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DEVELOPING A LIVESTOCK PRODUCER-CENTERED APPROACH TO DESIGN AND  
OPTIMIZE TRAINING PROGRAMS IN ANTIMICROBIAL STEWARDSHIP

BY

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THESIS

Submitted in partial fulfillment of the requirements  
for the degree of Master of Science in VMS-Veterinary Clinical Medicine  
in the Graduate College of the  
University of Illinois at Urbana-Champaign, 2017

Urbana, Illinois

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## ABSTRACT

Recently, the emergence of antimicrobial resistance has provoked numerous nation-wide initiatives that encourage the prudent use of antimicrobials in both human and veterinary medicine. The importance of effective education and training programs has been increasingly emphasized as a key area of expansion for improving antimicrobial stewardship at all levels. Large-scale, highly integrated livestock production systems have discovered that adoption of education and training helps livestock producers incorporate essential principles of antimicrobial stewardship and the latest advances in science and technology into their day to day operations. In many ways, there appears to be significant incongruity in availability, uptake, and impact of training between these large, cooperate agriculture entities, and the more common small-scale, owner-operator units. When evaluating Illinois livestock producers, age, farm size, farm diversity, and employment demographics provide ample evidence of this traditional, small-scale family farm culture. While the importance and benefit of training and education is well-established, the question of how to best provide these opportunities to differing demographics and learner preferences, and of how delivery and format can be engineered to maximize effectiveness, remains unanswered.

The long term goal of the projects represented in this thesis is to develop effective, evidence-and outcomes-based educational platforms that align with the needs and preferences of Illinois livestock producers. In the first project, a survey was conducted to identify areas of strengths and weaknesses in knowledge, attitude, behavior, and practice in antimicrobial usage in Illinois dairy producers. The survey data highlighted the need for producer training in several key areas of

antimicrobial stewardship and management. The results from this study can be used to guide development of producer-focused education and training programs aimed at encouraging best practices surrounding the practical antimicrobial stewardship necessary to foster high health animal care systems.

While it is evident that adults learn different than children, little work has been done investigating the role of adult learning in the workplace, specifically in an agricultural setting. In attempt to understand more about the educational needs of Illinois livestock producers, the second project in this series consisted of development and distribution of a survey regarding producer demographics, current methods or resources used for continuing education, level of engagement in their on-farm work environment, and learning style preferences, which was administered to Illinois livestock producers throughout the state. The goal of this project was to apply established adult learning tools and theories to identify previously uncharacterized attributes of mature learners currently employed in the Illinois livestock-based food production sector, and to explore the role of these attributes in the potential effectiveness of learning and training programs. The results of this study demonstrated previously undocumented patterns of learning style among livestock producers indicating a preference for a combination of reflective and theoretic learning. In addition, demographic variables were noted to be associated with learner preference. Understanding how to leverage this information to facilitate an atmosphere for effective adult learning is paramount for the transfer of information to improve on-farm livestock practices. Future studies are needed to examine the impact of these differences in adult learning styles on the design and delivery of effective training programs in the livestock production sector.

## ACKNOWLEDGEMENTS

First and foremost, I would like to thank my committee members, Drs. Brian Aldridge, Jim Lowe, and Larry Firkins, for believing in me and helping to guide me through the process of turning a thought into reality. In particular I would like to thank Dr. Aldridge for the immense amount of guidance and moral support during manuscript preparation.

I must also give a special thank you to Dr. Dennis French for believing in me enough to hire me and encouraging me to begin a Master's program. He saw something in me that I'm not sure I saw in myself when this journey began, and without his leadership I wouldn't be where I am today!

I would also like to recognize the Illinois livestock producers. Without their willingness to participate in my survey, none of this would have been possible!

A big thank you to Dr. Ryan McCann for keeping me organized during the data collection period, being my travel and survey companion, and inputting all of the data. I would also like to thank Dr. Ben Blair for his contribution to the statistical analysis of these data. Additionally, I would like to thank my all my colleagues for adjusting their schedules when needed to accommodate me, as well as all the students who helped with data collection.

Finally, I would like to thank my parents for teaching me the values of hard work and follow-through, and my husband for his support and encouragement throughout this journey.

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# CHAPTER 1

## LITERATURE REVIEW

### 1.1 Introduction

The global population is expected to surpass nine billion people by the year 2050, with the majority of the increase taking place in low and middle-income countries such as Africa (“FAO - News Article: 2050: A third more mouths to feed,” 2009). As the population continues to increase, changes in the nature of per capita demand, coupled with the ever-changing national and international governance of the food system will undoubtedly play a role in the delivery of a secure and sustainable food supply system. Additionally, environmental elements such as climate change and competition for key resources must be factored in, as sustainability of the food supply system is likely to be affected by these adverse events (Nelson et al., 2009). The agriculture sector has acknowledged this new era of livestock-based food production, and has responded to these challenges by increasing the use of technology throughout the industry, in both agronomy-based and animal-source food production systems. For example, the use of genetically modified organisms is widely utilized in modern day crop production, and antimicrobial and vaccine technology are almost universally applied in livestock-based food production systems. The ever-increasing demand for food is not, however, the only problem facing the agricultural sector. There have also been changes in customer preference and demand, increasingly volatile market prices, unstable government relationships at the local, regional and national levels. In these instances, modern technology is unlikely to be the only solution needed to maintain a safe, sustainable, yet affordable food supply in all sectors.

In concert with evolving technologies, there is also a need for skilled workers in agriculture to help increase productivity and social capital. Education and training helps livestock producers incorporate the latest advances in science and technology in to their day to day operations. The result of providing producers access to scientific discoveries is widespread, from promoting environmental sustainability and encouraging judicious use of antibiotics, to ensuring animal welfare and discovering new economic opportunities. Large scale, corporate agriculture stakeholders have identified the importance of these resources and have worked to incorporate robust training and continuing education programs in their companies. Within livestock production, national programs such as Beef Quality Assurance and Pork Quality Assurance have been created to assure proper management techniques within each segment of the industry in order to raise consumer confidence (“Beef Quality Assurance,” n.d.). While there has been a widespread adoption of these programs, the measurable benefits have been most clearly documented in large-scale, highly integrated, livestock production systems. In many ways, there appears to be significant incongruity in availability, uptake and impact of training between large scale, corporate agriculture entities, and the more common small-scale, owner-operator units. This size-based disparity in the adoption and efficacy of training programs has been widely recognized and addressed in countries with subsistence livestock production systems. The fact that many regions of the US depend on small scale farming has been largely overlooked, meaning that specific programs tailored to the unique attributes of this important segment of livestock farming, have fallen by the wayside.

