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REVIEW OF ‘STATE-OF-THE-ART’ OF RESEARCH

DOI: 10.5836/ijam/2019-08-31

A review of the intuition literature relative to a recent quantitative study of the determinants of farmers’ intuition

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ABSTRACT

Through a review of the literature covering the use of intuition for decision making, this article isolates the important intuition determining variables and relates them to recent quantitative intuition research. As most farm decisions are made through intuition farmers, consultants, researchers and students of farm management will find the review valuable when thinking about managerial ability. The literature reviewed is taken from both urban and rural business studies as urban based studies dominate. The search covered all journals and articles in recent decades. The summary, and the quoted quantitative research, consider the variables which can be targeted in improving intuitive skill and provides a basis for thinking about intuition and its improvement within the farming world. It is concluded the most important skill to concentrate on is improving a farmer’s self-criticism through using a decision diary in conjunction with reflection and consultation leading to improved decision understanding. But many other variables are also important and contribute.

KEYWORDS: Intuition; tacit knowledge; review of intuition literature; intuition variables; improving intuition; decision methods

1. Introduction

The use of intuition (Hogarth 2010; Kahneman, 2011) is undoubtedly most farmers’ main (Ohlmer, 2001) system of decision making and subsequent action. Understanding the development and improvement of a decision maker’s intuition is an important area of study leading to enhancing a farmer’s achievement of their objectives. Indeed, Hogarth (2010), for example, notes ‘the need to educate intuitive responses’ (p 338) and stresses the requirement for focused research as intuition is used in all aspects of living. This review covers management decision making, which is also Kahneman’s (2011) focus, as well as intuition’s relationship to analytical decision processes.

To date there has been only minimal agriculturally based studies on intuition as a decision system. One of the most recent studies (Nuthall and Old, 2018) used data from over 800 farmers to model the determinants of intuition. This review moves toward focusing farm management practitioners, consultants and researchers onto the many aspects underpinning intuition including Nuthall and Old’s results.

There are many and varied definitions of what is meant by intuition. Dane and Pratt (2007) reviewed several and effectively noted intuition as being ‘the provision of a conclusion reached without formal analysis’. Other definitions range from intuition being the provision of an instant decision without conscious thought, or contemplation, through to a decision based on a full and contemplative mental analysis. While each person’s process varies, the idea of a decision without formal analysis seems to make decision sense as a logical definition.

Intuition is very much a psychological construct (Sinclair, 2010) in that it results from the decision maker responding to observed stimuli. It is one of the many psychological processes that give rise to the totality of Homo sapiens. Intuition is also just one of the many decision making theories that appear in the literature. Nuthall and Old (ibid) present a diagram summarizing the range and intuition’s position within the schema.

In their quantitative analysis, Nuthall and Old (ibid, p 33), used a structural equation model to calculate regression coefficients which, when compared, indicate the relative importance of the variables they used in explaining a farmer’s intuitive skill. They found ‘*The coefficients*

Original submitted April 2018; revision received January 2019; accepted January 2019.

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(of the variables) *influencing intuition are decision theory knowledge 0.394, decision reflection and critique 0.163, anticipation skills 0.128, experience 0.019, feedback 0.015, observation skills -0.035, and, very importantly, technical knowledge 0.945*. They also concluded (p 35) that *'Besides the major contribution of decision and technology knowledge to intuition, feedback contributes 4.2%, experience 5.3%, anticipation 35.5%, observation 9.7%, and reflection 45.3%. Overall, each variable has a contribution, but anticipation and reflection stand out, though it is likely experience is a precursor to, particularly, reflection.'* If correct, their information makes it clear where efforts to improve decision ability should concentrate.

Importantly, they also commented (p 36) *'Future studies should collect variables suggested by the literature as being important but not collected in this study.'* The purpose of this review is to use the literature not only to amplify and reinforce the efficacy of the variables used in the Nuthall and Old (ibid) study, but to isolate and assess the additional variables that should be considered in future studies and assessments of intuition. These additional variables could well be important to farmers and others working on improving their intuitive skills and managerial ability. Furthermore, Nuthall and Old (ibid) did not refer to the past research used to isolate the variables that may influence a farmer's intuition, nor discuss the processes involved in assessing and altering the variables isolated. These gaps need coverage which is largely achieved through this review.

To achieve these objectives, the literature on intuition and tacit knowledge (another term used in the literature to refer to, effectively, intuition as defined), was extensively reviewed to discover the extensive list of variables likely to be involved in the development and maintenance of intuition. The five stage grounded theory review process (Wolfswinkel 2013) was largely followed. This involves searching the literature after assessing fields of research, and defining appropriate sources and search terms. Analysis and presentation then occur. The 'grounded' approach concentrates on letting the material introduce concepts and ideas in contrast to judging on preconceived theories and variables.

