

Designing policy interventions to change environmental behaviours: theory and practice

Terry Parminter

KapAg Ltd, PO Box 354, Paraparaumu, New Zealand 5254

terry.parminter@kapag.nz

ABSTRACT

Policy interventions are usually intended to result in changes in human behaviour to achieve social, economic and political outcomes. So, it is helpful for policy makers to have access to descriptions of human behaviour and theories of change that can improve the effectiveness and efficiency of natural resource policy. This paper reviews some of the available approaches used in New Zealand that have been developed from economic, sociological and psychological principles.

Economic frameworks are used to describe human behaviour as a process of making rational assessments of benefits and costs to maximise peoples' utility. Sociological and psychological descriptions of human behaviour explain the conscious and subconscious relationships between attitudes and behaviour, with additional influences such as identity, social norms, skills and resources, and personal confidence. By including a dual processing understanding it is possible to include the influence of peoples' habitual ways of doing things and their emotional reactions to choices and situations. When it comes to formulating behaviour change policies, psychological models such as stages-of-change can be used to segment intended audiences and design a range of appropriate policy interventions.

Diffusion principles provide a way of understanding how new technologies and practices can be adopted and spread through communities. These principles underpin models such as ADOPT that assist policy makers predict peak adoption levels and the time to peak adoption. In the United Kingdom, a 7E Policy Package model that integrates information about behaviours and behaviour change can be used to provide a balanced mix of coercive and non-coercive policy measures. Information about each of these approaches is provided in the paper, along with examples of their applications and applicability to a range of natural resource policy issues.

INTRODUCTION

In a liberal society there are going to be differences between people and social groups about what is best for people and society. In countries such as New Zealand, people are encouraged to develop their own values and goals and align with people that seek similar outcomes. It is axiomatic therefore, that the Government cannot expect everyone to conform to the same vision for the country. The implication is that as individuals and in organisations, all people may need to adapt and change according to local and national priorities and in response to inequalities between people for resources and opportunities (Lewis 2007). Government can make it possible as well as necessary for people to make informed, empowered and effective decisions. This particularly applies to environmental behaviours such as biodiversity, water quality and climate change affecting social groups such as farmers and rural communities. These issues often involve externalities affecting others in nearby communities, more remote groups and future generations.

New Zealand's Resource Management Act requires that any new policies proposed to be introduced can be shown to be efficient and effective at achieving their objectives (Section 32, NZ Government 1991). These Section 32 reports describe or assume an understanding of existing human behaviour and how changes in behaviour can be achieved.

It cannot be assumed that policy makers will stay up-to-date with theories on human behaviour to underpin their policy development. Over time policy heuristics evolve, based on personal experience and skills and familiar examples (Dye 1987, p36). These approaches can be successful for individual projects but they can also deliver inconsistent and biased results, people may miss learning opportunities and they may avoid untried innovation (Howlett and Ramesh 2003, p171).

This paper assists people preparing Section 32 reports by describing existing models of human behaviour and models of behaviour change. Selecting and applying frameworks from both sets of models is needed in policy development. The human behaviour models enable policy makers to understand how peoples' behaviours reflect their world views, beliefs and life-situations. On their own they are necessary for policy development but they are not enough for designing policy interventions (Darnton 2008). For effective policy interventions, additional behaviour change models are needed and they should be carefully selected to address concerns about on-going evaluation, and social equity, and to reduce the risks of unintended consequences (ibid). Once a behaviour is understood through a particular framework the principles associated with that framework can be applied in the design of an intervention. For example to understand and encourage behaviour change amongst Queensland sugar cane growers along the Great Barrier Reef, Pickering et al. (2017 and 2018) applied a cognitive social psychological approach. As proposed in this paper, the work with sugar cane growers could have been enhanced by separating the understanding of their behaviour from understanding how they might respond to policy interventions including an extension strategy.

FRAMEWORKS FOR UNDERSTANDING BEHAVIOUR

Attitudes

Common to all the behaviour models included here is the concept of attitude, where attitude is considered to be predisposition towards specific behaviours formed as a result of people evaluating the consequences for them of behaving in particular ways. Attitudes can therefore be either positive or negative (Eagly and Chaiken, 1993; p3).

Dual Processing

Dual processing of peoples' learning, reasoning and decision making has been widely used in psychology to explain how some behaviours reflect rapid, automatic and seemingly effortless decision making while other behaviours are characterised by thoughtful, considered and slow decision making. Sometimes within one person, the two types of thinking can even appear to be in conflict with each other, such as when we automatically purchase a familiar brand of food instead of stopping to consider whether or not an item matches our list of most desired attributes. These two types of processing are described in this paper as intuitive decision making and reasoned decision making (Parminter, 2002; Parminter and Neild 2013). The dual processing behind behavioural choices has also been described by Kaine as 'low involvement' and 'high involvement' decision making (Kaine and Johnson 2004).

Policy interventions are typically designed to influence reasoned decision making and so suit high investment, complex, risky behavioural choices. Policy interventions seem less designed to influence

intuitive decision making even though this is the main way that peoples' day-to-day behaviour is determined (Thaler and Sunstein p24, 2008).

The intuitive process makes use of routines, habits, emotions and heuristics (rules of thumb). These can replace the contribution of information in reasoned decision making and even dominate it (Darnton 2008). Novices generally need rules and guidelines for behaving when they first start out in a new technical area and these support reasoned decision making. Intuitive decision making is common with experienced people when they become experts in their field of practice (Benner 1982). Expecting technical experts to follow procedural rules in their area of expertise can become frustrating for all involved (ibid).