According to the United States Department of Agriculture, there are over 72,000 farms in Illinois (Agriculture, 2016). The vast majority of these farms are primarily utilized to produce crops,



with 95% of the operations that encompass >1,000 acres being solely devoted to corn or bean production (Kuethe, 2014). However, many Illinois farm operations are small, and have diversified their commodity portfolio, often raising livestock in conjunction with crop production. For instance, 50% of farming operations in Illinois span less than 100 acres, and small livestock operations account for approximately 20% of all Illinois farms (Kuethe, 2014).

The age and employment demographics of working farmers provide additional evidence of a traditional, part-time, small-scale, family farm-like culture in Illinois. The average age of an Illinois farmer is 57.8 years old, and approximately half of Illinois farmers consider farming as an ancillary occupation, as they hold a primary job away from the farm (Agriculture, 2016). While these facts and figures could be used to construct an image of traditional, local, family farm-based food production in this region, it could be argued that this sector of the Illinois livestock industry comprises a population of undertrained, low-skilled operators, leading to a future of inefficient and potentially unsustainable livestock production.

The agriculture sector has always recognized the need to provide its employees with continuing education and practical training that extends beyond the classroom. Historically, practical, research-based information from local land-grant institutions has been disseminated to agriculture producers throughout each state via Cooperative Extension specialists (National Institute of Food and Agriculture, n.d.). Originally, the Smith-Lever Act of 1914 provided federal resources that were allocated towards this initiative, which aimed to provide educational resources to the 42% (31.9 million) of people employed in the agricultural sector (West & Drake, 2009). Over time, the number and accessibility of agriculture specific Extension specialists has

declined, likely due to consolidation of traditional, small scale family farms and decreasing availability of federal resources. In addition, the scope of the Extension program has expanded, focusing on urban-based audiences and a variety of educational needs including family and consumer sciences, and youth development, as well as agriculture resources (Taylor, 2015).

Despite the diminishing role of Extension specialists in agriculture, the importance of education within the industry still remains paramount. However, for university, government, or private education to be effective, modern pedagogical approaches need to be adapted, in line with the defined needs of the learners. Teaching is much more than the transmission of information to a learner. Effective teaching actually encompasses a series of complex tasks that include the planning, preparation, and delivery, of relevant and engaging learning activities, in line with the expectations and needs of the learners. While this may seem straightforward, to be effective, the process involves an understanding and application of both the science, and craft, of learning. It also ensures that our learning content and delivery are not based solely on the intuition and professional judgment of our educators, but are continually informed by data regarding the learning needs, preferences, abilities, and styles of the learner.

While there are many extension and education programs aimed at attracting a new generation of workers into the livestock sector, there is a great need to upskill the current employees, and to help them maneuver through the ever-changing landscape of the industry. In view of the changing demographics, and to ensure that education and training programs have the greatest impact, they need to be constructed in a way that reaches and equips this existing population of workers. This means that they should attract learners who are adult laborers, at both a large and

small operational level, from a wide range of cultural and educational backgrounds, with the knowledge and capabilities needed for the industry to produce a safe, sustainable, yet affordable food supply.

While the importance and benefit of on the job training and education is well established, the question of how to best provide these opportunities, and of how delivery and format can be engineered to maximize effectiveness, remain unanswered. The overall goal of this project is to identify previously uncharacterized attributes of adult learners currently employed in the livestock-based food production sector, and to explore the role of these attributes in the effectiveness of learning and training programs. It is anticipated that the results of this study could be used in designing future education strategies that could help advance the efficiency and sustainability of Illinois small-scale, owner-operator livestock operations.

## **1.2 Andragogy**

While it is evident that adults learn differently than children, the definition of an adult remains vague. According to Malcolm Knowles (2015), a well-known pioneer of adult learning, an adult can be defined in several ways. Firstly, an individual is considered an adult biologically when they are able to reproduce in early adolescence. Legally, an adult is defined as the time point when one is eligible to vote, get married, etc. Society defines an adult as one who performs adult roles, such as a spouse, parent, or full time worker. Lastly, and most crucial for learning, is the psychological definition of adulthood, which is the stage at which one comprehends the concept of being responsible for their own life and self-directing. In the 1970's, incorporating the psychological definition of adulthood, Knowles developed the concept of andragogy, which is

the art and science of helping adults learn. The practice of andragogy is built around six hypotheses or presuppositions regarding adult learning:

1. The need to know – an adult has the desire to know why they should learn about something before they begin to learn about it
2. The learners' self-concept – an adult acknowledges that they are responsible for their actions and resist situations in which they feel others are imposing their wills upon them
3. The role of learner's experience – an adult gains more experience, and a wider variety of experiences as they mature, and these experiences play an important role in the development of self-identity
4. Readiness to learn – an adult becomes ready to learn the things that they need to know, and be able to do, in order to handle real-life situations successfully
5. Orientation to learning – an adult is motivated to learn as long as they perceive that the learning will help them with a real-life task or problem
6. Motivation to learn – an adult is somewhat motivated to learn by external factors, but more so by internal pressures, such as quality of life (Knowles, Malcolm, Holton III, Elwood, & Swanson, 2015).

A recurrent theme across these adult principles is the notion that adult engagement and motivation is directly related to perceived value. This idea has prompted a new education perspective in which the outcomes of learning are primary considerations in designing educational content and delivery formats. This is called outcomes based education (OBE).

