

**THE PSYCHOLOGY OF DECISION MAKING
IN FARM MANAGEMENT**

**A REVIEW OF THE BACKGROUND TO
MANAGERIAL ABILITY, AND SUGGESTIONS
FOR A RESEARCH PROGRAMME TO
INVESTIGATE ITS IMPROVEMENT**

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1. Introduction

Managerial ability has always been regarded as an important parameter in agricultural production. However, while there have been studies on descriptive aspects of management processes and abilities (e.g., Johnson et al (1961)), few studies have focussed on developing methods and procedures for improving the level of individual manager's abilities. This review is designed to appraise the background to managerial ability, particularly with respect to the relevant psychological research, and to consider the structure of research programmes designed to develop ability enhancing systems.

A few years ago Malcolm (1990) looked back over fifty years of farm management research and practice in Australia. What he concluded applied equally to most countries. He noted that despite all the research and development on a wide range of decision models and systems, the farmers of today still largely rely on intuition, experience, and simple budgeting. Researchers, on the other hand, have clearly benefited from the developments which in general have stemmed from other disciplines and require modification for primary production use. Many of the research method developments have been made possible by the increasing availability of powerful and affordable computers. Farmers have also benefited. Nuthall and Benbow (1998) found 43% of the New Zealand farming population had a micro-computer and this percentage was increasing at approximately 4% per year. Other western countries are experiencing similar rates. Despite this, the farmers still conform to Malcolm's conclusion that budgeting is their main analytical tool. The farmers' other main computer activity is financial recording.

It is no wonder there is a modicum of interest in the management factor and its psychology starting to appear. Ohlmer et al (1998) developed concepts of the steps Swedish farmers used when making decisions - this work was a useful and timely start. Rougour et al (1998) looked at measuring management capacity and noted 'explicit definitions (of management capacity) together with an elaboration of the concept are hard to find'. They introduced the notion of psychological aspects being important and reviewed efficiency studies- they noted the next step would be to include 'aspects of the decision making process'. Clearly the seeds have been sown.

While not in regard to managerial ability, Willock (a) et al (1999), and others, report on a study which measures and highlights many psychological variables of Scottish farmers. While this study did not involve managerial ability it has provided a valuable backdrop and experience for such studies, particularly with regard to quantifying the relationships (Austin et al (1998)).

Every farmers' aim is to achieve his or her goals and objectives - which may involve an amalgam of the farm family members' desires and wants. In a general sense the function to maximise is:

$$\text{Achieve goals/objectives} = f(\text{goal/objective recognition, resources available, farm environment, regulations, managerial ability})$$

Traditionally research has concentrated on the resources, environment and regulations with respect to profit maximisation, though in recent years multi-objective (Piech and Rehman (1993)) analysis has become more important. It is time emphasis was placed on the other

aspects - managerial ability and goal/objective classification - the two are intertwined.

Mention managerial ability and many beliefs and theories will be voiced. Preston (1996) is reported to have said farming success depends on (a) hard work both “with the brain and physically”, (b) timing - “everything is done when it should be”, and (c) achieving “consistently good figures, such as gross profit per stock unit, lambing percentage and wool weights”. Some might argue with these statements, but what is more important is that managerial ability revolves round rather more fundamental issues that eventually give rise to some of these more obvious traits. This is where study is required.

To investigate the more fundamental aspects of decision thought processes the obvious place to turn is the discipline of psychology - which Atkinson et al (1990) define as (p8): “the scientific study of (human) behaviour and mental processes”.

The potential gain from applying psychological concepts and methods to the management of primary resources needs to be investigated. This discussion moves in this direction. Both psychology and economics are concerned with choice theories. Weber (1994) compares the two disciplines through the following table:

| | PSYCHOLOGY | ECONOMICS |
|-----------------------------|--|---|
| FOCUS ON | <ul style="list-style-type: none"> • explaining processes • individual behaviour • learning phenomena | <ul style="list-style-type: none"> • predicting outcomes • aggregate behaviour • equilibrium solutions • theory |
| ANOMALIES STUDIED | <ul style="list-style-type: none"> • deviations from normal behaviour | <ul style="list-style-type: none"> • market inefficiencies |
| PROXY FOR IMPORTANCE | <ul style="list-style-type: none"> • can it lead to preference reversals? | <ul style="list-style-type: none"> • Can anybody make money with it? |

He also notes that economists could well use the psychological insights of the subjectivity of perception, the relativity of perception, the theories of individual difference and the role of intrinsic versus extrinsic incentives. It is contended that in the area of managerial ability all these aspects need investigating.

It could be argued that if the psychologists have the answers there is little point of further work. It is doubtful whether psychologists would agree that they do in fact have the answers, and more importantly, very little of their research has concerned field studies in agriculture. There are some exceptions - Weber (1994) is one example. The conditions under which primary production decisions are made is very different from, for example, an urban tyre factory or an urban insurance office.

Currently very few farm managers obtain any management skill training other than through 'on the job' experience. Furthermore, the increasing numbers of farmers graduating from tertiary institutions (in New Zealand 27.2% of farmers have had tertiary education (Nuthall and Benbow (1998)) do not have exposure to other than a few theoretical aspects of ability. This would seem an area for rewarding development.

In contrast many tertiary institutions, and specialist research establishments, have courses and research programmes on technology development, as well as adoption theories and practice. These programmes are important as it is clearly crucial that the on-farm decision makers fully understand the current technology available to them. Learning about technology is, however, only one aspect of managerial ability - one of the many competencies that make up a total manager.

With the development of computers and the associated software it might be argued they will increasingly take over the role of management. As noted above, the history of computer use on farms (Nuthall and Benbow (1998)) has shown that while more farmers are using computers they only use them for basic management support. The software available is not being found useful at a higher level. This is likely to continue as farmers tend to be reluctant to hand over control to systems they are not fully conversant with, and more importantly, the systems available are still very rudimentary and have not been proven to outperform a skilled human manager. This situation is likely to continue.

Thus, as Salmon (1980) concludes (p20), "the psychological correlates of farm management still remain a clouded issue and a new approach was needed from a different theoretical base". To this day this situation has not changed.

This review and discussion is divided into nine sections. The next section contains a brief review of the work on farmers' managerial processes, and this is followed by a section on man's thinking processes as an introductory understanding seems helpful to understanding decision processes. Section four, therefore, contains material looking at, and reviewing, man's decision and action cognition as this is the area that needs study and improvement. As understanding what managers are striving to achieve is a cornerstone to change, the following section briefly reviews goals, objectives and attitudes. Specific agricultural work is then introduced with the sixth section covering farmers' decision methods, though clearly the amount of work to report on here is somewhat limited. This leads into considering the components of managerial ability with respect to primary production so section seven contains a list of basic competencies thought to be important. As improving managerial ability is the main objective, section eight contains a discussion on whether the ability of mature managers can in fact be altered. Fortunately the evidence regarding adults in general is positive. Finally, consideration is given to research methods and a possible research programme with the discussion in section nine. A brief conclusion is then presented.

2. Studies of farmers' managerial processes and ability

There have been many studies of farm/farmer efficiency, but few on the farmer him or herself. One of the early in-depth studies was of US midwestern farmers (Johnson et al (1961)). The objectives of the survey and analysis was to examine the role of information in decision making, to examine the components of management (hypothesised as observing, analysing, deciding, action and acceptance), to learn what analytical procedures and expectation models were used, and to record the insurance strategies used. They documented large quantities of information (such as the sources of information) and attempted to relate the management processes to the dominant production economics thinking of the time (marginal analysis, pricing supply and demand models). The researchers were agricultural economists and this background dominated their approach. No work on the farmers' psychology or personal parameters was conducted.

Shanteau (1984) noted that most basic disciplines had an agricultural form (agricultural economics, agricultural botany.....), but this had never occurred in psychology though one or two pioneers worked in this area (such as Shanteau himself). Examples include Muggen (1969) who concluded, after a review of 73 studies, that farmers were not different to the population at large in factors such as abstract reasoning, memory, numerical ability right through to motivation and risk aversion attitudes. In addition, Salmon (1980) reviewed some of the early work and notes that Van Den Ban (1970) considered 25 Dutch studies and concluded they did not know which personal qualities were associated with high income. In contrast, Salmon also reports that Krause and Williams (1971) found a positive relationship between change in net worth over 1960-64 and personality factors.

Work on the adoption process, technology transfer and extension, (for example Morris et al (1995)), on the other hand, has been extensive and has made a major contribution to action in the field. Furthermore, many textbooks have been written in this area (e.g., Roling N (1988)) for the many courses in most universities with an agriculture faculty. This work focusses on the manager and change, but only considers a small component of the whole process of management.