Economic Understanding of Behaviour

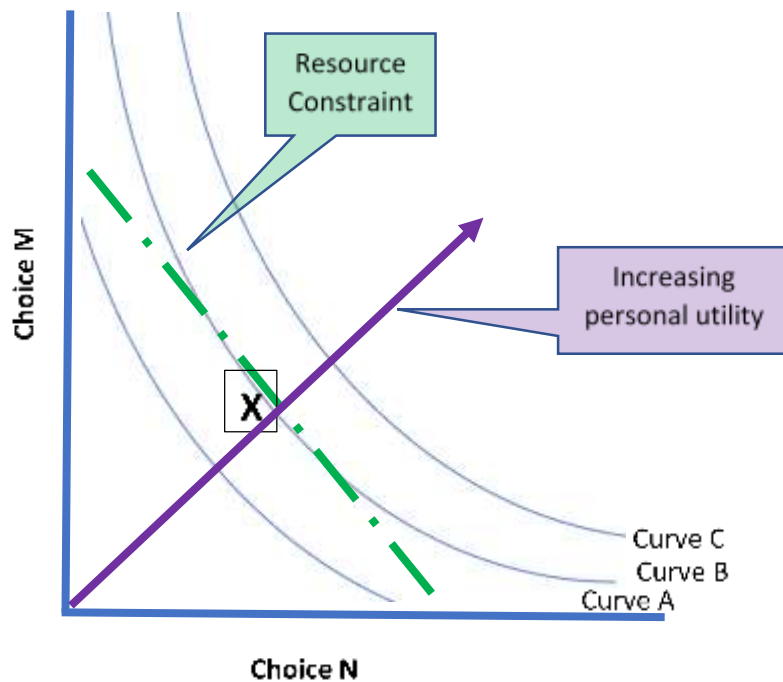
Behavioural decisions that involve considerable time or effort and with clear stable sets of benefits and costs suit economic understandings of human behaviour. Humans in these circumstances rely on reasoning to choose between alternatives using calculated comparisons of their benefits and costs. In classical economic approaches peoples' preferences between alternative behaviours are expected to be well-ordered and consistent, unvarying with changes in the availability of the options, the resources available or the length of time involved in decision making. Rational economic decision makers are expected to be autonomous, act as if socially isolated, and be self-interested. When they are making behavioural choices they are expected to maximise their resulting utility, such as their levels of satisfaction, happiness or personal benefit (Darnton 2008).

Figure 1 represents a simple decision making choice involving two alternatives – M and N. The decision maker improves their utility the more that they can do of both P and Q in combination. In the figure, Curves A-C represent points of equal utility. Combinations of P and Q lying along each of these lines provide equal satisfaction. Therefore the behavioural combinations along Curve C represent greater utility than the combinations along Curve B and Curve A. Decision makers have resource constraints (such as money and time) and in the figure the greatest utility available within the resource constraint lies along Curve B. A fully informed decision maker will therefore find that the combination of P and Q providing the greatest utility is at X.

The origins of peoples' preferences are not part of economic understandings of behaviour (Darnton 2008). The attributes that they are seeking may actually result in disadvantageous outcomes for them or be considered irrational by most other people, but if they are well ordered and consistent they can still be analysed according to rational choice decision making and aggregated up to whole markets (Keen 2011, p38).

In order to analyse choices through rational decision making individuals need to have access to all the information they need to make selections based on how their preferences relate to their choices, and how to process this information to optimise their decisions and maximise their utility (Simon 1996). Economists understand that peoples' access to information is constrained but "descriptive realism" has been less important to them than the "analytical power" of these assumptions (Darnton 2008).

Figure 1. Indifference curves representing peoples' decision making behaviour



The origins of peoples' preferences are not part of economic understandings of behaviour (Darnton 2008). The attributes that they are seeking may actually result in disadvantageous outcomes for them or be considered irrational by most other people, but if they are well ordered and consistent they can still be analysed according to rational choice decision making and aggregated up to whole markets (Keen 2011, p38).

In order to analyse choices through rational decision making individuals need to have access to all the information they need to make selections based on how their preferences relate to their choices, and how to process this information to optimise their decisions and maximise their utility (Simon 1996). Economists understand that peoples' access to information is constrained but "descriptive realism" has been less important to them than the "analytical power" of these assumptions (Darnton 2008).

Rational choice understandings of human behaviour have been helpful, but to accommodate more complex behaviours it has been integrated with psychology theory to develop behavioural economics models. These models include decision 'short-cuts' to attitude formation about behavioural preferences. They describe rational decision making when information is difficult to obtain, when people may lack decision making ability, or when time is short. Understanding this 'bounded rationality' in decision making is a way of improving its efficiency by considering broad categories of options rather than each specific one.

Some of the key principles from behavioural economics affecting our understanding of peoples' behaviour are (Darnton 2008):

- Hyperbolic discounting occurs when people's discount rates for time-delayed rewards vary throughout the timeframe of their decisions, usually by preferring short term rewards more than distant returns.
- Framing affects decisions as a result of peoples' preferences changing depending on whether they are presented as losses or gains, or in a different order.

- Inertia can apply when people feel that making a decision is just too difficult and prefer the easiest option available.
- Representativeness occurs when people make their new choices by selecting those behaviours most similar to previous decision outcomes.
- The availability of memories about similar situations in the past results in preference being shown towards choices that fit those situations occurring again.
- The anchoring of peoples' responses to initial reference points, so that things like changes in water quality are more influential in attitude formation than their mean state.

Some work with New Zealand farmers has described the importance of the private benefits associated with environmental policies of regional councils (Botha 2011). It also provides evidence of farmers' evaluating their options in land management through trusted relationships with council staff. For those farmers the information provided by staff eased the burden of information overload (ibid)