### **1.3 Outcomes Based Education**

Outcomes based education (OBE) is a clear and comprehensive approach to teaching and learning that focuses the curriculum around the essential knowledge, skills or behaviors, that the learner should successfully master by the end of their learning experience (Spady, 1994). OBE functions on four essential principles which are aimed at creating a basis for life-long learning (Killen, 2000). The first principle of OBE is centered on clarity of focus. This belief directs teachers to design activities and resources that focus on the knowledge or skill that is the desired outcome at the end of the learning activity, by clearly articulating their goals and intentions for student learning at every stage of the learning process. Linked to this is the second principle of backward design, where the learning content is constructed after the desired outcomes have been determined. The third principle of OBE involves the practice of setting high expectations for learners. Evidence shows that establishing and enforcing high standards of engagement and performance is closely linked to deep thinking and successful learning of students (Spady, 1994). Lastly, because all students do not learn equally, teachers must strive to provide expanded opportunities for all learners. This involves the idea of individualizing content to encompass the diverse and unique abilities, preferences, and needs of a particular population of learners.

In the field of agricultural extension, programs are almost universally designed with the view of the knowledge and skills of their audience in mind. As such, extension offerings could be defined as outcome based learning in that the content and format is often focused on a specific set of knowledge or skills required by the participants. However, the weakness of these programs in their current state, is they often neglect the last two principles of OBE, in that extension training activities are often designed around the perceived needs or abilities of the

‘average’ learner. As such these programs fail to incorporate modern pedagogy that would allow for the individualization of learning content and delivery based upon individual participant learning styles or preferences. While these programs are often well intentioned, and delivered by engaged teachers, the voluntary nature of adult learner participation, and the relational focus of many extension specialists, means that the enforcement of high standards in achieving best practices and outcomes in the learners, is also often neglected.

#### **1.4 Review of Learning Styles**

A learning style is a concept derived from psychology that describes the way people process and remember information (Biggs, 2001; Brown, 1998). While this seems straightforward, the literature is full of complex variations of this definition that can easily lead to confusion. For example, Linda Smith developed a definition that has been widely used in adult education, that describes a learning style as the individual’s characteristic approach in handling new knowledge, and their tendency towards specific emotions and behaviors during the learning process (L. H. Smith & Renzulli, 1984). Learning styles have also been referred to as ‘a particular set of behaviors and attitudes related to the learning context’ and ‘the cognitive, affective, and physiological factors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment’ (Swanson, 1995). James and Gardner (1995) describe learning style as the complex manner in which, and conditions under which, learners most efficiently and most effectively perceive, process, store, and recall information that they are attempting to learn. Alternatively, many investigators have defined learning styles in terms of the patterns of receptivity in the learner, such as cognitive, affective, and physiological styles

(James & Gardner, 1995), physical and sensory preferences, or brain hemisphericity (Asselin, Susan B and Mooney, 1996).

The variability in definitions regarding learning style or patterns of learning tend to reflect the perspectives of the various learning style instruments (LSI) that have been created and implemented over time (Brown, 1998). A semi-comprehensive list of learning style instruments can be found in Table 1.1. This list includes instruments that are centered on cognition (Kolb) as well as personality (Myers-Briggs). From that list, several key instruments were selected for further investigation based on their development and application for adult learners, documented reliability and validity studies, and ease of use.

David Kolb developed a LSI in 1969, which was based on the Experiential Learning Theory derived from the works of Carl Jung, Carl Rogers, and John Dewey, among others. This theory postulates that all learning is dependent on how the learner processes the experience (D. Kolb, 1984). Kolb contends that learners perceive information along a continuum, bounded by the dimensions of concrete experience and abstract generalization and subsequently process the information on a scale that ranges from active experimentation to reflective observation (Fenwick, 1994). Kolb identified four basic learning styles (Diverging, Assimilating, Converging, and Accommodating), which he believes are shaped by a learners personality, educational specialization, professional career, current job role, and adaptive competencies (D. A. Kolb & Kolb, 2016). Kolb's LSI has been modified 11 times, with the most recent edition (4.0), redefining the original four learning styles into a nine style typology that minimizes confusion caused by borderline cases and better defines patterns of individual learning styles (D.

A. Kolb & Kolb, 2016). The 4.0 edition of Kolb's LSI asks participants to complete 20 sentences by rank ordering four responses that correspond to the four original learning modalities. Due to the complex nature of the scoring, this instrument is only available online. Reliability of this particular instrument is .81, however, there have been no studies to date to determine the test-retest reliability of this tool. The average validity correlation between the current edition of the LSI and the previous version is 0.92. Others who have utilized Kolb's LSI have found statistically significant relationships between an individual's learning style and career choice (D. Kolb, 1984), however the majority of work in this area was done using college students as a model. An additional flaw of this instrument is that it only examines 'cognitive styles' in order to investigate how a learner best perceives, thinks, remembers, and problem-solves.

In 1982, Anthony Gregorc developed The Gregorc Style Delineator, which is based on "phenomenological research [that] identifies the three levels of existence: the essence/spirit of something, the nature of the driving forces that emanate from it, and the outer appearance, characteristics, behaviors and mannerisms that are the signatures of the spirit and invisible driving forces" (A. Gregorc, 2016). Within this model, bipolar concepts centered on perceptual quality and ordering ability are evaluated. For example, perceptual quality is sub-categorized into concrete qualities that can be detected directly through the five senses, and abstract qualities that utilize intuition and imagination to help the learner perceive information that is otherwise intangible. Ordering ability is also further defined as sequential versus random. Sequential ordering occurs when a learner organizes information in a step-by-step manner following a logical train of thought, while random ordering ability allows learners to organize information



into chunks, with no particular order (A. F. Gregorc, 1984). It has been demonstrated that all people have some combination of both aspects of the model, however there is generally one prevailing trait in each of the perceptual and ordering categories (Johnson, Carter, & Kaufman, 2008). This particular LSI consists of a ten-column word matrix with four choices each, that the learner must rank order the words as they describe the learner's sense of self. Reliability of this model has been reported as approximately 0.90 using the test-retest method. The instrument was also tested for validity by allowing 100 individuals to take the test and rate the attributes as descriptive of their learning style (A. F. Gregorc, 1984). The most recent version of this learning style instrument, the Mind Styles™ model, was created in 2005 (A. Gregorc, 2016). Gregorc's model has been faulted by many, saying his emphasis on organizational patterns of thinking does not distinguish between perceiving and processing information (Fenwick, 1994).