Similarly, there has been an appreciable amount of work on goals, objectives and attitudes (for example Fairweather (1990)). A common conclusion is that profit is only a small component of what underlies the decisions made. This is an important recognition, but is only background to the question of managerial ability. What is perhaps more important is farmers' attitudes to, and use of, information (for example, Lively and Nuthall (1983) & Ryde and Nuthall (1984)) as part of success is knowledge and successful forecasting. However, little more than recording the practices used has been achieved.

It is only very recently that managers' psychology has started to be included in research work in detailed and meaningful ways. One significant study is currently appearing in the literature - this is the Edinburgh Study of Farmer Decision Making which has given rise to a series of articles (Willock (1997), McGregor et al (1996), Austin et al (1998), Edwards-Jones et al (1998), Willock et al (1999) a & b)). A sample of over 200 Scottish farmers completed many psychological tests as well as questionnaires on goals, objectives, attitudes and farming practices. The tests included intelligence, personality, innovation and health/stress questionnaires that had been widely used and validated on many samples throughout the general population. This massive amount of data was carefully analysed using a range of

statistical methods (see later under research methods) to explore the underlying factors and relationships. A major emphasis in the study was farmers' attitudes to the environment as an underpinning objective was to provide policy makers with sufficient understanding to enable good environmental rules and regulations. The study was not directed at understanding managerial ability, but nevertheless provides an extremely valuable background to future studies.

'The results show that farmers do not differ from the normal population on any psychological factors. But psychological factors do play an important role in farm decision making' (p5, Willock (1997)). The researchers also related personality factors to goals and attitudes and gave what they regard as the direction and strength of causation. Whether all their conclusions can be applied to farmers in other regions and countries has yet to be ascertained so it is not appropriate to review the detailed results. However, another statement from the conclusion is (p6) "psychological variables are important contributors to the decision making process..... The study permits the identification of those who change more quickly..... they are extrovert, outgoing and likely to communicate the change to a number of other farmers." McGregor et al (1996) also reports that there was a correlation between farmers' IQ test score and gross farm income per hectare. Edwards-Jones et al (1998) reported that personological variables explained between 20 and 30% of the observed variation in environmentally oriented behaviour. They also report on a number of structural equations developed to predict environmental and production behaviour. All these results, and the many more in the written reports, are important if for no other reason than they focus attention on the psychology of decision making in a modern context.

Of direct relevance to managerial ability are the studies on the competencies important in management; and the reviews on management capacity and processes, the latter having recently appeared. The competencies, or skill areas, important in management will be reviewed in greater detail in a later section, but suffice to note that attempts have been made to list these for curriculum purposes - getting this list correct is likely to be crucial to the success of management training (see, for example, Lees (1991)).

Equally as important as training is the person's inherent capacity to manage. Rougoor et al (1998) reviews this topic and note that capacity can be divided into (i) drives and motivation, (ii) abilities, and (iii) biography. They comment on the alternative ways of observing a farmers' managerial ability, and list studies looking at efficiency. They note there is a clear correlation between education and efficiency, but mixed conclusions on the importance of age and experience. One study reported a positive correlation between the 'level of ambition' and milk yield, another correlation between personality and debt levels. Overall, however, clear theories and conclusion did not emerge from the literature. They conclude that the decision making process is 'under exposed'. (Ohlmer et al (1998), in the following article, concentrate on exploring this process and how it might be improved. They worked on a number of case studies and concluded the process was not a linear system through planning, execution and control, but a more complex system of dynamic "visits" to various phases and sub-processes. They summarise this with the following figure (p285).

A Revised Conceptual Model of the Decision Process

| Phase | Subprocess | | | |
|--------------------|--|-----------------|---|---|
| | Searching & Paying Attention | Planning | Evaluating & Choosing | Bearing Responsibility |
| Problem Detection | Information scanning Paying attention | _____ | Consequence Evaluation, Problem? | Checking the choice |
| Problem Definition | Information search Finding options | _____ | Consequence evaluation, Choose options to study | Checking the choice |
| Analysis & Choice | Information search | Planning | Consequence evaluation, Choice of option | Checking the choice |
| Implementation | Information search Clues to outcomes | _____ | Consequence evaluation, Choice of corrective action(s) | Bearing responsibility for final outcome, Feed forward information |

Many would agree with this concept. They also concluded that their case study farmers exhibited five characteristics in their decision making (p288) - "(i) continual updating, (ii) a qualitative approach, (iii) a quick and simple approach, (iv) small tests and incremental implementation, and (v), checking clues during implementation". In attempting to improve managerial ability these attitudes must be taken into account. Ohlmer et al also comment that personal networks and clubs are very important in the management process, but when it comes to improving ability their single suggestion is 'education'.

Progress has been made. Over the years some acceptance of the importance of managerial ability has occurred and there have been studies on the management process. In addition a start has been made on relating the managers' psychology to decision outcomes. There is, however, a long way to go to obtain a reasonable understanding of how to improve managerial efficiency.

3. A model of man's modus operandi

To consider increasing the efficiency of decision systems it is desirable to understand how decisions are made. This involves rather more than a study of the decision processes (e.g. reported by Ohlmer et al (1998)) so that it is clear how man observes information, how s/he stores the information, how it is retrieved, how it is processed and so on. The difficulty is that the types of experiments possible with human subjects is limited. The study of cognitive psychology (for example, see Eysenck & Keane (1990)) relies on simple observation, non-invasive experiments, and the study of brain damaged people (cognitive neuropsychology). However, some sort of conceptual model is an important starting point and one that will be improved as recording and analytical systems are improved. Due to the experimental difficulties, however, it is unlikely a universally accepted model will ever be introduced.

Each person is born with certain attributes (genotype) and eventually evolves into an individual with certain observable characteristics (phenotype). Thus, the genotype combined with the environment gives rise to each manager. The manager is exposed to 'cues', observes some, processes them and subsequently acts, sometimes appropriately, sometimes not so appropriately. The major question is whether, for any individual, the appropriateness of the action can be improved. This implies there is some kind of measuring stick (see the later section on goals).

A person, it seems, has 'traits' and 'states'. The traits are the stable components, whereas the states (moods) vary from time to time. Furthermore, traits can be broadly grouped into personality, intelligence and, possibly, motivation. A review of the literature suggests many psychologists tend toward this conclusion but there is by no means total agreement.

Personality is made up of several components (traits) with many studies concluding that there are probably five basic traits. The most recent review (Matthews and Deary (1998)) lists these as:

| | |
|-------------------|--|
| Neuroticism | - anxiety, angry hostility, depression, self-consciousness, impulsiveness, vulnerability |
| Extroversion | - warmth, gregarious, assertiveness, activity, excitement seeking, positive emotions |
| Openness | - fantasy, aesthetics, feelings, notions, ideas, values |
| Agreeableness | - trust, straightforwardness, altruism, compliance, modesty, tender mindedness |
| Conscientiousness | - competence, order, dutifulness, achievement striving, self-discipline, deliberation |

Kline (1993), a leading figure in psychometrics, also agrees with the five factor personality concept.

These traits tend to be stable though the situation can be a modifying factor, and, from an age of 20-30 years, small decreases in neuroticism, extroversion and openness, and increases in agreeableness and conscientiousness occur. Matthews and Deary also report on the many twin studies to assess the importance of genotype and the environment. It appears for extroversion the genetic contribution is of the order of 56-70% in women, and 54-80% in men. Overall, however, they conclude that the genetic contribution is about 36% with 12% being determined by the shared environment (of twins), and the remainder determined by the unique environment experienced. If true, the environment experienced in the formative years is a powerful modifying factor in determining the managerial component of the phenotype. This same review also noted that it appears the relationship between personality and performance is very context dependent. Thus, neurotics and introverts tend to perform badly on certain tasks when the environment is arousing and stressful. It was also reported that openness tends to correlate with intelligence (30%). Introverts are good at visual vigilance, long term memory tasks, and problem solving. The five factor model is also thought to be related to personality disorders (Costa and Widiger (1994)). It would appear that personality needs to be carefully considered in any work on managerial ability. Cantor and Zirkel (1990) note (p136) “....personality....serves as a source of autobiographical continuity for the individual, at the very same time it facilitates a break with the past and provides a thrust to the future via imaginative self reflection and goal setting”.

Some workers have already recognised the importance of personality - thus its inclusion in the Edinburgh study. Another example of personality inclusion is the work of Jose and Crumly (1993). They used the Myers-Briggs Type Indicator (Keirsey and Bates (1983)) to relate the financial structure of a sample of farms to personality and found some positive relationships.

This model of personality has four factors but is not as widely accepted.