Google Scholar was used to search for the scholarly articles covering intuition (and 'tacit knowledge') which then provided the entry into the intuition research world. Key words such as 'intuition', 'tacit knowledge', 'farmer decision making', 'decision making psychology', 'decision thinking', 'decision intuition', and similar, were used. Finding initial articles provided further ideas on key word searches. The applicable studies found contained many references which were subsequently checked for likely candidates for further consideration and inclusion. Many articles showed similarities so what appeared the most comprehensive and well researched were included in the review with the others discarded. The end result was over fifty studies being used. To be included the articles had to contribute new ideas about the components determining a decision makers' intuitive ability, methods of acquiring improved intuition, and the variables giving rise to intuition.

The review is divided into sections covering each main area of the factors likely to influence success in the use of intuition. The particular groupings used emerged from the studies themselves together with logic. They included (1) experience, feedback and repetition; (2) training and

mentoring; (3) reflection and self-critiquing; (4) intelligence and education; (5) personality; objectives and risk attitude; and, finally, (6) observation and anticipation skills.

The discourse that follows covers each of these areas together with a discussion and conclusions section. An appendix contains a table summarising the variables believed to be important as reviewed together with their source articles.

2. The literature giving rise to the variables likely to be important

After sorting all the literature it was relatively clear what the reviewed authors believed were the variables influencing intuition. These logically fell into a number of categories which were then used to form the sections which follow.

Experience, feedback and repetition

Kolb (1984) talks about learning from a process which involves, firstly, a concrete experience, reflective observation (of the experience), abstract conceptualisation leading to active experimentation. The cycle then repeats itself. Kolb (ibid) maintains that to learn from an experience certain conditions must hold. He lists these as a willingness to learn, an ability to reflect, the possession of analytical skills to conceptualise the experience, and an ability to use the new ideas. Feedback obtained by the decision maker from observing the outcomes of the decisions taken is also relevant to improvement. Effectively an iterative process proceeds. This 'non-formal' learning (Eraut, 2000) creates intuition, though formal learning will also contribute where relevant.

Non-formal learning can be divided into 'implicit learning' and 'reactive learning'. The former, according to Eraut (ibid), involves a well thought out linking of memories with current experience. In contrast, reactive learning involves near spontaneous reflection on past episodes. Whatever the process in developing intuition, Eraut (ibid) quotes Polanyi (1966) 'that which we know but cannot tell' to indicate intuition is seldom directly explainable by the decision maker.

Intuition should use all the relevant pieces of information that are activated from memory and/or observed from the environment (Betsch, 2005, as referenced by Betsch and Glockner, 2010). Nevertheless, if gaps exist, or the material is not accurately observed, intuition will be biased. Additionally, the time available to make a decision can influence the cognitive process. Eraut (2000) notes (p. 129) that where a quick response is necessary 'meta processes are limited to implicit monitoring and short reactive reflections. But ... with more time meta processes become more complex ... including the framing of problems, thinking about the deliberative process itself ... searching relevant knowledge, and introducing value considerations...?'

Effectively he is talking about going well beyond simple pattern matching which refers to matching up the current situation with a mind-stored replica, or similar, that has been faced before for which a decision had been sorted. Klein (2008) and Hogarth (2010) make similar comments. This matching is virtually instantaneous,

whereas with more time reflection is possible and may perhaps change the conclusion.

As noted by Salas *et al.* (2010), the extent of feedback available is important. They also believe decision makers *must* proactively seek input from others who have higher levels of expertise. Sources of feedback can be varied ranging from a manager's spouse through to a professional consultant.

The type and extent of experiences (Salas *et al.*, *ibid*) are important. Armstrong and Mahud (2008) found the length of managerial experience effected the level of 'tacit knowledge' (intuition). They also found people whose learning style was 'accommodating' (Kolb, 1984) (learn from practical experience and from other people) had higher tacit knowledge relative to all others. Furthermore, if the experience is repeated many times the lessons are reinforced (Eraut, 2000), even if modified as the sophistication of the mental analysis improves. Nuthall (1997) found in classroom experiments it took three repeats of a concept before the students understood the ideas involved. It is likely a similar situation exists for managers exposed to a new situation. Dijkstra *et al.* (2013) also concluded experience and knowledge of a domain (specific decision area) impacted on the success of intuitive conclusions.

For feedback, Shanteau and Stewart (1992) note it must be accurate (Plessner *et al.*, 2008), diagnostic and timely. And Betsch and Glockner (2010) believe 'coherence' is important in that the pattern of encoded material must make sense to the observer. If not, 'deliberate construction' (i.e. mentally finding what is believed to be a coherent explanation) is instigated to make sense of the material. They also believe 'dual processing' is involved in that analytical processes, perhaps subconsciously, occur in creating intuition.