Social-Psychological Framework For Understanding Behaviour

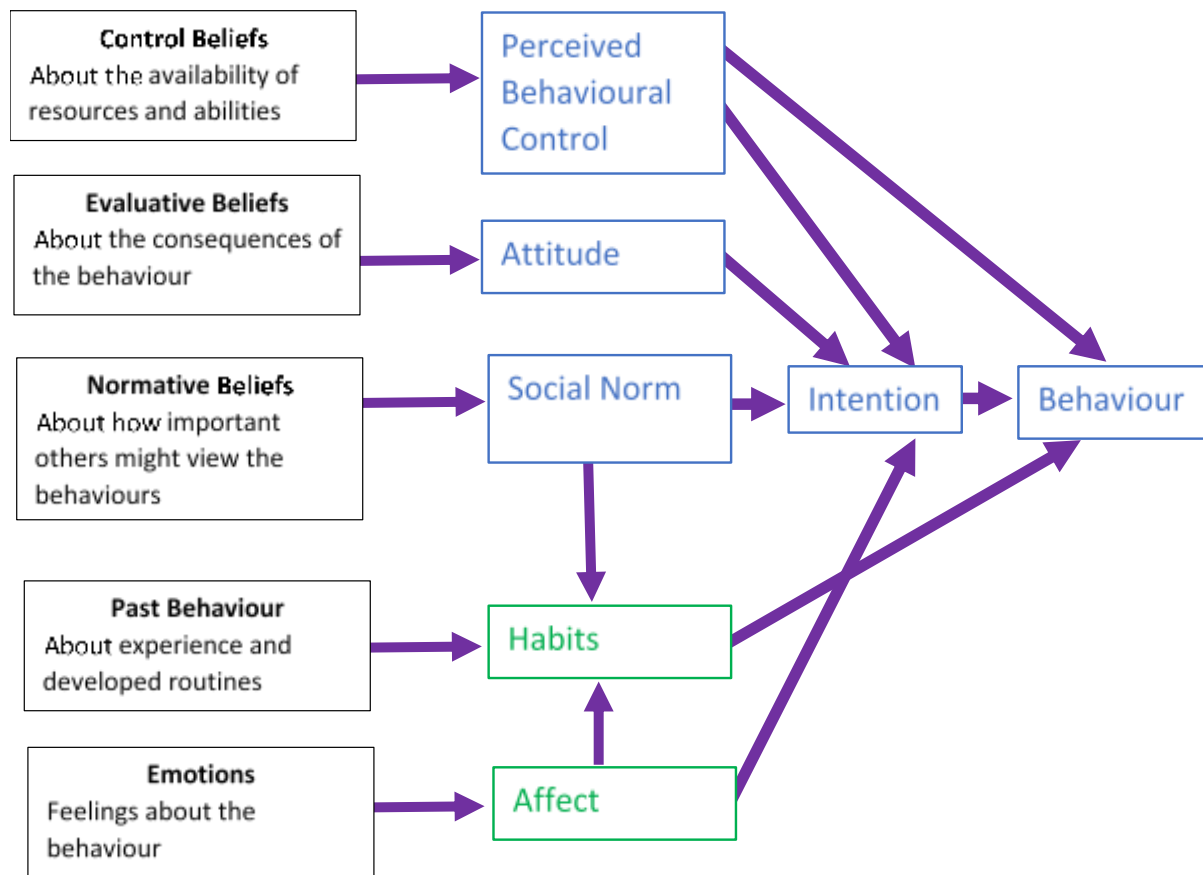
While useful for general behaviours, social psychologists examining the relationships between attitudes or preferences towards specific behaviours have found them to be tenuous and they explain at best about 30% of peoples' specific behaviour (Wicker 1969). On their own, attitude measurements are more closely related to general behaviour than specific behaviour, e.g. taking a range of steps to keep livestock out of waterways compared to the specific step of fencing riparian strips 5 meters wide along every waterway on a farm. For specific behaviours, the Theory of Planned Behaviour (TPB), has been put forward as a way of looking deeper to find the antecedents underlying attitudes and behavioural preferences and increasing explanatory power (Ajzen 1991). The TPB is based on peoples' beliefs about behavioural outcomes and their evaluation of those outcomes determining their intention to behave in specific ways. The evaluation can be through both conscious reasoning or subconscious influences (Ajzen & Fishbein 2000).

The TPB has been extended in a number of ways for specific behaviours (Parminter 2008). In Figure 2 the framework includes both reasoned and intuitive influences on behaviour by adding in parts of Triandis' Theory of Interpersonal Behaviour (1977). The framework in Figure 2 shows behaviour resulting from the direct influences of habit, intention, and behavioural control. The relative amount of influence that these factors have can be determined from the strength of peoples' beliefs, emotional responses (affect) and habitual ways of doing things. The framework also indicates that habit can be reinforced by social norms and disrupted by emotions such as fear (Darnton 2008).

Although models developed using the TPB can explain over 50% of peoples' environmental behaviour each model is very specific to the actual behaviour being modelled and developing a complete model can be very data intensive (Parminter 2009). The TPB indicates that beliefs precede behaviour and that isn't always the case. However, for behaviour to be sustained it is important for beliefs to become aligned. For example initially people may have felt legally constrained to wear seat-belts in cars. Over time however, they have generally developed supportive beliefs and their behaviour has become self-regulated and more automatic. Realigning beliefs to support new ways of behaving is explained by Festinger as overcoming initial cognitive dissonance (1957).

Although the Theory of Planned behaviour lacks feedback paths these are implicit for its authors. Other behavioural frameworks such as Bandura's social cognition theory of self-regulation (1991) make these more explicit.

Figure 2. An extended version of the Theory of Planned Behaviour to incorporate the Theory of Interpersonal Behaviour