Intelligence is clearly another important trait in managerial ability. Psychologists have a range of views on the components of intelligence, but generally agree that at least two components are important - ‘fluid ability’ (broad basic reasoning ability) and ‘crystallised ability’ (fluid ability as it is expressed in a particular culture). Horne and Cattell (1966), as reported in Kline (1993), further define intelligence using the following variables:

g_f = fluid - loading onto inference, induction, memory span, flexibility of closure, intellectual speed.

g_c = crystallised - loading onto verbal, mechanical, numerical and social skills.

g_v = visualisation - loading onto spatial, orientation, form.

g_r = retrieval capacity.

g_s = cognitive speed factor.

Aiken (1991) notes that intelligence is a complex of factors so that individuals will have various combinations giving rise to an overall score. Aiken points out that fluid intelligence is largely genetic whereas crystallised intelligence is environment related. Other than the Edinburgh study the literature does not appear to contain studies of farm

management/intelligence measure correlations.

Besides personality and intelligence some psychologists believe motivation is a basic trait, but there is less agreement on this particularly as motivation is difficult to measure with dynamic changes occurring from period to period. Kline (1993) believes the distinction between personality and motivation is somewhat arbitrary so perhaps aspects of motivation slip between 'trait' and 'state' classification. Thus, motivation tests need to include means and variances due to the dynamic aspects. 'Drives' are also related to motivation. Koestner & McClelland (1990) note that feelings of self determination are important to intrinsic motivation, and that studies have shown positive feedback enhances intrinsic motivation. They also believe there is a need to internalise self motivation. Kline (1993), however, does conclude that much more research is needed to clarify the motivation situation.

A further question in a 'model of man' is whether s/he is, or wants to be, rational, and, if so, the question of objectives or goals becomes important including the question of a persons' attitude to risk. Abelson and Levi (1985) provide a useful and extensive discussion on the rationality question, but do not venture into providing a strong evidence-based conclusion. They hint at a tendency towards believing in the existence of rationality. They also note (p 234) "the common sense view of the major cause of irrationality, when it occurs, is that people fall into the grip of emotional or motivational forces they cannot, or will not, control complimentarily - general motives such as the enhancement of self esteem, the management of the impression one makes on others, and the avoidance of anxiety, might produce well organised and systematic violations of normative standards". If man is not rational with respect to definable goals then developing systems and processes to improve the management of limited resources loses much of its reason. Few would accept this tenant.

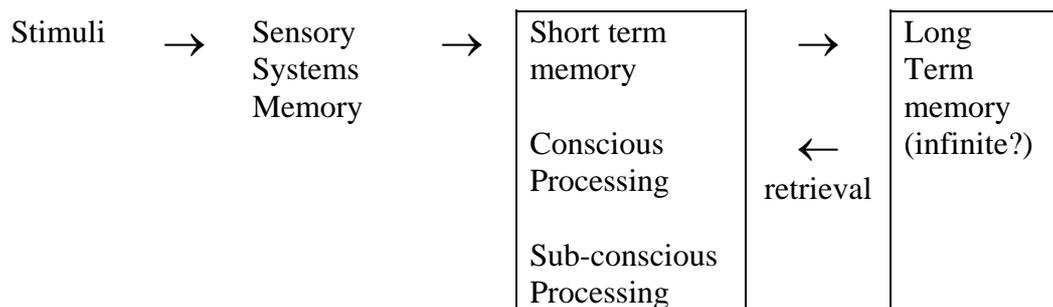
Given then, a relatively rational human being endowed with a potentially definable genetic makeup and a set of experiences culminating in a particular personality, intelligence and motivation endowment, this 'construct' will respond in various ways when exposed to stimuli. Such stimuli can range from a loud noise to a complex set of price signals. The 'person' holds her or his total psyche in a brain which in very simple terms has a memory and processor in much the same way as a computer.

Memory is thought to consist of short and long term components (Eysenck & Keane (1990)). Initial observations are held in short term memory, are processed in the same area, and are then transferred to long term memory if thought to be of significance. Short term memory capacity, and thus processing capacity, is thought to be limited. In contrast, long term memory is virtually limitless. There are also various theories on how information is stored, perhaps using tree associative structures. Atkinson et al (1990) note that a certain threshold must be exceeded before the brain acknowledges a stimulus (e.g., a disturbance in the cow shed), but that also a component of the brain (the sub-conscious) monitors all sorts of stimuli without alerting the conscious - alarms only occur once a level considered important is exceeded (crying offspring, perhaps). Miller (1956) believes it is only possible to hold 5 to 9 pieces of information in short term memory so given the serial arrival of material, problems can arise when too much information is offered. It is also generally accepted that 'rehearsal' is necessary to commit information to long term memory, and the more the better.

Eysenck & Keane (1990) discuss in some detail the whole process of observing, learning, recording and responding. While there are many theories, one plausible schema includes the

notions that humans create mental models or pictures of situations rather than using abstract procedures. Thus solutions and approaches are stored as schema. For example chess masters hold patterns that are used to make moves in contrast to logically sorting each move - thus experience is important. Furthermore, it seems the subconscious holds and controls many learnt skills automatically, for example bike riding and the subconscious also holds many learned emotions. Finally, the many aspects of our beings stemming from environmental influences are absorbed in the formative years and are difficult to subsequently change.

A diagrammatic summary might resemble the following:



Various researchers have attempted to quantify some of these processes - what cues (stimuli) are observed, and what is the relationship of their values to the conclusion - is it linear or more complex? This concept was expressed by one worker as the 'lens' model - the 'lens' (brain) took in information and modified it in some way (like the lens in glasses) to give a result. Abelson & Levi (1985) review a lot of this work and comment on the perception and adjustment of cues. Some of the work compares medical diagnoses performed by clinicians compared to 'objective' regression equations.

Through the observation, memory and processing system people, with time, take on their unique attributes, both stable and unstable. Aiken (1991) (p327) note that people respond to the world in terms of their unique, private perception of it. These perceptions are determined by individual experiences and meanings placed on these experiences in an effort to fully realise one's potentialities - people strive for 'self actualisation', a congruence between real and ideal selves.

Some workers believe a person's psyche is embedded in what Kelly (the inventor) called 'constructs' (Salmon (1980)) - Kelly believed 'man' is constantly striving to make sense of the world through actively setting up hypotheses and putting them to experimental test. Those that work for the individual become 'constructs' - essentially they are rules by which to operate. These constructs are in a continuous state of change resulting from new experiences.

Bannister (1997) has brought together a series of essays that portray the use of this theory in a contemporary context.

In a managerial sense, the idea of a manager developing a series of constructs, to guide operations is appealing. Such a set of constructs might evolve from a person's personality, intelligence and motivation all tempered by the environmental influences.

This section has briefly summarised various ideas on the makeup of ‘man’ and provides at least an initial backdrop to developing further ideas of decision processes and whether, and how, they might be changed and improved.

4. Decision processes and action

4.1 General review and the study of experts.

As noted in the previous section, the decision process involves observing stimuli, processing them, deciding and action. This is the general ‘lens’ model (Burnside & Faithfull (1993)) in which cues with a causal relationship to the criterion are noted. The details of the process are more complicated. Nickerson and Feehrer (1975) conclude decision making involves

- information gathering
- data evaluation
- problem structuring
- hypothesis generation
- hypothesis evaluation
- preference specifications
- action selection
- decision evaluation

Throughout the literature many variations on this process list can be found. What is crucial is that these steps, or their variations, are logically and rationally followed. In reality this is seldom the case. This section considers the process in general and presents information on the psychology of the various steps and, most importantly, biases that tend to modify the rationality of the process.

Bolger (1995) considers decision making and notes the process involves information collection and filtering by the peripheral system leading to core information being passed to the central processing system for deeper analysis, the results of which are passed to the peripheral output system for action. Thus problem recognition, interpretation and information gathering are important skills as are the cognitive skills, declarative and procedural domain knowledge as well as knowledge of one’s limitations and abilities. For the output phase social communication, production and application skills are all crucial. Extending these ideas Nickerson (1994) notes problem solving involves induction and deduction, and the development of a path through problem space - at each point there is a need to respond to the mental representation of the problem though there is a limit to working memory so the representation may need to be simplified. To overcome this problem schemata are developed thus shifting some of the problem to long term memory. Thus the importance of the discussion in the previous section becomes more apparent in understanding the process. In real world situations, which tend to be dynamic, the complexity means it is seldom possible to face a new problem and produce a totally rational and complete decision process. Experience and repetition are important (Brehmer (1990), Slovic et al (1977), as is the correct observation of the relevant cues in the first place (Stevenson & Naylor (1990)). The decision process is stated through some form of problem recognition - Abelson and Levi

(1985) suggest decision makers monitor whether there is a discrepancy between the existing and desired states. Accumulating stimuli must reach a 'threshold level' before problem recognition occurs - information gathering and the isolation of alternatives then starts. Of course, 'problems' might occur when it is recognised new opportunities have been observed in some way even though a problem in the traditional sense has not been isolated. Success at problem recognition is crucial to good managerial ability (Weber (1994)).