In 1982, Honey and Mumford used Kolb's LSI as a basis to create their own Learning Styles Questionnaire. Like Kolb, they agreed that learning is a four part process, however, instead of focusing on abstract words which were the basis of Kolb's original LSI, they thought it was imperative to focus the context of their questionnaire on real work activities based on management of work organizations (Van Zwanenberg, Wilkinson, & Anderson, 2000). Honey and Mumford believed that people prefer different styles of learning depending on the situation and on their prior experiences, so they created a learning styles model that allowed for movement in between their four modes of learning (Activists, Reflectors, Theorists, Pragmatists). The authors also suggest that learners tend to naturally rely on one style of learning when they are engaged in learning activities. With this particular LSI, 80 items are presented as a single statement and the respondent either agrees or disagrees. There are 20 questions associated with

each mode of learning and scores are determined by summing positive responses to each item (Van Zwanenberg et al., 2000). The original LSI has been adapted over time to allow for shortened versions. The Honey and Mumford LSQ has been reported to have a range of test-retest reliability from 0.81 for activists to 0.95 for theorists (Fung & Kwan, 1993). Internal consistency indices were also quite high, with the coefficient alphas ranging from 0.68 for the Activist and Reflector dimensions to 0.78 for the Theorist dimension (Simms, R.R, Veres, G.G., and Shake, 1989).

### **1.5 Criticisms of Learning Styles**

Despite the widespread use of learning style instruments, a multitude of criticisms exist around learning styles. The first problem that has been identified is a lack of a comprehensive, coherent model, as evidenced by the multiple types of available learning style instruments that provide various interpretations of an individual's preferred style of learning. Secondly, many of the variables that affect an individual's learning style have been identified through research in K-12 and college aged students, making them difficult to apply to adult learners. The majority of students involved in higher education are young adults who possess a different approach to learning than adults in the work place, who are not engaged in a 'learning mode' appropriate for formal academic learning. College students are cognizant that they are supposed to be learning, whereas the focused learning of adults is not a primary day to day activity (Fenwick, 1994). Others contend that because adults have gathered more experience and expertise in their lifetime, their cognition is qualitatively different from the cognitive styles that a child possesses (Smolak, 1993).

A third criticism of the application of learning styles is the lack of flexibility in the original foundation of learning style theories that support the belief that a person's learning style doesn't depend on the task, the environment, or even their stage of life development (Fenwick, 1994). This idea of stability likely stems from the results of research on children and young adults. Adults have accumulated learning experience and a wider variety of learning strategies when compared to children. In addition, non-learning influences such as life crisis, development of discipline, and attitude can affect the stability of adult learning styles.

The majority of teaching professionals and researchers agree that various learning styles exist within a population of individuals, however their relative importance when designing learning activities may be irrelevant. Instead, some research indicates that it is more important to provide correct learning methods, strategies, and context rather than attempting to match individual learner preferences (Coffield, Moseley, Hall, & Ecclestone, 2004). A large meta-study (Marzano & Road, 1998) along with several smaller studies (Constantinidou & Baker, 2002) indicate the use of pictures and physical objects as representations of the subject matter had significant effects on learning outcomes irrespective of learning preference.

Utilizing an OBE approach to education that combines individual learning styles can allow for adjustment and fine-tuning of training strategies. If learners are not aware of their personal learning style, they are unlikely to be open to learning in new ways. By investigating learning styles, learners and educators increase awareness of learning strengths and weaknesses, which can empower learners to be aware of and take control of their learning.

In the series of research projects that encompass this thesis, I attempt to apply modern adult learning theory and its associated tools to evaluate identify indicators of how Illinois livestock producers may perceive, interact with, and respond to a particular learning and training environment. My long-term goal is to develop effective, evidence- and outcome-based educational programs that align with the needs and preferences of Illinois livestock farmers, and the expectations of the consumers that they serve. In the first project, I conducted a survey to help identify areas of strengths and weaknesses in knowledge, attitude, behavior and practice in antimicrobial usage in Illinois dairy producers. The importance of effective education and training programs has been increasingly emphasized as a key area of expansion for improving antimicrobial stewardship at all levels, and an understanding of the particular areas of error and omission in knowledge and behavior is needed before appropriate and effective training programs can be designed and implemented. The overall goal of the second project was to use established methodologies for evaluating adult learner profiles to identify previously uncharacterized attributes of livestock-based food producers, and to explore the role of these attributes in the effectiveness of learning and training programs designed for individuals in this sector. Based on observed behaviors in previous, traditional, face to face training programs, I hypothesized that Illinois livestock producers would strongly associate with active and pragmatic leaning styles. In addition, I postulated that individual learning styles would be influenced by specific producer demographics and would be correlated with personal engagement associated with on-farm employment.

## CHAPTER 2

### EVIDENCE IN SUPPORT OF VETERINARY INVOLVEMENT IN ANTIMICROBIAL STEWARDSHIP TRAINING PROGRAMS IN THE DAIRY INDUSTRY: A PRELIMINARY STUDY

#### 2.1 Abstract

The recent emergence of antimicrobial resistance has triggered initiatives aimed at conveying antimicrobial stewardship in human and veterinary medicine. The importance of effective education and training programs has been highlighted as a key area of expansion for championing judicious use of antimicrobial agents. In order to provide data that would aid in design of interventions encouraging prudent antimicrobial use, Illinois dairy farmers (n=20) were surveyed using a probability cluster sampling technique. Survey responses were analyzed and examined for significant trends based upon potential knowledge, attitudinal, and behavioral indices of antimicrobial stewardship. The key areas of training need that were identified from the survey responses include appropriate antimicrobial selection, the use of protocols, improved on-farm record keeping, and understanding of the factors that constitute extra-label drug use. The results from this pilot study highlight the need for antimicrobial stewardship training in this sector of the livestock industry and may be used to guide veterinarians in developing producer-focused education and training programs aimed at encouraging best practices surrounding the practical antimicrobial stewardship necessary to foster high health animal care systems.