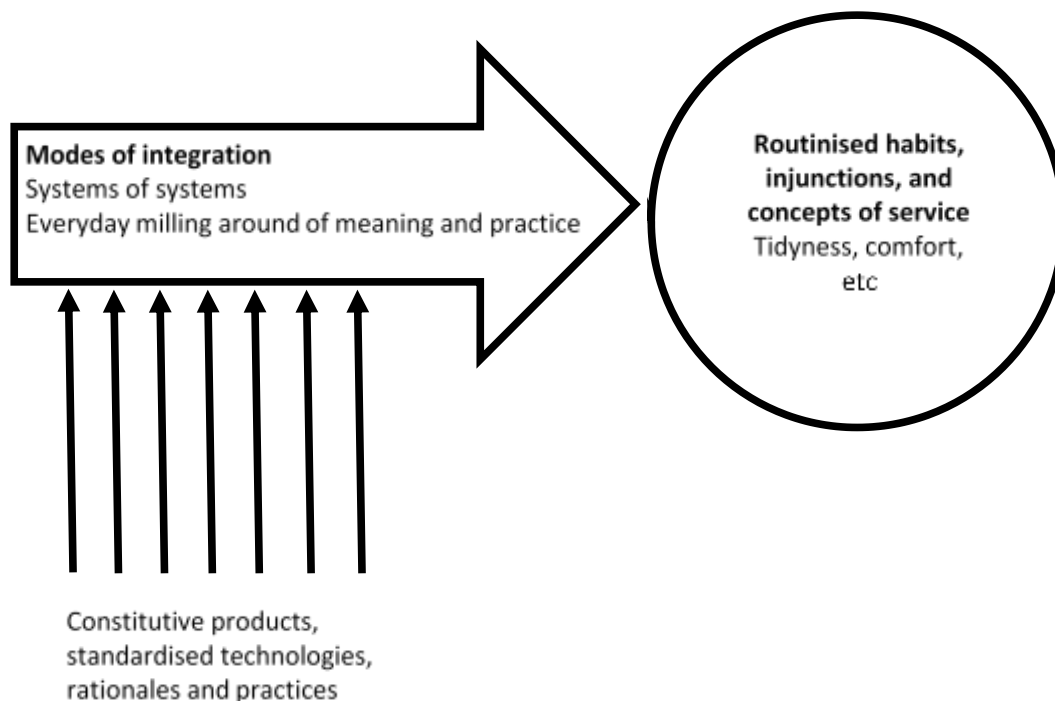


Contextual Models of Behaviour

Both the economic framework and the social psychology frameworks presented here are centred on an internal evaluation of choices and preferences. That is not the complete story however, as both the resources available in the economic model and the perceived behavioural control concept in the TPB are dependent on peoples’ external situation. The influence of external variables on attitudes and behaviour have been widely explored in New Zealand (examples include Scrimgeour 2017, Payne et. al. 2016, Bewsell et. al. 2007, Parminter 1994). Darnton (quoting Triandis) calls these facilitating conditions. They may provide opportunities to undertake certain behaviours but more commonly they are barriers to particular behaviours, interacting between people and their day-to-day world (Darnton 2008). Gray explored how context affected farmers’ decision making and behaviour and linked this to their use of formal and informal planning (2001, pp353).

Elizabeth Shove describes behaviours as evolving in clusters in response to their social and physical environment. Peoples’ behaviours are held in place by each person’s organising principles and the engrained habits that decide what should be done, when it should be done, and how it should be done. In Figure 3 the practices and technologies at the base of the diagram are organised and made sense of in the arrow shape and then incorporated and locked into peoples’ daily lives in the circular shape. People are not entirely in control of this process as the routines themselves help form the technologies and practices that themselves co-evolve new ways of living.

Figure 3. Pathways from practices to normality



From: Shove 2003

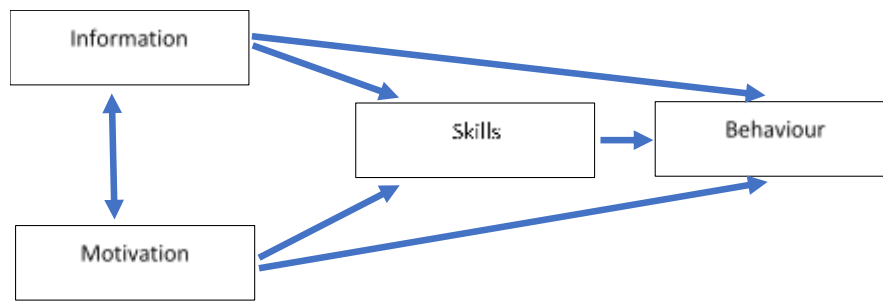
BEHAVIOUR CHANGE

Theories of change are different from theories of behaviour and they are informed by a number of other disciplines in addition to economics and social psychology. Change can be resisted by individuals and communities through maintaining habits and routines and remaining aligned with group values and norms. In many situations such resistance is considered a strength, but in others can be misguided. For example, society would benefit from having less people abuse alcohol (showing resistance to excessive drinking), and would benefit by people increasing their exercise (by agreeing to make changes to their lifestyle; Thaler & Sunstein, 2008, p72). Changing behaviour sustainably requires more than addressing the internal factors involved in setting peoples' behaviour. It needs on-going maintenance and addressing their external contexts so that people find reinforcement for their new behaviours. This could be through providing additional benefits, reinforcing routines, feedback about results and social approbation (Darnton 2008).

Change as Learning

Learning processes have been shown to be very important for changes in behaviour to be lasting (Darnton 2008). The Information-motivation-behavioural skills (IBM) approach to designing policy interventions has been used widely in human health (Fisher et. al. 2009). In Figure 4 information availability encourages peoples' motivation to follow expected ways of behaving and the information itself encourages people to have positive attitudes. From there people's skills grow and their confidence increases in their abilities to achieve successful results from changing their behaviour. The additional confidence and skills leads to changed behaviour.

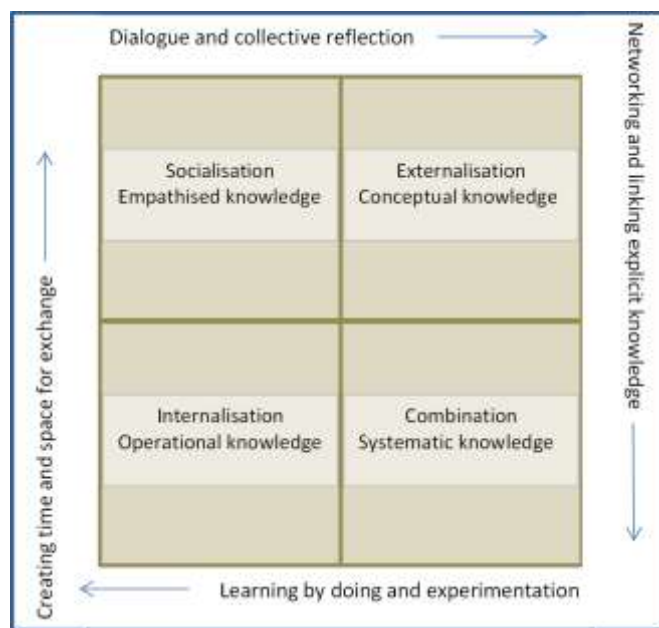
Figure 4. The information, motivation behavioural skills approach for the design of policy interventions



From: Fisher et. al., 2009

The straight technical approach to learning described in IBM does not build peoples’ capacity to problem solve themselves, adapt the information they have been given, or to resolve future issues in the same area. For that people need to learn skills in how to learn, or engage in double loop learning (Agyris and Schon 1996; Figure 5).