A conclusion is reached when the choice process is implemented and an action defined. Abelson and Levi also review choice system possibilities. Many theories exist - examples include simply going down the alternatives until an acceptable one is found, or not choosing until all alternatives have been considered - this introduces the question of goals and objectives which will be covered in more detail in a later section.

The dynamic nature of most decision situations is a complicating factor. Thus, not only must correct choices be made but they must also be made in the correct sequence and at the right time. Little research has been conducted on dynamic problems, (Stevenson et al (1990)), but one worker, Brehmer (1990), developed simulation models to study the problem and stressed the value of experience. Indeed, there is evidence that 'heuristics' are a common decision procedure - these are decision systems and guidelines developed from past experience. Stevenson et al note this, as does Plous (1993). People often transfer an acceptable heuristic from one problem type to another if it is similar and they have no better procedures available. Of course, if this process is not successful, changes will be necessary. Where the best process or course of action is not initially acceptable, the concept of cognitive dissonance comes into play (Festinger (1957)). This theory of attitude change suggests procedures that may not initially be acceptable are eventually taken as normal as no alternatives exist. Thus, the initial dissonance reduces through rationalisation.

Many people make decisions in complex situations without an apparent formal process, and certainly cannot explain how they achieve the outcome. Cook and Stewart (1975) compared subjective/intuitive processes with statistical measures and found few outcome differences. Broadbent et al (1986) found decision makers can learn to improve their performance without actually knowing why. The experience has provided lessons absorbed by processing and memory systems. This whole area of subjectivity and intuition has been little studied. Hammond (1990) provides a fascinating, though brief, review of the situation regarding intuition and notes there are few models explaining the process. Clearly, however, intuition is an important skill.

The study of experts, who may well develop excellent intuition, is important in considering managerial ability. Cooke (1992), in reviewing expertise, quotes several authors and lists the characteristics of experts as:

- 1) Experts excel mainly in their own domains.
- 2) Experts perceive large meaningful patterns in their domain.
- 3) Experts are fast; and they quickly solve problems with little error.
- 4) Experts have superior short-term and long-term memory.
- 5) Experts see and represent a problem in their domain at a deeper (more principled) level than novices.
- 6) Experts spend a great deal of time analysing a problem quantitatively.
- 7) Experts have strong self monitoring skills.

Shanteau and Phelps (1977) complemented this list with noting that learning to be an expert involves:

- 1) Learning what the problem is and what are its dimensions.
- 2) Learning how to accurately perceive stimuli.
- 3) Learning what weight to put on each stimuli.
- 4) Learning what the appropriate combination rule and output domain is for making the final judgement.

Shanteau (1990) also reviewed the literature and made a list of good and poor performing 'experts'. The 'good' included weather forecasters, livestock and soil judges, chess masters and accountants. The 'poor' included clinical psychologists, stock brokers, and student admission staff..... The key to becoming an expert must be receiving an appropriate outlook and training for each personality, intelligence and motivation combination.

4.2 Biases in decision making

Despite the best of intentions to follow the correct processes, many decision makers look back and decide they could have made a better decision. This might be due to chance, or more likely, error. In many cases people may not be aware of lost opportunities and mistakes. This raises the whole area of decision biases - they are part of the human decision process. Weber (1994) talks about some of the reasons for error - objectives unknown, unsure, alternatives not clear, too much uncertainty, ambiguous information to process, time pressure and stress, and so on. Clearly, a decision maker should be aware of potential biases and make every effort to overcome them.

Decision makers are human and are thus influenced by emotions and stress despite the best intentions. Bohm & Pfister (1996) showed that emotions can have a significant effect on the rationality of decisions. This is not difficult to accept. From a trait/state point of view Matthew and Deary (1998) discuss anxiety and decisions and note the impact of neuroticism on decisions. Eysenck & Keane (1990) similarly note that depressed people operate differently when in this state. Furthermore, McGregor et al (1995) found British farmers did experience considerable stress. Thus, personality, emotions and current anxiety levels must influence decision rationality and processes, and must be appropriately allowed for.

Atkinson et al (1990) talk about stress coping mechanisms.

There has been a significant amount of research into decision biases. The list of possible biases is given below together with appropriate references.

Anchoring (Chapman and Johnson (1994)) refers to conclusions being altered by the starting point. For example, real estate appraisers came to different conclusions when given different suggested valuations. Estimates of probabilities are notoriously prone to error (Bolger (1995), Payne et al (1997), Stevenson et al (1990)). Furthermore, general estimates are not adjusted according to the sample size. Other cognitive errors (De Rubeis & Beck (1988)) include conclusions without evidence, selective abstraction - picking out evidence that suits, overgeneralization - creating an hypothesis on a minimum of evidence and applying it widely, observation errors, dichotomous thinking - putting observations into two extreme categories rather than recognising the continuous reality, chunking - breaking difficult tasks into inappropriate chunks.

Remembering the good and not the bad outcomes is common, as is the 'availability effect' (Abelson & Levi (1985)) - ease of retrieval means such evidence is overweighted. Memory is fallible and often alters what happened in the light of hindsight. Similarly, what is remembered often depends on the context (Plous (1993)). Often the first information in a list is remembered (primacy effect). In contrast a 'recency effect' can occur where the most recent impression dominates. Then there is the 'halo' effect - something good is assumed to have several good attributes (e.g., high quality is assumed when getting a high yield). The way a problem or information is 'framed' can also influence the outcome. Thus, the way technical information is presented in a journal may well influence the conclusion. Research also shows the 'availability heuristic' affects conclusions - the ease with which instances come to mind.

Social influences and confidence are also important (Plous, (1993)). Who presents the information, and who assists in decision making can well lead to bias. Similarly, there is good evidence that overconfidence is a danger in making correct decisions (Bolger (1995)). Then there is the 'self fulfilling prophecy' - clearly there are many traps. Another common mistake is to continue investing in a bad project in the hope of recovering some of the money, there is also the tendency to assume a good outcome is likely after a run of bad events. Slovic et al (1977) describe some of the experiments associated with these biases. Besides selective memory recall, experiments indicate (Weber (1997)) people tend to smooth recollected reality thus reducing the real variability.

Some people are less than diligent in seeking good decisions. Slovic et al (1988) reviews work on accepting an "acceptable" outcome rather than continuing the search - perhaps this is rational in some cases as the cost of extra seeking is considered too great. Similarly, it was found (p721) that as a problem becomes more complex simplifying processes are sought - for example concentrating on what is regarded as the most important goal in a multi-goal situation. No doubt a decision makers' self esteem (Heatherton and Polivy (1991)) impacts on their diligence in the search for excellence, as will other personality factors.

Thaler and Shefrin (1981) looked at self control and rates of impatience, maintaining that a person was both a "doer" and a "planner" with the planner wanting to be rational whereas the doer wants to act now. One of these aspects tends to dominate at various levels giving rise to individual impatience.

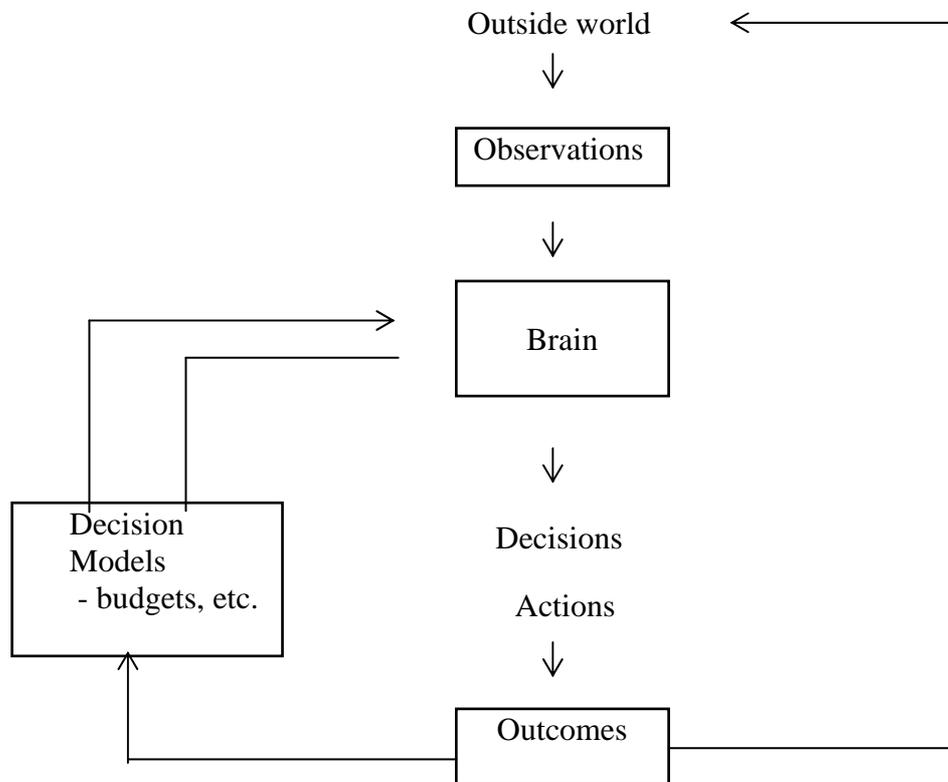
In a similar vein Kaine et al (1994) looked at a farmers' 'locus of control'. They determined how much control a farmer believed s/he had over what happened on the farm. There was a significant range so some believed planning was not relevant as their decisions would not alter outcomes.