Luck probably also plays a part in intuition. Hogarth (2010) talks about the forecast prices turning out to be correct thus rewarding the results of intuitive decisions. Furthermore, for example, by chance a person might experience a difficult season early in her/his career so in future has a better prepared intuition following assessing possible solutions following the difficult time.

This review of experience, feedback and repetition show the following variables play a part in the development of successful informed intuition: willingness to learn, learning style, length of managerial experience, type of experience, repetition of similar experiences, degree of active experimentation, and, finally, the frequency, coverage, extent, accuracy, and timeliness of feedback. Whether accurate measurement of all these variables is possible is another matter. Measurement would enable assessing the variables' relative importance in the development of intuition using quantitative models of the process.

Training and mentoring

There is considerable evidence on the value of farmer, and farm family, training (e.g. Xayavong *et al.*, 2015). Specifically, Salas *et al.* (2010) believe 'deliberate and guided practice' is important in developing intuition. For 'guided practice' Wagner and Sternberg (1987) note tacit knowledge has features which are all relevant in training content, context, and orientation (theory or practicality). Content is broken into managing oneself, managing

others, and managing tasks. Context is divided into local and global, whereas orientation covers the idealistic and pragmatic. Ambrosini and Bowman (2001) refer to work which suggests day to day contact with a mentor in an apprentice-like relationship is very important to developing tacit knowledge. And Andresen *et al.* (2000) believe the skill of the mentors can have a very significant impact on the benefits. The personal relationship between mentor and manager is also important - they propose an 'equal' relationship helps.

Similarly, a peer group can be important (Eraut, 2000) as a source of training and mentoring, potentially providing a rich array of knowledge, beliefs, attitudes and behaviour. Dempsey *et al.* (2001), as noted by Peltier *et al.* (2005), believe sharing of thoughts and feelings is fundamental to reflection. This is where discussion, or mentoring, groups of various kinds come into play. Indeed, Goulet (2013) found managers learn substantial knowledge from manager meetings and discussion.

There is also evidence that the use of management games, decision support (DSS), and expert systems can also enhance intuition. Nuthall and Bishop-Hurley (1996) found, for example, that farmers absorbed the lessons available from an expert system on animal management and subsequently gave up its formal use. Similarly both McCowan (2012) and McCowan *et al.* (2012) discuss the relationship between altering a farmer's intuition and the use of DSS.

Managers need to be trained to fully use their observations. Eraut (2000) notes the use of a new idea involves a) understanding the situation using prior knowledge, b) recognising the concept or idea is relevant, c) changing it into a form that is more relevant, and d) integrating the new knowledge with other knowledge already held. Similarly Hogarth (2010) notes if intuition can improve through experience there is no reason why with targeted training they will not similarly enhance intuition. Hogarth (*ibid*) provides suggestions on maximising the benefits of training through a) selecting and/or creating the right environments, b) seeking feedback, c) working on making the 'scientific method' intuitive, and d) shadowing recognised masters. Furthermore, Sadler-Smith and Burke (2009) report research has shown 'devils advocacy', provided by the instructor, can improve decisions in group situations.

The 'scientific method' (<https://explorable.com/what-is-the-scientific-method> accessed 12/10/2018) refers to creating an hypothesis, gathering data covering the hypothesis, analysing the data through comparing predictions of the hypothesis relative to the gathered data, and coming to a conclusion on whether the hypothesis is not disproven (it is difficult to categorically prove an hypothesis whereas if it is not disproven this is a step in the right direction). In the processes it is important to exercise a critical mind which questions all aspects of such an analysis for their possible fallaciousness.

Kolb (1984) believes different people learn in different ways, though not all researchers accept Kolb's theory in its entirety (e.g. Koob and Funk (2002) list many concerns including statistical issues). Kolb (*ibid*), as noted, talks about four learning factors - concrete experience, reflective observation, abstract conceptualisation and active experimentation. The specific mix determines how an individual learns. If true, a manager will approach developing informed intuition in her or his unique way.

This review of training and mentoring shows the following variables play a part in developing informed intuition: extent, form and content of training, skill at using the 'scientific method', skill at finding and using 'masters', extent of mentoring, and the quality and form of mentoring (group or individual).

Reflection and self-critiquing

Using Pee *et al.*'s (2000) work, Scott (2010) defines reflection as 'the conscious awareness and questioning of personal experience, a search for alternative explanations and interpretations, and identification of areas for improvement' (p. 438). Perhaps the subconscious does something similar, but exploring the subconscious is difficult (Casey *et al.*, 2005). However, managers that follow proposed reflective processes are more likely to acquire a successful 'informed intuition' (Cerasoli *et al.*, 2018).