Figure 5. Formalised learning about intuitive knowledge



From: Nonaka & Hirotaka, 1995

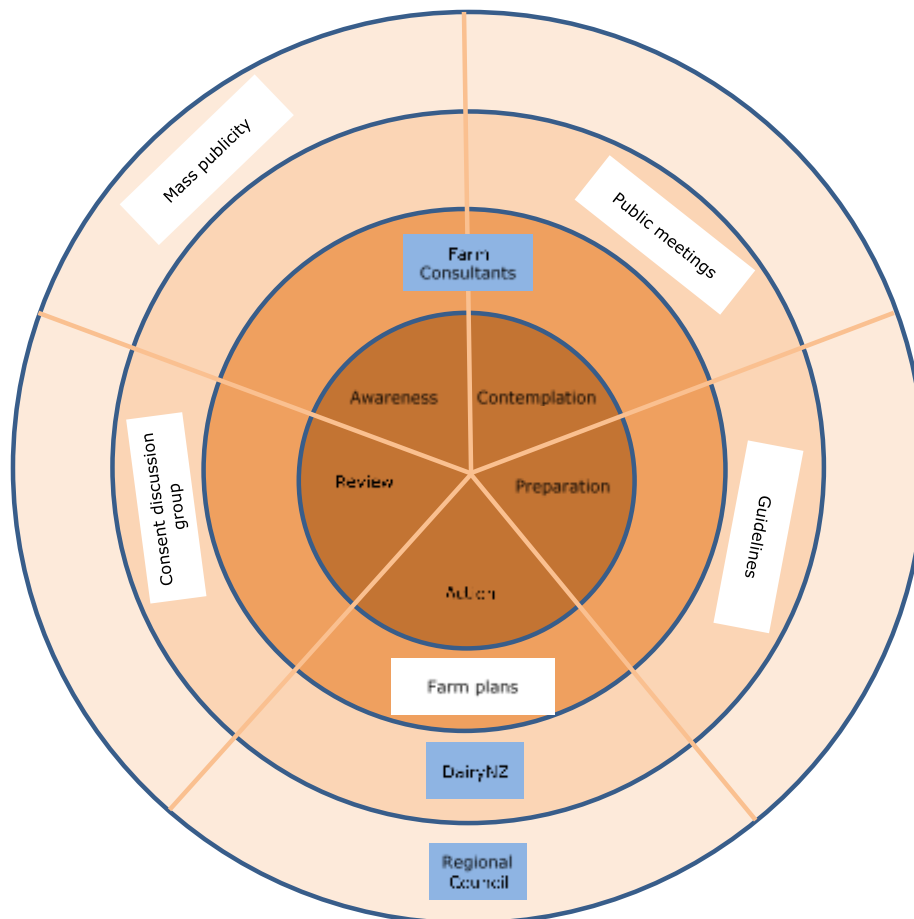
Whilst IBM addresses learning about reasoned decision making it does not explain intuitive decision making. Learning from intuitive behaviours may be particularly important when it is novices learning from experts (Benner 1982). In Figure 5 intuitive knowledge must first be made explicit before it can be codified and communicated to others.

In the learning process the previously codified intuitive knowledge is then assimilated by those receiving it before it becomes their own intuitive knowledge (Nonaka & Hirotaka 1995). This process is further described in an paper on New Zealand farmer knowledge (Parminter and Neild 2013).

Stages of Change

The stages of change framework has been developed from field observations of the change process, initially cessation of smoking (Prochaska and DiClement 1983). It is most helpful as a framework for segmenting populations and matching the different segments to behaviour-change interventions. Some marketing segmentation has used peoples' existing behaviours but these do not relate to the processes of change (RMPP 2015). In Figure 6 the stages of change framework has been applied to the work of the dairy industry and the regional council in the Manawatu Wanganui Region.

Figure 6. Farmer segmentation used to design a strategy for behaviour change



From Parminter et. al. 2017

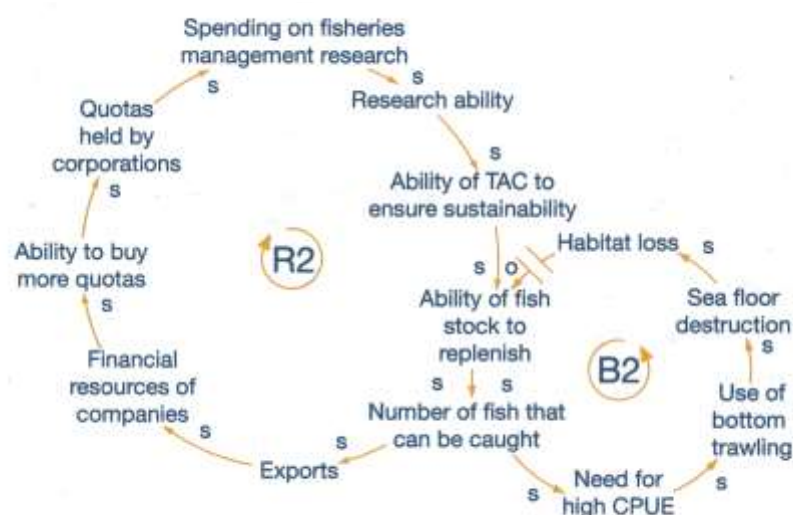
In Figure 6 the five stages of change are shown in the centre and around that the main mechanisms encouraging learning. When people are not familiar with a behaviour they mainly engage in intuitive learning and least cost engagement. This suits mass publicity and public meetings. For those people beginning to apply learning to their own circumstances more substantive communication will assist them with reasoned thinking. Guidelines and plans can be useful for them. After people have initially tried out a new behaviour further support is generally required to assist them review the results and further adapt what they are doing. In Figure 5 each concentric ring involves a different actor with specific roles including the policy organisation.

Systems in Change

A systems-in-change framework for behaviour change addresses the complexity often found in behaviour change. It helpfully addresses the emergent properties that result when policy interventions are being developed in new areas. These sometimes have unexpected results occurring when a number of different component policies are all linked together in something like a regional plan. Systems approaches to intervention design involve linking positive and negative forces for change along with their feedback loops. Every action in the system is either reinforced or counterbalanced by another (Senge 1990).

Systems thinking has two approaches (Maani and Cavana 2009). If the definition of a problem has been largely agreed to by the affected actors and its components are well recognised it can be analysed using hard system approaches. If there is still some uncertainty about the precise nature of the situation and the issue is confusing to many people, a soft systems approach might be best. In Figure 7 there is an example of a hard systems diagram describing the orange roughy fishery in New Zealand. In the diagram the ability of companies to build quota and catch fish is counterbalanced by bottom trawling and habitat loss. The diagram enables policy interventions to be designed to reduce the destruction of habitat and increase exports.

Figure 7. Systems diagram of the orange roughy fishery and habitat destruction



From: Maani & Cavana 2009.

Change through Social Networks

Social network theory describes how particular people in social networks become effective at communicating innovation and encouraging change. Opinion leaders are considered to be those people widely linked within their communities, that are very knowledgeable about specific issues and influential over other people. Bridging people (weak ties) may not be highly influential within their own communities but they link their community with other communities. Such people have degrees of influence depending on the types of behaviours involved, the social norms that have been established and the stability of their places in the community. In health behaviour opinion leaders have been able to model desired behaviours and encourage behaviour change amongst other people (Volente & Pitts 2017). The Red Meat Profit Partnership has put in place a social

network model of extension (figure 8). In Figure 8 the social network is developed around each farm team, shown in the centre. The farm team is closely connected to: subject matter experts, connectors, mentors and facilitators. Around these roles are arranged a number of professionals in a support capacity.