No doubt more biases will be discovered as the work in this area is quite extensive. This research is emerging into popular texts for managers. For example Russo and Schoemaker (1989) - "Decision Traps: Ten Barriers to Brilliant Decision Making and How to Overcome Them".

Work continues on the development and quantification of decision models and processes, particularly systems that explain how decision makers operate (see, for example, Lusk and Hammond (1991) who looked at weather forecasting using the Lens model). For an individual decision maker what is important is recognising failures and biases and then

attempting to counteract these actions. Furthermore, part of this improvement process must be the effective use of the aids that are available.

A schematic of the decision process might look like:



It is likely the human brain will outperform man made decision models in many areas so an appropriate integration is rational. As the ‘brain external’ models develop the mix between brain and model use should change. It is interesting to speculate on how far computer systems will progress towards replicating a brain and improving on its remarkable capabilities, particularly the appropriately trained and experienced brain. Overall, it might be noted that the brain, having been endowed with a particular genotype, takes on various processes and abilities as it observes from an early age - much of the acquisition is through trial and error as well as observation. Rules and procedures are stored and become automatic in many cases including all the ‘irrational’ aspects (biases). The challenge is to devise methods of observing the biases and then removing them. Is this possible?

5. Goals, objectives and attitudes

To gauge managerial ability requires some form of yardstick. While potential components of total ability can be measured in various ways, in the end their correlation with ultimate objectives must be assessed. This poses the question of what are the goals of a particular farmer? Or, in many cases, asking for the goals of the total farm family might be more appropriate. One of the difficulties is that there is little agreement in the literature on a general theory of goal measurement. In the end it is the farmer/farm family that chooses so perhaps in developing means of improving (changing?) managerial ability it should equally be the farmer/family that decides whether using such means might be beneficial.

Farmers do make choices and therefore express their preferences. Thus, the goals, objectives and attitudes come into play, though often inconsistently. What are goals, objectives and attitudes? They no doubt form over the years from family and environmental influences interacting with personality and motivation. Goals might be regarded as specific and measurable outcomes (e.g., lower debt by \$10,000 per year for five years), objectives as general states to be attained (e.g., profit maximisation - which might then lead to a specific goal), attitudes as views and philosophies on life within which an individual operates (e.g. preserve the natural bird life on the farm if at all possible). However, others will have different interpretations. Provided definitions are given in any particular work it does not really matter. What does matter is an ability to choose between competing courses of action.

When choices are made, according to Mischel (1990), a range of positive and negative emotional states are experienced resulting from the stimuli emanating from the alternatives. Mischel maintains the basic values, goals and interests are relatively stable, though other work (see below) suggests their expression may not. Performance is monitored by a person relative to the goals thus self criticism and reward occurs leading to potential change in behaviour. Numerous workers have tried to quantify this process in various ways leading to many proposed models. Plous (1993) reviews many of these such as prospect theory, regret theory, multi-attribute theory, and non-compensatory strategies. The simple expected utility maximisation theory does not explain observed decision making and thus the large range of suggested approaches for improving the predictability of decisions. Prospect theory proposes a special form of the utility curve and does explain some of the anomalies, as does regret theory which is based on the amount of regret resulting from a decision in contrast to the gains. MAUT (Slovic et al (1977)) weights the multiple attributes relative to their importance to provide a total utility for an alternative, whereas the non-compensatory approaches bring in ideas such as ignoring an alternative unless it meets some minimum criteria, lexicographic choice using a satisfactory level for each component of an alternative so it becomes acceptable if it has at least a minimum level for each characteristic - the list of possibilities is extensive. Weber (1994) introduces the concept that people compare possibilities relative to a 'base' and acceptance occurs if this is exceeded. Furthermore, people surrounding the decision maker will very likely impact on the choice - Weber notes people may be interested in whether they can adequately justify a choice to potential critics and this may override other considerations. Then there is the impact of risk and uncertainty as a factor in objectives (Dillon and Perry (1977)) - this is undoubtedly important as variability is an important feature of the real world with the shape of the utility function influencing choice (Abelson and Levi (1985)). It also appears past good, or bad, luck influences the approach taken (Weber (1994)).

In most of this work quantification of the objective function has been important (Dillon and Perry (1977)) as the development of computerised decision models is difficult without it. This quantification, however, has also made it clear that there are often many contrasting choices that produce a near optimal objective value (Thorngate (1980)). This is an important point as with the failure to achieve a general agreement on objectives this does not prevent positive and useful work from continuing. Another potentially complicating factor is the intransitivity of goals and objectives. Payne et al (1992) maintain that goals are dynamic and the current mood can affect choice. Beutler and Speckast (1981) maintain that behaviour impacts on attitudes. Thus, if behaviour ends up being inconsistent with an attitude, then the attitude is often changed through rationalisation. Effectively, a dynamic behaviour - attitude complex exists. Slovic et al (1988) also note (p705) 'people do not always make the same choice when faced with the same alternatives under seemingly identical conditions'. They postulate that there is a random element in choice as well as changing tastes. This random element may follow a definable probability distribution.

It is clear that developing an ability to quantify objective attainment that is universally acceptable is probably impossible. Thus, assessing improvement in managerial ability will need to rely on a range of measures with the decision operator making his/her own decisions. If the recipient feels they have made gains then clearly they will deem the process a success. This success will rest on the wide range of goals farmers seem to have, and because most generally regard primary production as more than a simple business, these goals will cover a wide spectrum. Gasson (1973), in a pioneering study, stressed this factor when talking about the components of farmer objectives as instrumental (oriented to income), social (getting recognition, belonging to farming community), expressive (feeling pride of ownership, chance to be creative), and intrinsic (enjoyment of work tasks). More recently Perkin and Rehman (1994), and the Edinburgh study group, have worked on quantifying the many aspects to farmers' objectives. Perkin and Rehman stressed the unique nature of each farm/family complex. This is probably another reason why the farmer must be the final arbitrator.

6. Decision methods used by farmers

There is not a lot of reason to propose that farmers are greatly different from the population at large. Indeed the Edinburgh study (Willock (1997)) found farmers (Scottish) as people were remarkably similar to the general population in terms of personality and intelligence (slightly greater). A feature of primary production, however, is its complexity compared to many forms of production. As a farmer must deal with most aspects of biology, economics, the weather, organisations, people and so on, they face very complex decision situations with only a modicum of support in an immediate office sense. A farmer's personality must be altered to some extent under this environment even though the basic underlying personality is consistent. Indeed, Jose and Crumly (1993) found, using the popular Myers-Briggs Type Indicator, (Kiersey and Bates (1984)) that their sample of 243 Nebraska farmers differed from the population at large. Nebraska farmers deal with quite extreme conditions. Nuthall and Bishop-Hurley (1996) also used a modified Myers-Briggs type question set to examine personality relative to computer use. This will provide a benchmark for further analysis as computer assisted decision aids further develop.

In one of the first, and few, detailed studies of farmer decision methods, Johnson et al (1961) found the midwest farmers followed the 'observation, analysis, decision action, acceptance' sequence, and found their main concerns were '(i) change in prices, or lack of information concerning prices, (ii) lack of information concerning existing production methods, (iii) changes in production methods, (iv) changes in personalities, and (v) changes in economic, political and social institutions, and lack of information on existing institutions'. It is unlikely these concerns have changed. They also found that price expectations were based on the standard supply model, but that farmers had naive models of people and institutions. The farmers commonly noted that they often intuitively knew when a problem existed but could not always ascertain it at an appropriately early stage. It was also found there was a correlation between education levels and a good understanding of problem solving. While farmers with higher debt carried out more analysis, levels were not high. Malcolm (1990) also concludes, in a more recent context, that farmers only use simple tools such as budgeting.

As noted in section 2, Ohlmer et al (1998) studied Swedish farmers' processes and greatly extended the Johnson et al view of the steps involved in decision making - they stressed the dynamic nature of a process that jumped backwards and forwards between the various stages. This level of complexity must be included in any study of managerial ability.