Matthew and Sternberg (2009) provide a further definition of reflection believing it constitutes a 'guided critical thinking that directs attention selectively to various aspects of experience, making knowledge typically acquired without conscious awareness explicit and available for examination and modification' (p. 530). They believe the whole process is subconscious. Reality is a continuum from the conscious to the subconscious with the pendulum swinging with the particular situation. Managers think consciously about an experience in some circumstances, and in others they are not conscious of their brain modifying and developing their intuition.

Cox (2005) talks about the need to have a structured reflective process to gain the most from experiences. While using a process is probably beneficial, many managers tend to rely on their subconscious processes to acquire the lessons (Nuthall, 2012).

Furthermore, Eraut (2000) believes an experience largely stays in 'episodic memory' and is quickly lost unless reflection on the experience occurs. The consequent message can then be persuaded into long-term memory. Cope (2003) comments that a bad outcome might be necessary to stimulate a mental review of what went wrong and the decision improvements necessary. Cope (*ibid*) quotes Argyris and Schon (1974) '(managers) must reflect on this error to the point where they cannot correct it by *doing better what they already know how to do...*' (p. 439). This suggests a manager must review the problem experienced to come up with new rules to resolve any differences. This is called a 'double loop' as new rules or concepts are produced in contrast to more knowledge about an already held concept (van Woerkom, 2004).

Salas *et al.* (2010) support Eraut (*ibid*) in believing 'self-regulation' is important. They note regulation involves 'conscious monitoring and self-assessment', and that true experts are better at detecting errors and understating why they occurred.

In the same vein Wagner and Sternberg (1987) comment that a person must be able to sort out from the mass of observations which information is relevant (encoding), and then select out the meanings that specifically relate to the decision maker's purpose (selective combination), and thirdly, be able to relate this new information to previously known information to provide a new conclusion. Following any event, they suggest the

decision maker should ask what they have learned about their strengths, weaknesses, values and ambitions, and how you would approach a similar situation in the future. Eraut (2000) has similar views and stresses the need to have the ability to consider the practicality and net benefit of proposed changes.

Scott (2010) carried out an experiment with students requiring one group to keep a detailed diary of their learning activities encouraging them to record their reflections. It was very clear that the students with well structured and analysed diaries achieved better grades. Similarly Peltier *et al.* (2005) developed a questionnaire to assess reflective action and concluded the important aspects involved personal reflection, peer reflection (discussions), and instructor or mentor discussions. The degree of each was shown to be correlated with success. They also found 'habitual learning' was negatively correlated with success. By 'habitual' they meant simple learning systems akin to rote approaches.

The concept of keeping a diary appears frequently in the literature. Another example is given by Sadler-Smith and Burke (2009) using Taggart (1997) who suggests an 'intuition diary' containing a write up of the experience, context, distractions, message, source, information and evaluation is valuable.

In reflection over experiences, Andresen *et al.* (2000) believe a decision maker will recall past experiences in conjunction with mentally analysing the current experience. They comment learning is holistic, socially and culturally influenced, and the emotional context in which it occurs influences the conclusion. Effectively, the reflection, which may be subconscious, involves 'the whole person – intellect, feelings and senses' (p. 225). In support of this idea Kolb (1984) quotes Dewey (1938, p. 35) 'the continuity of experience means that every experience both takes up something from those which have gone before and modifies in some way the quality of those that come after.....'. Hogarth (2010) comes to a similar conclusion.

Continuous learning undoubtedly occurs. Scott (2010) believes reflection is a critical part of the process which is characterised by habit at one end of the spectrum, and critical reflection at the other. Scott (*ibid*) records that Klimoski (2007, p. 495) noted reflection is 'organize or conceptualize what is going on, identify new insights, ...'. Scott (*ibid*), from her review of the literature, believes a reflective practitioner not only questions why things are done in a certain way, but also considers how their reasoning may at times become self-referential and self-confirming.

Maclellan (2004), as recorded by Peltier *et al.* (2005), believes a component of reflection is dealing with fuzzy ideas to reconcile ambiguity and inconsistency, and also involves recognising one's current knowledge set might be confused, incomplete or misconceived. Reflection provides a purposeful realignment, particularly to those with highly informed and successful intuition. A person might continuously reflect on the conundrums until a resolution emerges.

Other dimensions are listed by van Woerkom (2004) and include experimentation, learning from mistakes, career awareness, critical opinion sharing, asking for feedback, and challenging group think. However, career awareness is unlikely to be particularly relevant for farmers, or other small/medium family businesses.