## **2.2 Introduction**

The benefits of antimicrobial use to animal health, wellbeing and system efficiency are well established in modern intensive livestock production. However, the emergence of antimicrobial resistance is seen as an impending public health crisis, provoking numerous initiatives that encourage the prudent use of antimicrobials in both human and veterinary medicine (Belongia et al., 2005). Most of these initiatives recognize the multifactorial and complex ecology underlying the development of antimicrobial resistance, and have therefore recommended a multifaceted approach in developing risk reduction solutions (“National Action Plan for Combating Antibiotic-Resistant Bacteria,” 2015). Universally, these solutions highlight the need for a collaborative approach that incorporates the expansion of regulatory policy and process, surveillance, research, and innovation at local, national, and international levels. The importance of effective education and training programs has been increasingly emphasized as a key area of expansion for improving antimicrobial stewardship at all levels. The benefit of effective education and training programs in other aspects of agricultural productivity and efficiency has been recognized for many years. In the US, formal and structured adult farmer education programs can be traced back to the Morrill Land Grant Act, with a strategic expansion of targeted training after the First and Second World Wars (Niewolny & Lillard, 2010). In the recent US National Action Plan for Combating Antibiotic-Resistant Bacteria, a specific milestone to implement educational outreach efforts for veterinarians and animal producers was described (“National Action Plan for Combating Antibiotic-Resistant Bacteria,” 2015). In this paper, we describe a preliminary study that gathers evidence on current attitudes and behaviors regarding antimicrobial use by Illinois dairy producers. It is anticipated that the data collected and analyzed from this simple critical incidence survey can be used to guide the

future design of veterinarian-led, producer-focused, education and training programs aimed at advancing antimicrobial stewardship.

Antimicrobial stewardship encompasses a system of planning and implementing practices designed to appraise and improve the appropriate use of antimicrobials (Wagstrom, 2006). In livestock-based food production systems, antimicrobial stewardship is focused on providing a safe and affordable food product that assures and bolsters consumer confidence. The administration of antimicrobials, when needed, must be performed in line with Food and Drug Administration (FDA) regulations, ensuring that assigned time frames for withdrawal are followed (U.S Food and Drug Administration, 2002). In practical terms, regulatory compliance involves selection of an appropriate and approved antimicrobial for the relevant disease indication, administered at the correct dose, by the correct route, at the correct frequency, for the appropriate duration. While legally, the use of antimicrobials in food producing animals requires veterinary oversight, the majority of decisions regarding antimicrobial administration are being made by lay farm workers (Landers, Cohen, Thomas Wittum, & Larson, 2012; Raymond, Wohrle, & Call, 2006; Sawant, Sordillo, & Jayarao, 2005). Although there are numerous studies exploring the impact and effectiveness of antimicrobial stewardship programs in people (Goff, 2011; Khadem, Ashley, Wrobel, & Brown, 2012), the design and implementation of effective programs in specific livestock systems has only recently begun (“Food Armor,” 2016). The innovative Food Armor<sup>®</sup> initiative has highlighted several important areas of focus, including valid veterinary oversight, careful maintenance of complete records (drug lists and medical management), and the application of treatment protocols and standard operating procedures (“Food Armor,” 2016).

### **2.3 Materials and Methods**

To help identify areas of strengths and weaknesses in knowledge, attitude, behavior and practice in antimicrobial usage, we undertook a study using a probability cluster survey of dairy producers (n=20) at the 2013 Illinois State Fair. The sampling frame was State Fair attendance, and inclusion requirements were for the participants to be current Illinois-based dairy owners, or herd managers, on farms that shipped milk. There were no prerequisites for herd size, breed, conventional/organic status, or record keeping system. No participant identifying or geographic information was collected. The study was entirely opinion-based, with no consultation of farm records, and no participation incentives. The trained survey administrators (n=6) were DVM students, hospital interns, researchers, or faculty from the University of Illinois College of Veterinary Medicine.

Participation consisted of a multi-question, in-person interview that characterized potential knowledge, attitudinal, and behavioral indices of antimicrobial stewardship. These indices included (i) antimicrobial preference based on suspected disease, (ii) the maintenance of treatment records, (iii) the presence of diagnostic and treatment protocols for common diseases, (iv) the level of active veterinary involvement, (v) understanding of the concept and consequences of extra label drug use, (vi) familiarity with the concept of antimicrobial resistance. Data was aggregated and analyzed using an online survey-based data collection tool (SurveyMonkey<sup>®</sup><sub>1</sub>). Since the data was descriptive, no statistical analysis was performed.

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<sup>1</sup> SurveyMonkey<sup>®</sup> Inc. Palo Alto, CA USA



## **2.4 Results and Discussion**

Participants were questioned on their first line antimicrobial choices for seven common dairy cattle diseases including respiratory disease (calf or adult), diarrhea (calf), mastitis, lameness/hoof problems (adult), uterine (metritis/retained placenta), and umbilical infections (calf). Overall the most common, systemically administered antimicrobials used by Illinois dairy producers (% of respondents in brackets) were penicillin (100%), oxytetracycline (74%), ampicillin (67%), ceftiofur hydrochloride (67%), and florfenicol (58%). The preferred antimicrobial varied according to the suspected, diseased body system (% of respondents in brackets); calf respiratory (florfenicol 50%), calf diarrhea (enrofloxacin 33%, penicillin 33%), adult lameness (ceftiofur hydrochloride 38%), uterine infection (oxytetracycline 38%), umbilical infections (penicillin 100%), and mastitis (penicillin 45%). The incidence of adult respiratory disease and umbilical infections were low and so these categories were removed from further analyses.

The results of the preferential antimicrobial choices made by producers were further evaluated with a view to their compliance with FDA regulations (Table 2.1). Overall the majority of antimicrobials (61%, 33/54) were used in an extra-label fashion. In fact, respiratory disease was the only category in which 100% of drug choices were fully compliant with FDA regulations. An additional, and more noteworthy, concern was that a striking proportion of treatment choices (13%, 7/54) would be classified as illegal, particularly in cases of calf diarrhea. Interestingly, current literature suggests that antimicrobial therapy is not even warranted in most cases of calf enteric disease (G. Smith, 2015). While some of these suboptimal practices are likely related to health illiteracy on the part of some of the producers, difficulties also arise from flaws in the

pharmaceutical regulatory structure leading to a lack of approved therapies for some diseases. This means that veterinarians and producers are often required to make therapeutic decisions based on a very limited number of available products.