Also of relevance to altering ability is the farmer's view of how important s/he is in the control of a farm. Kaine (1994) showed the variation that exists in a sample of Australian farmers. Similarly McNairn and Mitchell (1992) found 85% of a sample of farmers in Ontario had an 'internal locus of control' when it came to soil conservation practice. Clearly, the environment and the farmers' backgrounds will impact on how much control they believe they have. Despite the control belief of the Ontario farmers they had not adopted the soil conservation processes to the extent expected. Adoption is another factor impinging on farmers' processes with respect to ability.

Reid et al (1996) examined a number of dairying innovations in New Zealand and found the important factor in Rogers' (1983) adoption system list were trialability, complexity, compatibility (to existing systems), and relative advantage. They also noted risk assessment and flexibility were important. Rogers' other factor, observability, was not found to be crucial - perhaps the farmers accepted this without note. Reid et al concluded the farmers were rational in their adoptions.

The importance of considering farmers' processes is to ensure all aspects of managerial ability are covered. The farmers' environment is clearly very different from many production systems. Bigras-Poulin et al (1985), while considering only dairying, believed socio-psychological variables were important in achieving successful production levels. Thus, full account of the dynamic and complex situation encountered must be considered in relation to the socio-psychological situation of each farmer and her/his managerial situation. Furthermore, it is clear that the paucity of managerial process studies that have occurred needs to be rectified to balance the existing knowledge of primary production.

7. Competencies involved in the management of primary production.

Besides understanding the nature of human processes in decision making, and how they might be improved, the significant factor in improving ability is an understanding of the skills used in management. These are referred to as competencies.

A study of expert decision makers is clearly a starting point in listing the competencies, as is a search of the literature for already compiled lists. Such lists have been developed through logic and asking practitioners to consider and list the skills they use. (See Lees (1991) for a review of methods.) Of course, the skills of experts are not necessarily comprehensive as many practitioners may not be able to extend to these levels.

It seems experts do not in fact use as much information as novices. Shanteau (1992) concluded, after an extensive literature review, that experts tend to select specific key information and this list is somewhat less comprehensive than what others might use. Experience has ingrained relevance and economy. Similarly, experts use simplifying heuristics which only practice and experience can produce. Novices do not have the knowledge to easily discard certain information - confidence must be a factor. As noted earlier, Cooke (1992) found experts perceive large meaningful patterns in their domain. In making a list of competencies such lists of the characteristics of experts needs to be taken into account. However, there is no mention of record keeping. Studies have found a correlation between success and adequate records (see, for example, Benbow and Nuthall (1998)).

Shanteau (1990) gives a list of abilities exhibited by experts relative to novices - this list is:-

- Highly developed perceptual abilities - can see/observe things novices do not notice.
- Good sense of what is relevant/irrelevant.
- Ability to simplify complex problems (in an objective way) (see also Payne et al (1992)).
- Can communicate their expertise (not so important for a farmer).
- Can handle adversity - can work under stressful conditions.
- Are good at identifying and adapting to exceptions to standard procedures.
- Strong self confidence.
- Know when to adapt decision strategies as conditions change.
- Are creative in adapting old decision strategies or finding new ones.
- Up to date current knowledge.

Most would agree with this list.

Specific lists have been created by several workers. For commerce in general Page et al (1994) interviewed many groups and concluded on a forty-five component list for New Zealand conditions. A more general list was provided by Linstead (1990). For Australian educational purposes Lees (1991) interviewed groups from different farming backgrounds and produced further comprehensive lists. Salmon (1980) also produced Australian oriented lists.

Rather than repeat these lists, a more general amalgam that could well be applicable to most situations has been produced. This list is:

Enunciating the objectives and goals for the totality of the farm family within the bounds of the group attitudes, and the dynamic life cycles.

Identifying opportunities and problems.

Ability to search out relevant information and observe appropriate material both on and off the farm.

Possessing the appropriate analytical skills and understanding economic principles - calculational, marginal analyses and opportunity cost concepts.

Ability to visualise and understand the current state of the farm in its totality, including the financial, animal, feed, crop, machinery, building and labour state details and their interrelationship implications.

Ability to visualise the consequences of decisions both independently and across all components of the farm system. Visualisation should occur through to the appropriate planning horizon.

Ability to anticipate the consequences of current events and to think ahead and act appropriately in “good” time.

Ability to empathise with people and successfully supervise and negotiate - an appropriate ‘person’ and leadership personality.

Ability to satisfactorily handle stressful situations - having coping skills, and an ability to meet deadlines and cope with time pressures using appropriate strategies.

A drive and motivation to successfully conclude relevant tasks on time. The confidence to achieve this.

Adequate office skills and competency - records, retrieving, etc.

Having appropriate technical skills and factual knowledge to complete the required tasks.

Exhibiting suitable learning skills to enable updating all competencies so they are fully valid - with appropriate speed, and an ability to learn from mistakes and similarly enhance all competencies.

Have an appropriate understanding of, and an empathy with, the (i) climate and weather experienced in the relevant region, (ii) animals and plants dealt with.

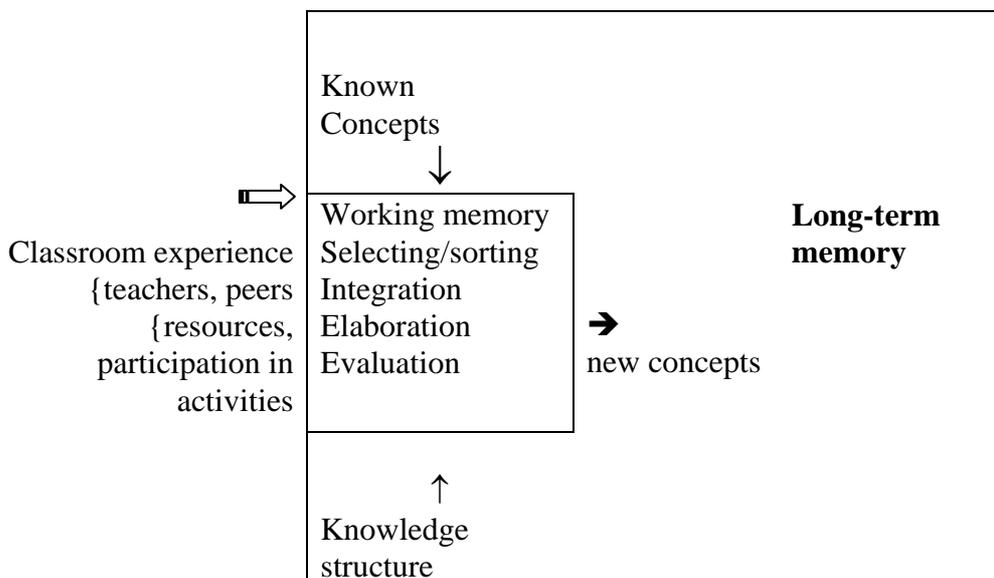
8. Changing and improving managerial ability

Any manager brings to the task a set of skill levels for the relative competencies. This set is a product of his or her genotype and environmental experiences up to that point, though it does appear the early formative years are more important than the latter periods. However, each person will have had varying degrees and levels of education and experience which have honed the early lessons. Clearly some educational and experience programs will have been more appropriate than others. Whatever the case, at any point, the question is 'can the skill levels be improved'? To achieve change the manager will need to desire improvement, and s/he must have access to suggestions on how to change. These 'suggestions' can come from a range of relatively formal course work and/or reading programs, or from working with a mentor on a more intensive one to one way, or some combination of these extremes. This process involves improving the general competencies in contrast to simply acquiring new technical knowledge per se - this is a different process. Skill attributes are probably more deeply embedded.

To consider possible change it is useful to understand the learning process and consider past studies on its effectiveness. According to Cooke (1990), learning has three components:

- (i) Interpretative stage - factual/declarative knowledge related to the domain is learned.
- (ii) Knowledge compilation - development of general purpose production rules -
 - (a) composition - putting together in chunks, understanding the structure and theories.
 - (b) proceduralization - embedding domain specific factual knowledge into production rules.
- (iii) Fine tuning - strengthening of successful production rules, weakening of unsuccessful ones.

Nuthall (1997), in a study of primary education classroom processes, suggests a similar process is involved, but stresses the social and interactive nature of learning. His diagram is informative:



It would appear learning is a highly interactive process with, eventually, new concepts being embedded into long term memory. Furthermore, this process takes place in everyday life as well as in formal teaching/learning situations. Page et al (1994) stress this point as does Linstead (1990) who contends the best approach is “experiential learning”. This does not mean leaving the process to experience, but rather developing teaching methods that are discovery based experiential, use simulated problem solving and involve group working. Nickerson and Feehrer (1975) also stressed the importance of experience and the need to repeat a process with proper instruction following an erroneous activity. The mental model of the process can thus be corrected. As Eysenck and Keane (1990) also point out, many decision systems eventually become internalised and thus automatic. This is acceptable if the lessons learnt are logical and correct, but if not, changing these internalised rules may be difficult.