To encourage learning through reflection, Sadler-Smith and Burke (2009) considered the use of cognitive mapping (making a structured diagram of thoughts surrounding the problem) to identify the causal patterns and accordingly allow reflection on the mental model and how it might be improved. Perhaps this approach has possibilities for farmers given its easily assessed visual properties.

Finally, to obtain maximum benefit from reflection, Cope (2003) quotes various authors to come to the conclusion that organised self-critiquing involving a strict goal is important in contrast to just 'letting it happen' through casual and subconscious reviews. A decision maker should set aside personal time for reflection using a structured decision–outcome review approach. What can also be important is the use of reflective questions being posed with a requirement to consider and conclude on each question.

While carrying out experiments will always be challenging given unobservable cognitive processes, a number of researchers have tried. For example, Matthew and Sternberg (2009) explored the impact of various reflection methods on tacit knowledge. They concluded 'the combined condition and reflection method was significantly different from the control condition' (p. 534). They also believe social factors may be important involving peers and experts. They conclude 'learning requires social interaction, including feedback and collaboration ...' (p. 531).

This review of reflection and self-critique covers many aspects. Overall, the variables that record reflection include hours spent on reflection, whether a structured review process is used, whether peers are involved, the quality of the review (the assessment on whether the decision made was correct; ability to relate past experiences to the current situation; were the critical factors isolated?; and determination of what went wrong), use of benchmarking information available, extent and appropriateness of records kept, use of diaries and written self-reviews of incidents, perseverance in trying to make sense of incidents, ability to assess strengths, weaknesses, opportunities and threats. Measuring many of these variables is difficult as it requires, for example, the subjects to accurately record the hours they spent on reflection, and the nature of the reflection.

Intelligence and education

A manager's inherent intelligence, and subsequent formal education, influences the extent and quality of her or his intuition. The form, type and extent of the educational experience, as well as how it relates to the manager's learning style (Koob and Funk, 2002), will influence the value of the education.

At the same time Wagner and Sternberg (1987) noted 'training ... in business schools ... can be useful at times, but not a vital ingredient of managerial success ... Ability to learn informally on the job is a critical determinant of managerial success.' (p. 302). But Hogarth (2010) has the view that 'intuition is shaped by learning' (p. 343) and that the learning process subconsciously influences intuition. However, where the skills, understanding and knowledge acquired is incorrect, a person's intuition will be biased. A decision maker, for example, in learning production economics might mistakenly believe equating marginal return with average cost maximises returns subsequently

incorrectly informing their intuition. Sadler-Smith and Burke (2009), as a further example, talk about 'confirmation bias' in which a decision maker construes the evidence to confirm their previously held conclusion.

Similarly, as discussed by Hogarth (2010), the decision maker may 'lack the metacognitive ability to correct for sampling biases and/or missing feedback' (p. 343). Checking conclusions will always be important in developing an accurate intuition as well as adherence to the concepts espoused by the 'scientific method'. This requires a constant review of observed material to ensure a person is comfortable with currently held views.

Overall, the important variables are the type and extent of formal education and its suitability for assessing primary production situations. Furthermore, given the nature of primary production, a manager's 'practical intelligence' (ability to assess, and solve, practical issues and problems, both mental and physical (Sternberg *et al.* 2001)) will be important. Whether this can be accurately measured (Sternberg *et al.*, *ibid*; Wagner and Sternberg, 1987) is another matter. A reasonable level of Standard IQ is also likely to be important, though IQ as an independent variable, while correlated with managerial ability, has been shown to be much less important than experience in developing ability (Nuthall, 2009). However, this research did not isolate intuition as a component of overall managerial ability. Furthermore, Nuthall and Old (*ibid*), when comparing farmers with successful intuition relative to the remainder, found their level of education and grades were only marginally different.

Personality

Plessner *et al.* (2008) believe emotions can influence decisions, as does Hogarth (2010). For example, disgust decreases risk taking and anger increases it. Salas *et al.* (2010) also noted decision pressure forces some people to rely more on intuition. The feeling of pressure relates to a manager's personality. Furthermore, some managers have a natural curiosity to understand situations they encounter and this personality factor may well influence the development of intuition (known as 'openness' in the five factor model (Matthews and Deary, 1998)). Most psychologists accept personality is made up of five factors: openness, conscientiousness, extraversion, agreeableness and neuroticism).

Salas *et al.* (2010) note some people are more disposed to formal deliberation than to using intuition (some people reach for their calculator, others not). They also believe the nature of the decision influences whether intuition is used in that complex situations might require intuition relative to simple decisions such as a decision on which fertiliser supplier to use. Here a simple logical analysis may well suffice. Overall, personality influences the choice of using logic relative to intuition with each decision maker being unique over the choice of decisions in which to use a formal analysis.