Additional insight regarding the high rate of regulatory non-compliance in this study population was provided by examining participant responses to questions regarding the concept of Extra Label Drug Usage (ELDU). Many producers were uncertain regarding specific elements of definition for ELDU. Only 50% of respondents were able to identify the criteria that constitute drug label restrictions, and only a modest average percentage of participants (46%) could correctly identify specific elements of ELDU risk. Approximately 45% of respondents could not identify any example of practices that would constitute the extra-label use of antimicrobials. A sizeable proportion of the study population (95%) demonstrated a superficial recognition of the relationship of ELDU between meat and milk withholding. For instance, 65% of respondents indicated that they would use an antimicrobial labelled only for beef cattle in an adult dairy cow being sent to slaughter. This implies a significant misunderstanding of the term “dairy” and “beef” cow, particularly with regard to a regulatory definition.

While appropriate drug selection and administration are important aspects of antimicrobial stewardship, the maintenance of accurate medical records and the enactment of appropriate Standard Operating Procedures (SOPs), and protocols, are also paramount (Food Armor, 2016), particularly in avoiding milk and meat antimicrobial residue violations (Federal Register 77, 2012). In this study population, only 15% of participants had written protocols for diagnosing disease, with another 25% stating that they had ‘implied’ protocols that were not written.

Interestingly, 21% of the producers surveyed did not keep written records of drug use, and of those that maintained data, only 19% used a computerized system. This was similar to the totals reported in other mid-west dairy studies (Zwald et al., 2004). Among producers who kept records, a large proportion were incomplete when compared to best practice (U.S Food and Drug Administration, 2002). While all of the respondents keeping records reported recording animal identification, treatment date, and name of drug used, a lower proportion recorded drug dose (67%), route of administration (13%), duration of therapy (40%), identity of the individual administering the drug (27%), and milk (40%) or meat (13%) withdrawal times. All of these are widely recognized as major risk factors in residue violations (Kaneene & Ahl, 1987; *New Animal Drugs; Cephalosporin Drugs; Extralabel animal Drug Use; Order of Prohibition, Final Rule*, 2012)

## **2.5 Conclusion**

It is interesting to consider how the absence of veterinary oversight may contribute to some of the suboptimal antimicrobial stewardship practices in this sector of the dairy industry. In this study, less than half of the producers (40%) sought regular veterinary input in to antimicrobial selection. Only 25% of producers reported seeking veterinary advice on ELDU on every occasion, with 75% contravening FDA prohibitions by never obtaining prescription or veterinary guidance before administering an antimicrobial in an ELDU manner (*New Animal Drugs; Cephalosporin Drugs; Extralabel animal Drug Use; Order of Prohibition, Final Rule*, 2012). Similar findings have been reported in other animal production sectors (Sawant et al., 2005).

Overall, this survey highlights several areas where intervention could have significant impact on antimicrobial stewardship in Illinois dairy producers. These areas include appropriate antimicrobial treatment selection, the use of protocols and SOPs, improved on-farm record keeping, and an understanding of the factors that constitute extra-label drug use. Antimicrobial treatment records, cautious extra label drug use, and adherence to consistent and legal treatment protocols are essential components of judicious antimicrobial use. Veterinarians are in an ideal position to assist their dairy clients in developing the type of effective and practical antimicrobial stewardship protocols necessary to foster high health animal care systems. This can be achieved by emphasizing management approaches that improve health, productivity and clinical outcomes, reduce the risk of drug residues, limit the selection of antimicrobial resistant bacterial strains, and increase compliance with regulatory mandates, while maximizing cost-benefits for the producer and confidence from the consumer.

## CHAPTER 3

### ILLINOIS LIVESTOCK PRODUCERS' LEARNING STYLES AND PREFERENCES

#### 3.1 Abstract

The agriculture sector has always recognized the need to provide its employees with continuing education and practical training that extends beyond the classroom. Historically, practical, research-based information from local land-grant institutions has been disseminated to agriculture producers throughout each state via Cooperative Extension specialists. In view of the changing demographics, and to ensure that education and training programs have the greatest impact, educational programs need to be constructed in a way that reaches and equips this existing population of workers. The result of providing producers access to scientific discoveries is widespread, from promoting environmental sustainability and encouraging judicious use of antibiotics, to ensuring animal welfare and discovering new economic opportunities.

While it is evident that adults learn different than children, little work has been done investigating the role of adult learning in the workplace, specifically in an agricultural setting. Literature suggests that adult engagement and motivation is directly related to perceived value of an educational experience. In attempt to understand more about the educational needs of Illinois livestock producers, a questionnaire regarding producer demographics, current methods or resources used for continuing education, level of engagement in their on-farm work environment, and learning style preferences was administered to 185 livestock producers by face-to-face interviews at the Illinois State Fair, as well as county fairs throughout Illinois. Survey responses were analyzed and examined for statistically significant responses based on gender, age,

educational status, size of operation, perceived level of employment engagement, and learning style. The results of this study demonstrated previously undocumented patterns of learning style among livestock producers indicating a preference for a combination of reflective and theoretic learning. In addition, demographic variables (age, education level, education lapse, engagement) were noted to be associated with learner preference. Understanding how to leverage this information to facilitate an atmosphere for effective adult learning is paramount for the transfer of information to improve on-farm livestock practices.

### **3.2 Introduction**

The global population is expected to surpass nine billion people by the year 2050 (“FAO - News Article: 2050: A third more mouths to feed,” 2009). Education and training help livestock producers incorporate the latest advances in science and technology into their day to day operations, and will be vital in meeting the food production needs of this massive population. Historically, practical, research-based information from local land-grant institutions has been disseminated to agriculture producers throughout each state via Cooperative Extension specialists (National Institute of Food and Agriculture, n.d.). However, over time, the number and accessibility of agriculture specific Extension specialists has declined, likely due to consolidation of traditional, small scale family farms and decreasing availability of federal resources. Despite the diminishing role of Extension specialists in agriculture, the importance of education within the industry still remains paramount. While there still is a wide variety of extension and education programs available (“University of Illinois Extension,” 2016), it appears much of the content is developed and delivered without regard to producers’ characteristics, such as learning style preference. In addition, the vast majority of these materials seem to be aimed at

attracting a new generation of workers into the livestock sector, overlooking the need to upskill the current employees, in order to help them maneuver through the ever-changing landscape of the industry.

