everyone is trying very hard to push it in the wrong direction!'*

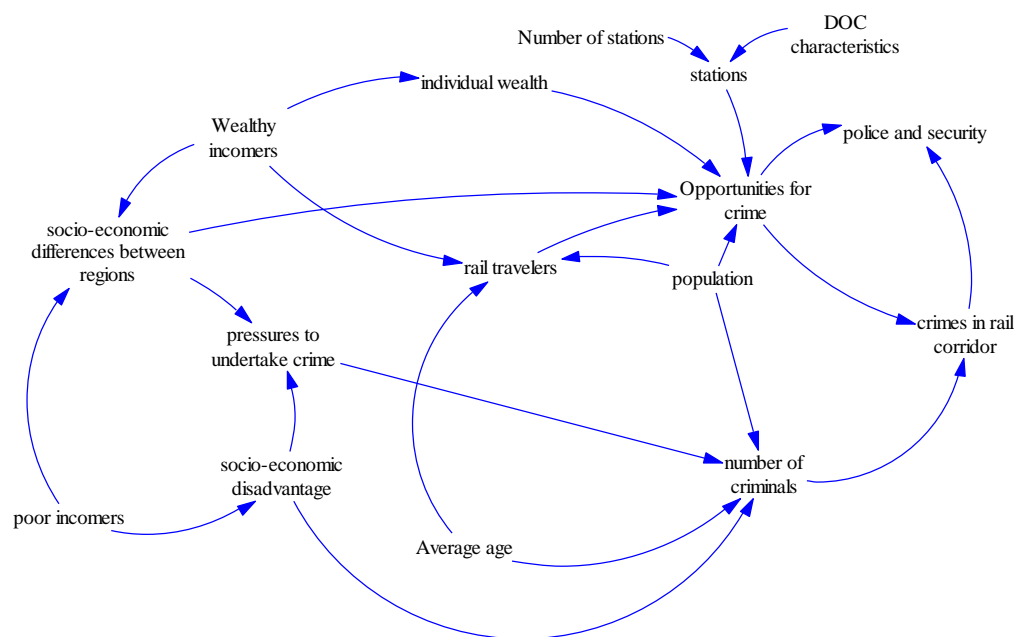
This is a potentially significant problem of developing crime prevention interventions for situations with 2 or more feedback loops: individuals falsely feel and believe they can intuitively understand and predict the behaviour of systems with multiple interlinked feedback loops. Erroneously our minds and bodies both give clear indications that we can understand and predict complex design behaviours with 2 or more feedback loops when we cannot.

An additional problem is crime prevention practitioners produce solutions in complex multi-feedback loop situations using the approaches suited to non-feedback loop problems. There is typically a gap in time between the initial intervention and failure. Commonly, complex designs function well at first and later when problems emerge due to the actions of the feedback loops, the design failures are blamed on something else.

This situation is common to a variety of professionals. Forrester and later Meadows (1999) identified there were an uncommonly large number of instances in which highly competent professional involved in intervening in complex socio-technical and organisational systems designed interventions that in the longer term resulted in movement *away* from the intended outcomes rather than towards them. The same issues are found in all areas involving two or more feedback loops. Urban Planners are famous for it! In manufacturing design and organisational design, Deming (1986, 1993) identified it was common for managers to make similar errors in the direction of their judgments when asked to resolve production problems

and improve the quality of output. In the environmental design field, designers, planners and managers of third world development of food production suffered similar misguided design decision making (Harrison, 1987).

The only approach that has proven success in helping professionals understand the behaviour of crime prevention interventions in situations with 2 or more feedback loops is the use of mathematically-based systems modelling techniques (see, for example, McGold, 1990, Minami & Kucik, 2009; Tawileh, Almagwashi, & McIntosh, 2008). The approach has been widely used in a relatively covert manner by military developing interventions in places such as Iraq and Afghanistan. The approach is also widely practiced in developing public-professional interventions in the public sphere such as AIDS prevention and economic change. Typically, the approach combines Causal Loop diagrams and System Dynamics modeling to develop a representation of a complex situation that will predict and display the behaviours of outcomes and other aspects of the situation in response to different ideas for crime prevention interventions. By providing a model of the behaviour of the crime prevention situation, the approach completely circumvents the human limitations of thinking and intuition.



Casual loop diagrams have value for helping crime prevention professionals ‘think through’ the causal relationships in a situation and also for checking that the thoughts and opinions of all contributors to a consultative process have been included.



intended. The use of causal loop diagramming is limited, however, to helping professionals understand ‘snapshots’ in time rather than the dynamic behaviour of the situation.