Figure 8. Red Meat Profit Partnership extension strategy using social networks



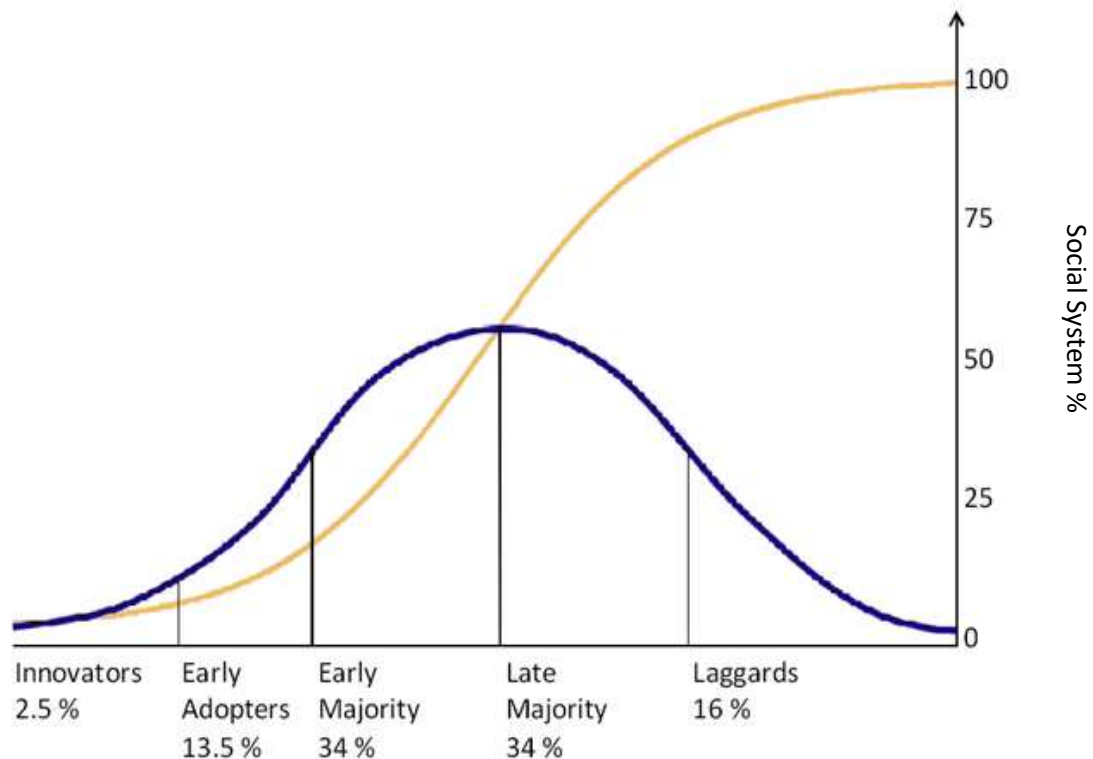
From Red Meat Profit Partnership 2015

Social networks provide a mechanism for diffusing social change through communities. Rogers (p5, 1995) describes diffusion as “the process in which an innovation is communicated [or transferred] ... among members of a social system.” One of the factors involved is the degree of innovativeness shown by individuals in a social system relative to others in their social system (Figure 9).

The set of categories shown in the diagram are described as a way of “understanding human behaviour” when social systems are confronted by change. Some people appeared to Rogers to be more innovative than others. Considering the social system as a whole, more innovative people may be more greatly connected with people that are socially different from them (Szreter and Woolcock 2004). This involves building bridging or linking social capital. Innovators and early adopters with bridging social capital are able to learn about new ideas from people outside their peer group – people such as technical experts and community leaders. Those with linking social capital are engaged with people in industry and political structures around them. Less innovative people (the late majority and laggards above) may have less bridging social capital and instead have more bonding social capital. These latter groups learn about innovations from their peers with similar

values, production systems and ways of doing things. They rely upon learning about innovations from people in their communities that are similar to themselves (Szreter and Woolcock 2004).

Figure 9. Adopter categorization on the basis of innovativeness



From: Rogers (p281 1995)