Densten and Gray (2001), as noted by Peltier *et al.* (2005), contend that learning is a function of the personality factors open mindedness, responsibility and willingness to make change. It is suggested those with a closed mind will most probably learn little from experience and reflection. No doubt there is a continuum between being completely objective and open minded through to a state of having a totally closed mind. Peltier *et al.* (*ibid*) believe

reflective critiquing is not an innate trait and must be learnt. A novice manager is probably a novice 'reflector'.

Leonard and Insch (2005) discovered 'cognitive self-organisational skills' were a factor in tacit knowledge. They also concluded 'social skills' were important for obtaining information. Both these factors are related to personality.

Finally, Fang and Zhang (2014) explored the five factor model of personality (Matthews and Deary, *ibid*) and how it related to tacit knowledge. Using a version of Wagner and Sternberg's (1991) test for tacit knowledge they discovered 'agreeableness' (trust, compliance, modesty, altruism) was significantly correlated with the level of tacit knowledge as was 'conscientiousness' and 'anxiety' (neuroticism). These results further suggest personality is a basic factor in the development of successful tacit knowledge.

Overall, the literature does point to personality being a factor in intuition. As the five factor personality model is considered (Matthews and Deary, *ibid*) the basis of many of the traits mentioned, it is important these component variables are included in any model of intuition.

Objectives and risk attitude

Salas *et al.* (2010) also note that strong 'goal setting' is important as it provides focus and a desire to achieve. They also comment that, as part of motivation, self-efficacy beliefs, goal orientations, and a drive for success in contrast to a fear of failure are all important in developing an informed intuition.

Leonard and Insch (2005), in experiments with MBA students, came up with a similar conclusion in finding 'cognitive self-motivation' was an important ingredient to tacit skills. As part of a manager's objectives, the attitude to risk must also be important if not only as an incentive to improve, but also as a factor in creating decision rules that reflect the decision maker's objectives.

Glockner and Witteman (2010) also relate objectives to the development of intuition. They discuss the formal classic expected utility model, 'utility' being an overarching measure of attaining a farmer's set of objectives (Anderson *et al.*, 1977), but note few decision makers seem to follow this model in the development of their intuitive conclusions. Using expected utility requires a full search of alternatives, but Glockner and Witteman (*ibid*) point out few have the cognitive ability nor patience to follow the theory. In contrast the decision maker uses a simplified objective system that might, for example, seek a solution which 'satisfices'. Their intuition develops accordingly.

Glockner and Witteman (*ibid*) also referred to lexicographic objectives where the range of outcomes from a decision are given priorities. They stressed a decision maker that uses this system will similarly develop an intuition reflecting this objective structure.

If a farmer does not have clear and strong goals, there is no yard stick for assessing alternative decisions. Consequently the decision makers' intuition will be confused, inconsistent and confounded. To allow for all these issues, a model must include variables which measure the strength and type of objectives held as well as a farmer's risk attitude. A farmer's 'locus of control' (a measure of a farmer's belief in the control s/he has over outcomes (Nuthall, 2010).) might also be relevant.

Observation and anticipation skills

Any decision must relate to the current resource situation. In addition, to assess alternative decisions, managers must be able to successfully forecast, either intuitively, or consciously, outcomes for each alternative course of action. Taylor *et al.* (1998) believe mental simulation is important for success in these attributes. Overall, a manager must be an accurate and comprehensive observer as well as having an ability to anticipate prices, outcomes and conditions.

In this regard, Salas *et al.* (2010) note that successful CEO's are able to categorise complex situations more quickly than novices. It is suggested this is related to semantic networks in the brain in which pieces of knowledge are connected so that schemas represent patterns which have developed through experience. However, this process is totally dependent on observing the current situation accurately, as are all processes which rely on knowing the current state of the business and its environment.

Salas *et al.* (2010) review experiments where 'mental simulation' is associated with the successful use of intuition. Simulation must both recall the past allowing pattern matching, and anticipate likely future outcomes from intuitively proposed action. One study they quote covering these points is Klein and Crandall (1995). Klein (2003), and Gaglio (2004), also talk about mental simulation to facilitate the use of experience to relate to a decision.

Salas *et al.* (2010) review work on pattern matching and believe that if a decision maker does not find a match they seek more information to better understand the current situation. They also talk about 'sense making' which is invoked when the decision maker does not make immediate sense of an observation. The process involves problem detection, problem identification, anticipatory thinking, forming explanations, identifying explanations, discovering inadequacies in initial explanations, and projecting the future. Similarly, Dreyfus and Dreyfus (1986) talk about invoking 'implicit monitoring' when a situation is 'not feeling right'. Overall, both simple logic and the literature show the importance of both comprehensive and accurate observation, and an ability to anticipate likely outcomes from alternative decisions, in the development and use of informed intuition, or in decision making in general.