A strength of causal loop diagrams is they can be converted into a fully-fledged active system dynamics models that will dynamically predictively demonstrate the behaviour of a situation over time for different crime prevention interventions. Figure 6 below shows a simple system dynamic crime prevention model. The complexity of the feedback relationships in, e.g. Figure 5 above are ‘plugged into’ the factor tails in the lower half of the model in Figure 6

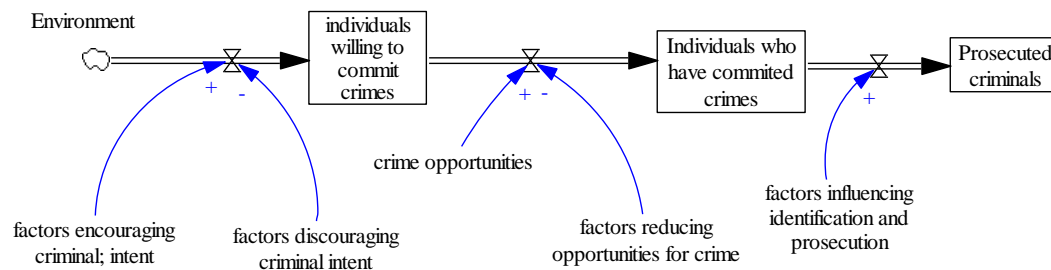


Figure 5: Preliminary model of relationships affecting crime and crime prevention interventions in a rail corridor (unpublished Love, T, Cooper, T, Cozens, P, Morgan, F and Clare, J)

## Conclusions

This paper applied insights from complex systems field to crime prevention. It focused on the implications of the human cognitive limitations to situations with 2 or more feedback loops.

The paper identified crucial differences in crime prevention either side of this 2 feedback loops boundary. In parallel, the paper identified limitations to a wide range of conventional crime prevention planning approaches when applied to situations involving 2 or more feedback loops. The literature and the analyses indicate this consistently results in failures of crime prevention outcomes and underperforming crime prevention interventions. The paper points briefly to these issues as being a reason for the relative failure of social approaches to crime prevention compared to situational approaches. The paper points also to the failure for *complex* crime prevention when approaches are used typical of addressing *complicated* crime prevention situations: such as stakeholder collaboration, expert think tanks and many of the futures methods. The paper suggests that in line with recent advanced military approaches to crime prevention in difficult arenas such as Iraq and Afghanistan, the most appropriate strategy for developing *complex* crime prevention interventions in situations involving 2 or more feedback loops is to use Causal loop diagrams and system dynamic modelling. The prior use of Causal Loop diagramming provides the professionally protective act of identifying whether the situation has two or more significant feedback loops or not.

To recap, humans are biologically inadequate to understand unaided the behaviour of *complex* crime prevention situations and interventions involving 2 or more feedback loops. Experience shows that most system outcomes involving two or more feedback loops are counter-intuitive, i.e. people typically suggest wrong interventions and result in outcomes opposite to those intended. At the same time, people are typically falsely confident about their ability to identify the most critical issues and the direction of the correct interventions.

Implications of these understandings for crime prevention education and practice include:

- It is important to distinguish between *complex* crime prevention situations involving two or more feedback loops and merely *complicated* crime prevention situations with less than two feedback loops.
- Being aware that crime prevention strategies and interventions involving systems with two or more feedback loops cannot be successfully achieved by thinking, by collaboration with others, by intuition or feelings, or by replicating previous interventions in similar situations.



- In crime prevention situations where there are two or more feedback loops the characteristics of successful interventions will likely display counter-intuitive relationships that individuals will 'feel' or be thought of as wrong. There are implications for the validity of current crime prevention theories and models of best practice.
- Causal Loop diagrams and Systems Dynamics models offer a way forward to identify interventions for complex crime prevention situations that will result in the correct behaviour of outcomes
- It is likely to require different forms of training of crime prevention professionals and researchers in the skills to address complex crime prevention situations using the appropriate complex systems methods.