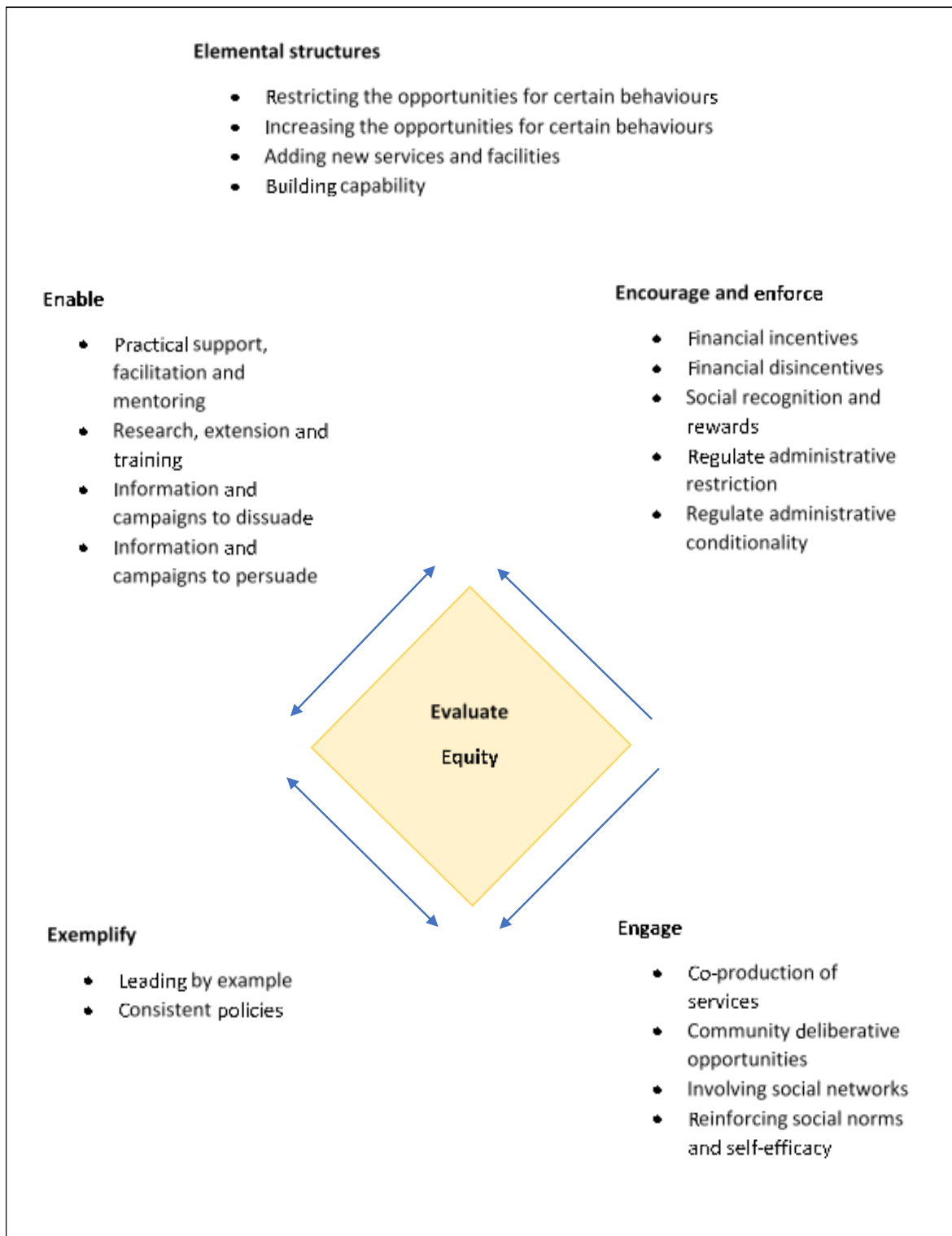
Being able to predict ex ante the adoption of new technologies and practices by a community or group of farmers can assist policy makers designing interventions that encourage practice change. It assists people develop their understanding of the critical factors involved in practice adoption and diffusion, and it reduces the problem of pro-innovation bias common amongst researchers, academics and politicians (Kuehne et. al. 2017). The adoption and diffusion prediction outcome tool (ADOPT) provides a standardised way of analysing the opportunities for change. It takes into account the characteristics of the target population and the characteristics of the technology or practice. The results are used to calculate adoption level and time to peak adoption (Kuehne et. al. 2017).

A FRAMEWORK FOR INTERVENTION

The Institute for Public Policy Research in the United Kingdom developed a framework for designing interventions that encourage behaviour change, particularly in areas of human health, climate change, environment and social policy (Lewis 2007). In their framework (Figure 10), enabling, encouraging, enforcing and elemental categories provide the main groups of interventions. The main principles that they embody are exemplifying, and engaging. The values of evaluation and equity are central. Adaptive management in policy requires ongoing evaluation. Equity in society and between those bearing the costs of change and the benefits of change strengthens society (Lewis 2007). Equity means that the people affected by policy interventions should have greater choice and empowerment as a result of the interventions (Thaler & Sunstein 2008). The 7Es provide

for the development of a package of policy measures strong enough to disrupt habits and routines and catalyse behaviour change.

Figure 10. The seven E's for policy formulation



From Lewis 2007 and Parminter 2010.

CONCLUSIONS

Human behaviours are complex, arising from an array of social psychological factors influenced by personal, social, cultural and societal factors.

All the frameworks and models described provide insights into different parts of policy formulation and behaviour change. They can be applied in isolation or used in a co-ordinated way. To understand existing behaviour, policy makers may use economic frameworks to understand the balance between private-good and public-good benefits and costs. If the behaviours are more complex or lack clear private-good motivations, social psychology models such as the TPB might provide the necessary insight. To understand the background to existing behaviours and how established they are in the day-to-day life of decision makers, a contextual model of behaviour could be used.

When it comes to developing policies to encourage behaviour change, systems-of-change frameworks provide a way of understanding how existing social structures and behaviours interact to produce predicted undesirable outcomes and where interventions can be introduced to be most effective at changing those outcomes. The stages-of-change framework provides a way of segmenting groups depending on their understanding of the processes of change. Social network theory can be used to suggest who should be transmitting information about making changes through their communities. The change-as-learning models can be used to design formal and informal learning opportunities that support the dual processing of information and behaviour change. Diffusion models of change highlight that social change is a process rather than an event. The diffusion models reinforce the importance of on-going evaluation and adapting policy interventions over time to achieve lasting policy outcomes.

Each of the frameworks and models described in this paper provides an insight into a component of policy formulation. The seven E's provides a way of bringing them all together in an integrated and coordinated way for achieving reliable socially acceptable results.

REFERENCES

- Argyris C, & Schon D. (1974). *Theory in practice: Increasing professional effectiveness*. Jossey-Bass, San Francisco.
- Argyris C & Schon D (1996). *Organizational learning II: Theory, method and practice* Addison-Wesley, Reading, MA.
- Ajzen I, (1991). The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes*, vol50, p179-211.
- Ajzen I & Fishbein M, (2000). Attitudes and the attitude-behavior relation: reasoned and automatic processes. *European Review of Social Psychology*, vol11, p1-33.
- Agris C & Schon D, (1996). *Organisational learning II: theory, method and practice*. Addison-Wesley, Reading, Massachusetts.
- Bandura A, (1991). Social cognition theory of self-regulation. *Organizational behaviour and Human Decision Processes* vol 50, no2, p248-287.
- Benner P, (1982). From novice to expert. *The American Journal of Nursing*, vol 82, no 3, p402-407.

Bewsell D, Monaghan RM & Kaine G, (2007). Adoption of stream fencing among dairy farmers in four New Zealand catchments. *Environmental Management* vol40, no2, p201-209

Botha N & Roth H, (2011). Eliciting New Zealand hill country farmers' decisions to participate in a voluntary soil conservation strategy. *Extension Farming Systems Journal* vol7, no2, p98-102.

Chaiken S & Trope Y, Eds., (1999). *Dual-process theories in social psychology*. Guilford Press, New York.

Darnton A, (2008). GSR Behaviour change knowledge review. Reference report: an overview of behaviour change models and their uses. Accessed July 2018, Government Social Research website: www.gsr.gov.uk .

DellaVigna S, 2009. Psychology and economics: evidence from the field. *Journal of Economic Literature*, 47(2), p315-372.

Dye TR, (1987). *Understanding public policy*. Prentice-Hall Inc., New Jersey.