Just as the science of agriculture production has changed over time to accommodate use of current technologies to promote efficiencies and sustainability of the industry, the science of learning has also advanced. Educational methods, such as learning style evaluations and outcomes based learning, have been established, which allow for improved educational outcomes by understanding more about the learner. When strategizing about teaching and learning opportunities in the workplace, it is important for the educator to understand the dynamics of the learner population of interest. This includes demographics, prior experiences, and learning styles along with preferred methods of communication.

The study of learning styles has been employed by educators to help understand how learning best takes place on an individual basis. A learning style, in general terms, is a combination of cognitive, affective, and psychological factors that determines how an individual perceives, interacts with, and responds to a particular learning environment (Felder & Brent, 2005).

Various learning style instruments (LSI) have been created over time that attempt to capture and categorize learner attributes in order to assist with this process (Table 1.1). The Honey and Mumford Learning Style Questionnaire (LSQ) was created in 1982, when researchers acknowledged a void in LSIs that were usable for adult learners in the workplace (Van Zwanenberg et al., 2000). Honey and Mumford modeled their LSQ after an LSI developed by David Kolb, a prominent researcher in the field. Like Kolb, they agreed that learning is a four

part process, but rather than focusing on abstract concepts, Honey and Mumford chose to focus their LSQ on real-life work activities (Mumford & Honey, 1992). The two researchers acknowledged that adult learners naturally choose a single preferred style of learning when they are engaged in a particular learning activity, but are likely to utilize different styles of learning depending on the situation and on their prior experiences (Van Zwanenberg et al., 2000). Using this information, a learning styles model was created, that allowed for a learner's movement between the four modes of learning (Activist, Reflector, Theorist, Pragmatist) (Mumford & Honey, 1992). The original Honey and Mumford LSQ is comprised of 80 single statement items to which the respondent either agrees or disagrees. There are 20 questions associated with each mode of learning, and the overall scores are determined by summing positive responses to each item (Van Zwanenberg et al., 2000). The category that receives the most positive responses is deemed as the learner's primary learning style. The original LSQ has been adapted over time to allow for shortened versions.

In addition to understanding learning style preferences, there has been a significant interest in defining other parameters that can be combined in to a learner profile and that can be ultimately employed in the development and delivery of effective training material. For instance, an evaluation of an individual's satisfaction with their job has been reported to be highly associated with their engagement in work-related learning activities. Dr. George Gallup, a prominent researcher in human needs and satisfaction was the first researcher to report the correlation of job satisfaction with work effectiveness in the 1930s, and his work has been confirmed by many investigators since then (Judge, Thoresen, Bono, & Patton, 2001). The combination of many research studies and meta-analyses on this topic, has led to the development of a powerful and



reliable instrument to measure employee engagement, Gallup's Q<sup>12</sup> (Table 3.1) (Marzano & Road, 1998). The Q<sup>12</sup> is a series of twelve questions that analyses a specific set of respondent perceptions that have been demonstrated to be reliably predictive of attitudinal outcomes such as satisfaction, pride, etc. It is well documented that the profile produced by this combination of questions reliably correlates employee attitude to the following outcome measures: employee retention, productivity, customer satisfaction, safety, and profitability (Gallup, 2010). To date, this instrument has been administered to more than 7 million employees in 112 countries, and has been evaluated with a large meta-analysis performed across more than 600,000 employees in 125 companies. In combination, these studies have calculated the reliability of this approach to be ~0.88 (Harter et al., n.d.), which means that the validity of results of studies using this methodology, are highly repeatable, and can be assumed to be generalizable.

Despite the availability of a large number of diverse, reliable and valid tools for measuring and characterizing attributes in adult learner populations, there are few studies that have applied these techniques to livestock producers. The overall goal of this project is to use established methodologies for evaluating adult learner profiles to identify previously uncharacterized attributes of livestock-based food producers, and to explore the role of these attributes in the effectiveness of learning and training programs designed for individuals in this sector. Based on observed behaviors in previous, traditional, face to face training programs, we hypothesize that Illinois livestock producers will strongly associate with active and pragmatic leaning styles. In addition, we postulate that individual learning styles will be influenced by specific producer demographics and will be correlated with personal engagement associated with on-farm employment.

### **3.3 Materials and Methods**

A qualitative research method was used, alongside purposive sampling, to identify county fairs throughout Illinois where there were likely to be a high number of livestock producers present. These sampling cohorts were identified by reference to historical livestock entry numbers produced by each county fair district. An effort was made to locate county fairs in multiple and disparate regions of Illinois, in order to produce a data set that would represent producer preferences throughout the state. Surveys were conducted face to face, by trained interviewers, at four county fairs throughout the state (Champaign, McHenry, Monroe, and Vermilion counties) as well as at the State Fair in Springfield, IL. Inclusion criteria for the survey consisted of adults over the age of 18 who owned livestock, or adults who were employed by livestock producers. Response to the survey was voluntary and each participant completed informed consent documents prior to administration of the survey. Participant confidentiality was protected in compliance with the University of Illinois Institutional Review Board (IRB #: 16034)

The survey contained questions related to producer demographics (Table 3.2), preferred methods of receiving information pertaining to livestock production (Table 3.2), as well as Gallup's Q<sup>12</sup> employee engagement questionnaire (Table 3.1) to evaluate job satisfaction as it relates to livestock production. In addition, an abbreviated, 20 question version of Honey and Mumford's LSQ was administered to determine the producers' learning style preference (Table 3.3). This particular LSI was selected because of its low cost and ease of use and interpretation of results. Additionally, the Honey and Mumford LSQ was developed around real work activities, which enhances its use for practical application in the workplace.