## References

- Damasio, A. (1994). *Descartes' Error: Emotion, Reason and the Human Brain*. New York: Grosset.
- Damasio, A. (1999). *The Feeling of What Happens*. London: Random House.
- Deming, W. E. (1986). *Out of the crisis*. Cambridge, Mass: Massachusetts Institute of Technology and Cambridge University Press.
- Deming, W. E. (1993). *The new economics for industry, government, education*. Cambridge, MA: Massachusetts Institute of Technology Center for Advanced Engineering Study.
- Eklblom, P. (2008). *Managing the risks of evaluating crime prevention interventions using the 5Is framework*. London: Design Against Crime Research Centre.
- Felson, M., & Clarke, R. V. (1998). *Opportunity Makes the Thief. Practical theory for crime prevention*. London: Policing and Reducing Crime Unit.
- Fernandez-Armesto, F. (2004). *So You Think You're Human?: A Brief History of Humankind*. Oxford: Oxford University Press.
- Frank, C. (2003). What have we learned? Social crime prevention in SA: A critical overview. *Crime Quarterly*, 6.
- Gill, M., Rose, A., Collins, K., & Hemming, M. (2006). Redeployable CCTV and drug-related crime: A case of implementation failure *Drugs: education, prevention and policy*, 13(5), 451-460.
- Gilovich, T. (1993). *How We Know What Isn't So: The Fallibility of Human Reason in Everyday Life*. New York: The Free Press.
- Harrison, P. (1987). *The Greening of Africa*. London: Paladin.
- Holloway, K., Bennett, T., & Farrington, D. P. (2008). *Crime Prevention Research Review No. 3: Does Neighborhood Watch Reduce Crime?* Washington, D. C.: U.S. Department of Justice Office of Community Oriented Policing Services.
- Homel, R. (Ed.). (2005). *The Politics & Practice of Situational Crime Prevention* (Vol. 5). Monsey, NY: Criminal Justice Press.
- Klein, E. (1996). *Conversations with the Sphinx: Paradoxes in Physics* (D. Le Vay, Trans.). London: Souvenir Press.
- Knight, J. (1999a). How stressful days steal your memories. *New Scientist*(26 June 1999), 6.
- Knight, J. (1999b). Sex on the brain. *New Scientist*(26 June 1999), 17.

- Labossiere, M. C. (1995). Fallacies. *Journal*. Retrieved from <http://www.nizkor.org/features/fallacies/>
- Mawby, R. I., & Jones, C. (2007). Attempting to Reduce Hotel Burglary: Implementation Failure in A Multi-Agency Context. *Crime Prevention and Community Safety: an International Journal* 9, 145-166.
- McGold. (1990). A numerical sensitivity analysis of process delay in the incarceration of juvenile offenders. In *8th International Conference of the System Dynamics Society*. Chestnut Hill, MA: System Dynamics Society.
- Meadows, D. (1999). *Leverage Points. Places to Intervene in a System*. Hartland, VT: The Sustainability Institute.
- Meadows, D. H., Meadows, D. L., Randers, J., & Behrens III, W. W. (1972). *The Limits to Growth* (2nd ed.). G.B.: Pan Books.
- Minami, N. A., & Kucik, P. (2009). Developing a dynamic model of the Iraqi insurgency. In *Proceedings of the 2009 Spring Simulation Multiconference*. San Diego: Society for Computer Simulation International.
- Pelser, E. (2007). Understanding the failure of crime prevention. *SA Crime Quarterly*, 22, 1-6.
- Schacter, D. L. (1999). The Seven Sins of Memory: Insights From Psychology and Cognitive Neuroscience. *American Psychologist*, 54(3), 182-203.
- Scott, M. S. (2006). Implementing Crime Prevention: Lessons Learned from Problem-oriented Policing Projects. In J. Knutsson & R. V. Clarke (Eds.), *Putting Theory To Work: Implementing Situational Prevention and Problem-oriented Policing*. Monsey, NY: Criminal Justice Press.
- Shipway, C., & Homel, P. (1999). *Safer Cities And Towns: Crime Prevention Planning In Rural New South Wales*. Sydney: Crime Prevention Division, NSW Attorney-General's Department.
- Stroessner, S., & Heuer, L. B. (1996). Cognitive Bias in Procedural Justice: Formation and Implications of Illusory Correlations in Perceived Intergroup Fairness. *Journal of Personality & Social Psychology*, 71(4 ), 717-728.
- Tawileh, A., Almagwashi, H., & McIntosh, S. (2008). A System Dynamics Approach to Assessing Policies to
- Tackle Alcohol Misuse. In *Proceedings of the 26th System Dynamics Conference, July 20-24, 2008, Athens, Greece*. Athens: System Dynamics Society.
- Warren, N. T. (1976). Self-esteem and sources of cognitive bias in the evaluation of past performance. *Journal of Consulting & Clinical Psychology*, 44(6), 966-975.