As Paine (1993) stresses, each manager has her/his unique personality and intelligence and therefore acquires new and improved skills in slightly different ways. He puts people into four classes - the accommodator (learns by experience), the diverger (weighs up different perspectives), the converger (puts theories into practice) and the assimilator (puts information into concise logic). Thus, any programmes must be sufficiently flexible to enable individuals to use methods that best suit them. It would also seem feedback (Busemeyer and Myung (1992)) is a very important part of the learning process, and if properly organised, can enhance the effectiveness markedly.

There is considerable evidence to support the effectiveness of formal training in adults with respect to a wide range of skills. Gaeth and Shanteau (1984) report on making lasting improvements to soil judges after comparing alternative training systems, Nickerson (1994) reports the quality of statistical and probability thinking processes is improved by training as was deductive reasoning. Bolger (1995), in reviewing 50 comparisons between experts and novices, concludes training has a significant effect on accuracy, but simple experience little or no effect (perhaps due to the lack of appropriate feedback?). Garb (1989) comments formally on this point - he found a correlation between training and clinical judgement, but not between experience and judgement due to the poor feedback.

In a study of farmer education and efficiency in less developed countries, Phillips (1994) concludes that four years of education increases efficiency by approximately 6%. In another study Lockhead et al (1980) found four years of study increased productivity by 7.4% in a range of less developed countries. The results are remarkably similar. In a study of US dairy farmers Stefanon and Saxena (1988) showed that education and experience were substitutes in improving efficiency (production levels) - perhaps the higher levels of base education allow learning from experience more effectively than in less developed countries.

The list of reported benefits continues, and there are many more studies - some others are Shanteau (1978) reporting on the impact of training on livestock judges, Slovic et al (1977) noting the impact of various procedures on probability estimation improvement, Slovic et al (1988) pointing out the benefits of training on reducing decision bias, and, finally, Burnside and Faithfull (1993) demonstrating the improvement of Western Australian graziers' judgment of flora through the use of photographs. The conclusion must be that appropriate formal training programmes that utilise the current knowledge of learning procedures can improve adult farmers' competency skills. The quantification of the potential benefits, both monetary and other, has yet to be determined in developed country situations.

Formal training is only part of the picture. Some farmers might require more detailed personal training, either because they feel they could benefit and perhaps enhance already well trained skills, or because they are having significant problems maintaining the efficiency of production at an adequate level. Such farmers may require a different approach.

Psychologist and psychiatrists have developed many theories, skills and procedures for modifying personalities and skills. There is no reason why appropriate components cannot be utilised for improving management competencies. The therapies used are designed to alter the stimuli-reaction processes to ones more appropriate and acceptable to society at large. The same situation exists in decision making - some people wish to modify their decision processes to better achieve their goals.

An overview of the massive literature in psychology indicates there are many theories on how to modify thinking and action. Atkinson et al (1990) and Dobson (1988) both provide summaries of the more important theories. Dobson gives 18 different concepts ranging from classical psychoanalysis developed by Freud with its emphasis on the sub-conscious, through to conditioning systems with its emphasis on external events, behavioural changes and association. According to Atkinson et al the basic idea of psychoanalysis is to bring suppressed conflict into awareness so they can be dealt with. Humanist therapies rely on a do-it-yourself approach with the therapist supporting the client in self-actualization. Behaviour therapies are concerned with current problems in contrast to the past history and rely on systematic desensitization through modelling (someone showing what to do, role playing.....). The approach modifies the behaviour rather than the thought processes. In contrast 'cognitive behaviour therapies' change maladaptive beliefs through the therapist attempting to have the client see the distortion in their thinking and rationality. This process is sometimes helped through keeping appropriate records. This is clearly a very brief review of the range of concepts, but it does appear that the only therapy for which there is substantiated scientifically based evidence is cognitive behaviour therapy. Thus, this section will concentrate on this approach. Evidence of the objective studies will be presented below. This does not mean there are not strong advocates of other approaches, nor that some are effective, but this has yet to be generally proved. Indeed, Atkinson et al (1990) note that many of the therapies do have common features - these are:

Interpersonal client-therapist relationships with warmth, trust and understanding.

Reassurance and support, and hope.

Desensitization - reduce the threatening qualities of each situation.

Reinforcement of adaptive responses - increase the positive attitudes and actions and reinforce them.

Understanding or insight - providing an explanation of the problems experienced.

Atkinson et al also note that double-blind trials have shown the powerful affect of the placebo response, and some workers believe therapy is effective for this reason - a belief in change and its benefits may be all that is necessary and is achievable through a range of approaches.

There are a range of variations on cognitive behaviour therapies. Dobson and Block (1988) review many of these. They state (p 17) "logical errors in thinking acquired during the development period become the substance of schemata that predispose individuals to experience emotional problems". Therapy involves replacing the distorted appraisals. The components of treatment involve teaching the recipient to (i) monitor automatic thoughts, (ii)

recognize the relations between cognition, affect and behaviour, (iii) test the validity of the automatic thoughts, (iv) substitute more realistic cognition for these distorted thoughts and (v) learn to identify and alter the underlying assumptions or beliefs that predispose individuals to engage in faulty thinking patterns. It would seem logical to apply this proven process to decision making competencies.

Dobson & Block report that some psychologists believe that the development of control over behaviour involves a gradual progression from external regulation by significant others (e.g., parents) to self regulation through internalisation. Thus, self instructional training is required to develop (i) problem definition, (ii) problem approach, (iii) attention focussing, (iv) coping 'statements', (v) error correcting options, and (vi) self re-inforcement. Dobson and Block also describe the 'interpersonal cognitive problem solving model' which consists of (i) ability to recognize the range of possible problem situations, (ii) ability to generate multiple alternative solutions, (iii) ability to plan a series of steps necessary to achieve action goals, (iv) ability to see the short and long term consequences of a given alternative, and (v) the ability to identify the motivational elements related to one's actions and those of others. This list looks remarkably similar to the competency list presented earlier further suggesting cognitive behaviour therapy may have an important role to play. These processes train people to be their own 'scientist' in solving personal (management?) problems. It is all about developing self regulation, self monitoring and self evaluation. D'Zurilla (1988) stresses the importance of developing 'self talk, self praise and self support' in these cognitive processes. As Dryden and Ellis (1988) point out, 'Epictetus said "people are disturbed not by things, but their view of things"'. They describe RET (Rational Emotive Therapy) and note that to change it is necessary for a person to (i) recognize they create their own 'disturbance', (ii) recognize they have the ability to change these 'disturbances', (iii) understand 'disturbance' comes from irrational, absolutest, dogmatic beliefs, (iv) detect the irrational beliefs and dispute them rationally, (v) work towards internalizing the new rational beliefs, and (vi) constantly repeat the process. For 'disturbance' the words 'management beliefs' could perhaps be substituted. The steps and procedures in this variant on the general cognitive behaviour therapy idea looks very familiar - the themes seem to be the same. That is, as De Rubeis and Beck (1988) point out, there is a relevance on working on the conscious thoughts in contrast to the unconscious - they talk about the cognitive triad - views of self, views of the future, and views of the world. The therapist's task (Guidano (1988)) is to assist clients recognise and implement the steps. This process may need repeating and re-enforcing many times to ensure the revised models are stable (locked into long term memory).

There is considerable statistically grounded evidence that cognitive behaviour therapy creates lasting and beneficial change. This evidence relates to conditions such as depression and agoraphobia, so research is necessary to test the model on management competencies. Dobson and Block (1988) note the benefits for depression, D'Zurilla (1988) similarly quotes work on unipolar depression trials, Rehm and Rokke (1988) found that with constant reinforcement of appropriate attributions permanent shifts occur, and they also give reference (p 194) to treatment versus control studies that have shown significant success. Similarly, Dryden and Ellis (1988) provide (p 259) reference to the positive results of using Rational Emotive Therapy.

It would seem both appropriate formal training and specifically designed cognitive behaviour therapy could well be a significant force in improving the managerial ability of farm managers and so improve a nation's allocation of scarce resources.

9. Research and development

The theme of the discussion is that a farmers' managerial ability can be improved. Research is necessary to develop procedures to achieve this, to compare and contrast these procedures to isolate the most appropriate for different situations, and to ascertain the extent and type of the improvement possible. This programme has many components and will involve many years particularly as the change process would not be rapid, nor would measuring its potential success. All aspects must be quantified.