To include these aspects in a model, results from tests of observational skill are relevant provided they specifically relate to the manager's situation. Any test should include the variables important to the specific industry situation under consideration (prices and costs, regulations, markets, resource levels, condition of resources, and production relationships are likely to be the main examples). For simulation capabilities, both of past and future situations, specific tests would be necessary which provide scenarios and require the manager to choose from possible outcomes.

3. Discussion and Conclusions

For most farmers the efficacy of the components of his/her intuition change with time provided the lessons available from the concomitant experiences are observed and processed correctly. Indeed Dreyfus and Dreyfus (1986), as quoted by Eraut (2000), developed a model of

skill acquisition in which the following stages were defined - novice (rigid adherence to taught rules or plans), advanced beginner, competent, proficient and, finally, expert (no longer relies on rules, guidelines or maxims). Some managers do not progress through all stages. And some will believe they have progressed but in reality their internal models and assumptions will be biased and misleading. An important question here involves whether the biases can be identified and the managers assisted in overcoming them.

To ensure the improvement of intuition, it is worth noting Hogarth (2010) comments intuition is codified knowledge in a personalised form which includes procedural knowledge, process knowledge, experiential knowledge and impressions in episodic memory. When assessing decision situations a manager must learn to use each of these personal resources.

Similarly, Kayes (2002) believes people who clearly understand learning is a process of self-discovery, and who challenge their own personal assumptions and beliefs, who question the actions of others and have an understanding of managerial practices, will become effective leaders. In the farm management case, the decision maker is the leader of the farm, and the leader of her/his colleagues.

What Sadler-Smith and Burke (2009) propose may summarise the reality of the process used by a manager in developing his 'informed intuition'. They talk about a rational analysis/intuitive mixed model involving the steps: 1) intuitively sensing the problem, 2) logically considering the situation, 3) developing an intuitive, integrated, picture, 4) rationally articulating the situation and identifying alternatives, 5) sensing the value of the alternatives, 6) logically assessing the alternatives, 7) conducting a 'gut feel' check on the alternative selected and then, finally, carrying out the decision. In reality, however, the process may well have more steps which could be dynamic rather than linear.

The literature on intuition, and related issues, makes it clear intuition is a complex subject involving all aspects of human decision making.

When comparing farmers with successful intuitive skills with those somewhat less skilled Nuthall and Old (ibid) found their technical and decision method knowledge measures were over 200% different. They divided their sample of farmers into three groups based on their level of intuitive skills, and compared the top and bottom groups and came up with the percentage differences in each variable recorded. Other important significant differences included aspects of personality (e.g. 315% difference for conscientiousness), of farmer objectives (e.g. 437% difference for the 'community supporter'), feedback factors (e.g. 258% difference for the 'professional conferrer'), and similar. Surprisingly, there was little difference in the educational level and grades attained not that these variables can be changed as they are historic.

However, in assessing these quantitative results it must be remembered they relate to 'snapshot' data as they reflected the situation when the questionnaire was completed. If several snapshots had been collected at, say, yearly intervals some of the dynamic aspects may have modified the conclusions in that, for example, the changes may have led to emphasizing specific variables.

Further changes in Nuthall and Old's (ibid) quantitative results may occur if the additional variables isolated by this review were included. Given the limit of an eight page postal questionnaire choices had to be made, and some variables would have required a personal interview. A comparison of those used compared with the literature review lists shows the additional items which might have been included are farmer learning characteristics; types and frequency of experiences; further details of feedback (frequency, coverage, accuracy and timeliness); extent, form and content of training courses undertaken; ability of the mentors used and the form of mentoring; and critical skills of the manager (scientific method); details of reflection including time spent and form of reviewing, use of benchmarks, extent of records and diaries and their use; details of observation systems and methods (time spent on different variable observations), ability in mentally simulating likely outcomes; and the processes used in changing attitudes and skill levels and how successful they had been in the past.

As noted earlier, another factor not isolated from the literature review, nor the quantitative study, that could well impinge on intuition is a farmer's Locus of Control (Nuthall 2010) which reflects the farmer's belief in how much control over outcomes is possible. A further issue is the farmer's family background and early experiences which similarly does not feature. It has been shown, as would be expected, these experiences influence managerial ability quite markedly (Nuthall 2009).