Eagly AH & Chaiken S, (1993). *The Psychology of Attitudes*, Orlando, Harcourt Brace Jovanovich College, Florida.

Emmerling T, (2018). DRIVE: A practical framework for applying behavioural science in strategy. In A. Samson (Ed.), *The Behavioural Economics Guide 2018* (with an introduction by Robert Cialdin) p36-48. Accessed October 2018: www.behaviouraleconomics.com .

Festinger L, (1957). *A theory of cognitive dissonance*. Stanford University Press, Stanford.

Fisher JD, Fisher WA, & Shuper (PA, 2009). The information-motivation-behavioral skills model of HIV prevention behaviour. In R.J. DiClemente, R.A. Crosby, M.C. Kegler (Eds.), *Emerging theories in health promotion practice and research*, Jossey-Bass, San Francisco, CA, p. 21-63.

Gray DI, 2001. The tactical management processes used by pastoral-based farmers: a multiple-case study of experts. Thesis for PhD, Massey University, Palmerston North, New Zealand.

Howlett M & Ramesh M, (2003). *Studying public policy: policy cycles and policy subsystems*. Oxford University Press.

Kahneman D, (2003) A perspective on judgement and choice: mapping bounded rationality. *The American Psychologist* 58(9) p697-720.

Kahneman D, (2011) *Thinking, fast and slow*. Allen lane, London.

Kahneman D & Tversky A, (1979). Prospect theory: an analysis of decision under risk. *Econometrica* 47(2), p263-291.

Kaine G & Johnson F, (2004). Applying marketing principles to policy design and implementation. Social Research Working Paper 02/04. <http://geoffkaineresearch.com/download/getfile/6>

Keen S, (2011). *Debunking economics revised and expanded edition: the naked emperor dethroned?* Zed Books Ltd, New York.

Kuehne G, Llewellyn R, Pannell DJ, Wilkinson R, Dolling P, Ouzman & Ewing M, (2017). Predicting farmer uptake of new agricultural practices: a tool for research, extension and policy. *Agricultural Systems* vol156, p115-125.

Larsen C, Montagu K, Lucas D, Blaesing D, Boland Anne-Maree & Rogers G (2018). Evaluating the effectiveness of an integrated extension delivery approach in the Australian vegetable industry. *Rural Extension & Innovation Systems Journal*, 14 1, p124-129

Lewis M, (2007). *States of reason: freedom, responsibility and the governing of behaviour change*. Institute for Public Policy Research, London.

Maani KE & Cavana RY, (2009). *Introduction to systems thinking*, 2012 edition. Pearson Education, Auckland, New Zealand.

New Zealand Government, (1991). *Resource Management Act*, reprint 2015. New Zealand Government, Wellington, New Zealand.

Nonaka I and Hirotaka T 1995, *The knowledge creating company: how Japanese companies create the dynamics of innovation*, Oxford University Press, New York.

Parminter TG (1994). The use of a marketing approach to improve the development of new technologies: a case study. *Proceedings of the New Zealand Society of Animal Production* vol54, p393-397.

Parminter TG, (2008). *An examination of the use of a human behaviour model for natural resource policy design and implementation by government (central and regional) agencies*. PhD thesis, The University of Waikato, Hamilton, New Zealand.

Parminter TG, (2009). *Natural resource policy management in New Zealand: three studies based upon the Theory of Planned Behaviour*. VDM verlag, Saarbruchen, Germany.

Parminter TG, (2002). *A framework for policy agencies to design and evaluate communication strategies to achieve behavioural change*. New Zealand Agricultural and Resource Economics Society Conference. Lincoln College Discussion Paper No.149, p206-210.

Parminter TG & Neild J, (2013). *Just knowing: tacit knowledge*. *Extension Farming Systems Journal*, vol9, no1, p231-239.

Parminter TG, Duker A & Hughes J, (2016). *A regional collaborative extension project to decrease nutrient losses to waterways in the New Zealand dairy industry*. *Extension Farming Systems Journal*, vol12, no1, p23-31.

Payne TA, Turner JA, Rijswijk K, McDermott AK, Wakelin RDN, (2016). *Informing extension project design: the right tool for the job*. Hill Country Symposium. *Grassland Research and Practice Series* vol16, p33-38.

Pickering JA, Hong J, Hong D & Keally M, (2017). *Applying behavioural science to the Queensland sugar cane industry and its relationship to the Great Barrier Reef*. *Rural Extension & Innovation Systems Journal* 13(2), p1-10.

Pickering J, Hong J, Stower R, Hong D & Kealley M, (2018). *Using psychology to understand practice change among sugar cane growers*. *Rural Extension & Innovation Systems Journal* 14(1), p62-72.

Prochaska, J. and DiClemente, C. (1983) *Stages and processes of self-change in smoking: toward an integrative model of change*. *Journal of Consulting and Clinical Psychology* , 5, 390–395.

Red Meat Profit Partnership (2015). *Farmer Segmentation - RMPP Research Summary Overview*. A presentation,

[http://www.rmpp.co.nz/site_files/13089/upload_files/RMPPSegmentationResearchSummaryDec2015\(1\)\(1\).pdf?dl=1](http://www.rmpp.co.nz/site_files/13089/upload_files/RMPPSegmentationResearchSummaryDec2015(1)(1).pdf?dl=1) .Accessed August 2018.

Rogers EM, (1995). Diffusion of Innovations (fifth edition 2003). Free Press, new York.

Scrimgeour FG 2016. Pathways ahead for New Zealand hill country farming. Journal of New Zealand Grasslands, vol78, p73-82.

Shove E, 2003. Comfort, cleanliness and convenience. Routledge, London.

Simon HA (1996). The sciences of the artificial. MIT Press, Cambridge, Massachusetts.

Szreter S & Woolcock M, (2004). International Journal of Epidemiology vol 33, p650–667

Thaler RH & Sunstein CR, (2008). Nudge: improving decisions about health, wealth and happiness (2009 edition). Penguin Books, London.

Triandis H, (1977). Interpersonal behavior. Brooks/Cole, Monterey, California

Valente TW & Pitts SR (2017). An appraisal of social network theory and analysis as applied to public health: challenges and opportunities. Annual Review of Public Health, vol38, p103–18

Wicker AW, (1969). Attitudes verses actions: The relationship of verbal and overt behavioural responses to attitude objects. Journal of Social Issues, vol25, p41-78.