There are four major components to the research programme. Initially it will be necessary to verify the list of proposed important competencies through interacting with farmers and associated groups (for example, farm consultants). Secondly, it will then be necessary to develop psychometric tests (Kline (1993), Loewenthal (1996)) to measure competency levels. Thirdly, and associated with this test development work, must be the development of training programmes and management therapy procedures and protocols for each competency. Fourthly, the tests must then be used throughout the implementation of the training systems to gauge success levels of change. In addition, throughout and beyond the training treatment periods it will be necessary to monitor and gauge levels of the goals and objectives nominated by the farmers as these values must be the final arbiter in quantifying the success or otherwise of the programmes. Such data will enable comparison between the approaches.

This whole programme requires many observation, measuring and questioning procedures, all related to human behaviour. The obvious place to turn for assistance is the discipline of psychology. Many tests already exist for personality, intelligence, stress, innovation and coping (Austin et al (1998)), and these can be used for observing the basic psychological characteristics of farmers, though, as they have been developed and tested for the general population, some modification to better suit primary production situations may be appropriate.

Psychologists and sociologists, as well as statisticians, have developed a body of literature on the development of defensible tests. These procedures will need to be instituted for the development of competency tests. Aiken (1991), Kline (1993) and Loewenthal (1996) all discuss the principles involved and, in particular, Kline gives examples. For ascertaining competencies workers such as Lees (1991) and Krzystofiak et al (1979) need to be consulted.

There is a wide range of psychometric tests available ranging from ink blot tests (the subject observes ink blots and provides an interpretation which then enables classification), drawing tests (similar approach) right through to statistically validated tests - Kline (1993) reviews the range and is quite strong in recommending the use of only well validated and logical procedures. Kline also discusses the development and use of specialist statistical tests for verifying psychometric tests.

Tests, according to Kline (1993), must be reliable, consistent and valid. It is also necessary to have test values for normal populations so individual test recipients can be assessed relative to these norms. Reliability refers to stability over time and internal consistency - you get the same results with test and re-test situations given reasonable time lapses. Split half reliability is also important. This means splitting the series of questions making up the test into two groups (odds & evens) with the results from each being perfectly correlated. Frequently it is necessary to have several forms of a test (a different set of questions designed to test the same

factor (competency)) so that when repeating a test on the same subjects they are not exposed to the same set of questions. These must have a 'parallel form' reliability with correlations greater than the generally accepted cut off of 0.7.

Kline (1993) defines a valid test as one that measures what it purports to measure. Thus, if a test is for fluid intelligence then clearly it needs to be tested to ensure it does this. Validity assessment requires other measures to relate to. Thus, school results might be correlated with the intelligence test results. An overall test for managerial ability for farmers that profess to be profit maximisers might be related to historic farm profit data suitably amended for time trends. Validity can be broken into concurrent validity (the correlation between several tests), predictive validity (correlation of test with subsequent verifying measures - e.g., future profit), content validity (cover all components of a competency), differential validity (valid answers in different areas). Note that a reliable test may not be valid, and that a test must be discriminatory - distinguish between individuals. It's a pity the very many farm questionnaires have not been tested to the extent suggested above.

As with general questionnaires, psychometric tests have systematic and random errors. Systematic errors should be eliminated. As noted earlier, various test statistics have been developed for reliability and validity.

Having developed a test it must be standardised (Kline, (1993), p 42) - that is, population samples are used to develop expected scores. Normal sampling and stratification procedures are necessary. Use of regression analysis over large samples enables creating correction factors for age, education, sex, and perhaps other potentially modifying parameters that should be eliminated (e.g., farming type experience).

All proposed test questions need to be analysed for correlation and the underlying factors. Kline (1993) believes factor analysis (Lewis - Beck (1994)) should be used to ensure each test group only tests for one basic factor, otherwise the results can be confounded without being clear what exactly the test is measuring. Thus, test development requires initially setting up a series of questions designed to test, in this case, a competency, then using the set on several samples, testing its reliability and validity, and then developing norms after proper factor and statistical analysis. Matthews and Deary (1998) also discuss these procedures with a particular emphasis on using factor analysis to ensure isolating the underlying structures.

In developing the relevant questions consideration must be given to measuring procedures. Many workers, including Kline (1993), discuss various scales and procedures. Aiken (1991) describes Likert Scales (degree of agreement on a 1 to 5 (usually) scale, Thurston Scales (a series of belief statements), Auttman Scales, Q sorts, Repertory Grids (Slater, (1965)), and so on. Perkin and Rehman (1994) consider numerical rating systems as well as paired comparisons when ranking alternatives - in this case different objectives and goals. Aiken (1996) extends a discussion on measurement to include even further possibilities.

The procedures outlined assume written questions and answers but other possibilities exist for recording cognition. Dobson (1988) provides suggestions such as 'think aloud' methods in which a subject is asked to record thoughts as various activities are performed, and computer assisted tree branch paths to follow when isolating activities, to provide two examples. It is not always possible to measure what is required so proxy variables may be important. Edwards-Jones et al (1998) suggests easily measured variables such as age and education

might be correlated with, for example, objectives. Psychological research has even gone to the length of videoing eye movements as certain tasks are accomplished in order to record the procedures used. A question in all this work, however, is how well the question answers actually reflect the truth rather than what the responder believes the researcher would like to hear (Birnbaum and Stegner (1981)).

The major component in a research programme will be the development of a range of competency enhancement training programmes. These can range from group programmes to courses for individual tuition with or without tutor support, for each competency. Use of computer based programmes must also be considered including simulation games. Salmon (1980) believes games are a powerful way to alter beliefs. Initially dichotomous approaches should be used to indicate the most rewarding approach for each competency. Learning principles (Nuthall, 1997) should be allowed for in the designs. The psychometric tests developed can then be used to gauge the success of the programmes.

It will also be necessary to quantify the relationships between training programmes and outcomes if for no other reason to assess the potential gains relative to costs. However, it will also be important to obtain a basic understanding of the personality and intelligence relationships to the various competencies and their change. Linear and non-linear multi-variate procedures will be necessary. Austin et al (1998) provide a good review of analytical methods suitable for psychological, social and economic variables - the proposed set was developed for analysing the Edinburgh Farm Survey data (Willock, (1997)). The Austin review also considers structural modelling.

In developing the competency tests full account needs to be taken of the management staff recruitment tests that are commercially available. An example is the 'IMC Competency Model' produced by an international company - this tests managerial qualities (leadership, planning and organisation, quality orientation & persuasiveness), professional qualities (specialist knowledge, problem solving and analysis, oral communication, written communication), entrepreneurial qualities (commercial awareness, creativity and innovation, action orientation, strategic views), and personal qualities (interpersonal sensitivity, flexibility, resilience and personal motivation). Many of these skills are important in primary production, when suitably presented, and need including. Unfortunately, details and statistical validation data is not always available in the scientific literature for these commercial products.

10. Conclusions

Efficient production and appropriate goal attainment depends on the correct resource allocation. Research into the technology of production has dominated the development of efficiency. Economists' contributions have been relatively insignificant in research dollar terms, through developing and applying production economic, decision and related models. Farmers, however, have seldom used such models (Malcolm, (1990), and Ohlmer (1998)) relying largely on common sense to make their decisions. Their success levels vary enormously as shown by many studies including the economists' efficiency studies using both data envelope analysis and stochastic frontier production function approaches. For example Battese et al (1996) found Pakistani wheat farmers exhibited a mean efficiency of 57% to 79% depending on the district - surprisingly low. Arnade (1998), who used a data envelope analysis compared efficiency in 70 countries and found, in relative terms, countries like New Zealand had 100% efficiency, but this ranged down to 35% for Zambia.

Most efficiency studies look at technical and profit efficiency and rely on comparing one farm with another. The variation is assumed to occur through misallocation and thus due to managerial efficiency failure. That is, farmers' managerial ability has considerable room for improvement. This crucial aspect has had little study over the decades of primary production research. The tenant of this discussion is that there could be significant returns from increasing the research effort. The production economics assumption of diminishing marginal returns and its conclusion that optimality demands equi-marginal returns would suggest greater research funds should be directed to research on improving managerial ability. In that it will be centuries, if ever, that a computer can totally replace a human mind, it is this aspect that must be studied. This may, in turn, help the effective use of computers.

It has been argued that for this research to proceed it is necessary to introduce what psychologists have learnt about cognitive processes, judgement and decision making into a new programme. This should ascertain the important competencies and develop valid and reliable tests for these competencies, create competency training programmes, and then test their effectiveness. Due to the complexities of the human mind, and the many components to manage, it will take many years of research to enable assessing the payoff from well tested training regimes that are designed for both group and individual use. While a study of management in general can provide some lessons, the uniqueness of primary production with all its complexities, demands specific procedures and programmes.

In 1990, Stevenson et al (1990) noted (p 364) "judgement and decision making research has made few inroads into our psychological understanding of cognition and choice. We think this will change". The opportunities for applying this to primary production are significant and potentially profound.

11. References

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