Overall, it is clear where a farmer's efforts must go when working on improving their decision skills using a range of methods one of which might well be through advised farmer decision review groups (Nuthall, 2016) and related self-critique which was shown to be very important in the quantitative work. Perseverance in using diaries and mentors is likely to have value. Nuthall (1997) has shown three exposures to an idea is often required to comprehend an issue even when using the best learning approach for an individual which is likely to involve practical experience, mentors and peer groups. The review has also shown attention to detail related to each variable is important. For example, feedback must be accurate, diagnostic and timely as stressed by the reviewed articles.

The quoted quantitative study also made it clear the main variables isolated by this review do contribute to intuition even if at differing levels. It is similarly likely many of the additional variables listed would further help explain the development of expert and informed intuition. This would mean the contributions of the quantified variables in the Nuthall and Old (ibid) study would decline. The critical question is whether their relative importance would change.

Another area of potential importance not covered in the review is the relationship between intuition and entrepreneurship. An entrepreneurship reviewer (Baldacchino *et al.*, 2015) believes much more work is required in assessing this factor. Another general review (Akinci and Sadler-Smith, 2012) lists out the areas in which they believe future research should proceed and should be consulted by prospective researchers.

Overall, this review has highlighted the additional variables that need to be included in future research in addition to providing much needed details of the important variables impacting on intuition. There is, however,

room for many more valuable studies on the development and use of farmer intuition particularly with an emphasis on further developing successful training and improvement methods.

About the author

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Acknowledgement

Lincoln University for funding support, and the research journals of the world, and the authors of all the research articles reviewed.

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Appendix

A summary of the important intuition related variables is provided in the Table below. It contains the general

information and skill categories likely to be relevant, and a list of variables likely to be important in explaining intuition. Each skill area has the important literature associated with the area listed.

Appendix Table: Factors important in determining a farmer’s intuition (the table references have been numbered and alphabetised. Where a reference appears in subsequent areas only its number is included).

General area	Specific variables	References
Experience, feedback & repetition	Willingness to learn	1 Armstrong & Mahud (2008)
	Learning style	2 Betsch (2005); 3 Betsch & Glockner (2010); 4 Eraut (2000)
Training & mentoring quality	Repetition of experiences	5 Klein (2008); 6 Kolb (1984)
	Degrees of experimentation	7 Hogarth (2010); 8 Nuthall (1997); 9 Plessner (2008); 10 Salas <i>et al.</i> (2010); 11 Shanteau & Stewart (1992); 15 Dijkstra <i>et al.</i> (2013).
	Feedback (frequency, coverage extent, accuracy, timeliness)	4,6,7,8, 12 Ambrosini & Bowman (2001)
	Extent, form & content of training	13 Andresen <i>et al.</i> (2000)
Reflection & self critique	Finding and using ‘masters’	14 Dempsey <i>et al.</i> (2001); 15 Goulet (2013); 16 Koob & Funck (2002)
	Extent of mentoring and its form	17 Peltier <i>et al.</i> (2005); 18 Sadler-Smith & Burke (2009); 19 Wagner & Sternberg (1987); 20 Xayavong <i>et al.</i> (2015)
	Skill at using ‘scientific method’	4,6,7,10,13, 17, 18, 19
	Hours spent on reflection	21 Argyris & Schon (1974)
	Structured reviews	22 Cope (2003); 23 Cox (2005)
	Quality of reviews	24 Dewey (1938); 25 Klimoski (2007)
	Use of benchmarking	26 Maclellan (2004)
	Extent and type of records	27 Matthew & Sternberg (2009)
	Use of diaries and reviews thereof	28 Nuthall (2012); 29 Pee <i>et al.</i> (2000)
	Making sense of incidents	30 Scott (2010); 31 Taggart (1997); 32 Van Woerkom (2004)
Intelligence & education	Assessment of strengths, weaknesses, opportunities & threats	7,18,19, 33 Koob & Funck (2002)
	Practical intelligence	34 Nuthall (2009); 35 Sternberg <i>et al.</i> (2000)
Personality	Type and extent of education	7,9,10,17, 35 Densten & Gray (2001); 36 Fang & Zhang (2014); 37 Leonard & Insch (2005); 38 Matthews & Deary (1998); 39 Wagner & Sternberg (1991)
	Components of the five factor personality model	10,37, 40 Glockner & Witteman (2010)
Objectives & risk attitude	Strength & type of objectives	41 Nuthall (2010)
Observation & anticipation skills	Risk aversion/preference	10, 42 Dreyfus & Dreyfus (1986); 43 Klein & Crandall (1995)
	Observation skill level in each area of relevance	44 Klein (2003), Gaglio (2004)
General	Mental simulation skills in each area	7,18,42, 45 Kayes (2002)
	Ability to change attitudes and systems	
	Leadership skills	
	Improvement process	