The multiple survey approach generated layers of data that was analyzed statistically to identify significant relationships between learning style profile, learner demographic features and work engagement. The surveys yielded continuous (e.g. educational lapse), nominal (categorical; e.g. producer's role, enterprise diversity) and scalar (e.g. level of agreement with a statement, such as learning resource preference) independent data. For the continuous variables, the weakly associated outliers were removed to create a normally distributed data set. A MANOVA test was performed to determine if the groups, as described by the categorical, independent variables, differed in their learning styles. The relationships between learning style and independent variables, including age, highest level of education achieved, length of education lapse, and employment engagement were evaluated using Pearson's correlation coefficient. (Table 3.4). A significance value of  $P < 0.05$  was used to identify statistical significance. The frequency of learning style preferences were visualized using a principle coordinate analysis (Figure 3.1).

### **3.4 Results**

#### ***3.4.1 Demographics***

The survey yielded data on 185 livestock producers (114 males, 71 females) from across the dairy (6.5%), beef (53%), small ruminant (32%), and swine (40%) production sectors, with some respondents being involved in more than one enterprise.

The age distribution of respondents showed a bell-shaped curve centered on 45-50 years, and ranged from 18 to >71 years (Figure 3.2). Survey participants universally articulated their participation on the farm as multi-functional, which prevented us from allocating and evaluating

the effect of concrete role categories (e.g. laborers, animal health care providers, or financial decision makers) on learning style.

### ***3.4.2 Education***

All participants completed some level of schooling. Twenty six percent (n=49) of survey respondents completed high school as their highest level of formal education, and an additional 57% (n=105) reported holding post-secondary degrees (Figure 3.3). Forty-two (23%) individuals indicated a time lapse of less than 5 years since their last formal education, and 30 (16%) participants had not received formal training in 20-25 years. The educational hiatus for the remainder of the population (n= 133) were evenly distributed (Figure 3.4).

### ***3.4.3 Enterprise Diversity***

The livestock composition and commercial activities of the surveyed producers was extremely diverse, and ranged from enterprises with a small number of show pigs to those that possessed more than 1200 beef cow-calf pairs intended solely for production purposes. Some producers reported diverse populations of livestock on their premises, while others indicated a single species focus. All major livestock species were represented in this survey cohort, and while beef cattle and swine were most common, there was no single, dominant production sector. Because many Illinois farm operations are small, and have diversified their commodity portfolios, questions regarding allied, arable enterprises were included in the survey. Approximately two thirds (n=142/183) of the respondents indicated that they either did not row crop, or farmed less than 1500 acres of crops in conjunction with raising livestock. The balance of the population (n=41/183), was heavily involved in crop production, farming more than 1,500 acres of land.

#### ***3.4.4 Information Source Preferences***

In order to understand current trends in self-education and training, survey participants were asked to select methods and frequency of information dissemination that were currently being used to receive education or training in production related topics (Table 3.5). While all of the respondents employed multiple information sources, some formats were used more commonly than others. For instance, survey participants described utilizing fellow producers (47%), magazines (42%), veterinarians (42%), and internet articles (40%) most frequently. Methods of communication that were less commonly used included internet chat forums, continuing education classes, and attendance at focus groups such as Cattleman's Association.

#### ***3.4.5 Gallup's Q<sup>12</sup> employee engagement questionnaire***

Participants were also provided with Gallup's Q<sup>12</sup> employee engagement questionnaire (Table 3.1). Overall, responses to the engagement questionnaire indicated positive affirmations to 8/12 of the questions, suggesting a moderate level of employee engagement across the survey population. Individual questions that had notably high positive response rates included:

1. Knowing what is expected of you at the farm (97%, n=179)
2. Having access to materials and equipment on the farm to do your work correctly (90%, n=167)
3. Having the opportunity on the farm to do what you do best every day (84%, n=155)
4. Someone on the farm seems to care about you as a person (89%, n=165)
5. On farm, my opinions seem to count (90%, n=166)
6. The purpose of the farm makes you feel that your job is important (94%, n=173)
7. Other employees on the farm are committed to doing quality work (80%, n=146)

8. In the last year, the farm has provided opportunities to learn and grow (90%, n=166)

#### ***3.4.6 Overall distribution of Learning Styles across the livestock producer population***

A shortened version of Honey and Mumford's LSQ was administered to collect information about individual learning styles. The frequency of each learning style across the population was visualized using a Principle Coordinate Analysis (PCA) map (Figure 3.1).

Of the 185 livestock producers surveyed, the majority of participant scores (45%, n=84) indicated a preference for a combination of reflective and theoretic learning styles (Table 3.6; Figure 3.1). In addition, 43 (23%) strongly identified with theoretic learning and 13 (7%) conveyed a preference for reflective learning. Surprisingly, only 2 individuals aligned with an active learning style, 5 preferred a combination of active and pragmatic, and 7 identified themselves as preferring to learn through a combination of active and reflective techniques (Table 3.6). Lastly, results of the LSQ designated 9 respondents as likely to favor pragmatic learning styles, with an additional 18 (10%) that desire a combination of pragmatic and theoretic learning methods (Table 3.6). Four individuals scored very evenly on the LSQ, indicating the likelihood of being a universal learner and having the capability to easily switch between learning styles.

Out of the 20 questions in the LSQ, the following questions had similar responses from multiple respondents:

1. I take pride in doing a thorough job (99% yes, n= 183)

2. I get along best with logical, analytical people and less well with spontaneous, irrational people (84% yes, n=155)
3. I prefer discussions that get straight to the point (95% yes, n=176)
4. Similarly, equal numbers of participants said that they think that decisions made on a thorough analysis of all the information are more sound than those based on intuition (82% yes, n=151)
5. I often see better, more practical ways to get things done (88% yes, n=162)
6. I often find that I am the realist in discussions, keeping people to the point and avoiding wild speculations (83% - yes, n=154)
7. I believe it's best to think carefully before taking action (96% - yes, n=178)
8. I often act without considering the possible consequences (85% no, n=157) of the survey population responded no.
9. I am attracted to novel or unusual ideas over those ideas that seem practical (84% no, n=155)
10. I jump to conclusions quickly (82% no, n=151)

### ***3.4.7 Relationship of producer demographics with learning style***

A MANOVA test was performed to determine if producer sub-groups, as defined by the categorical, independent variables, differed in their learning style (table 3.7). Of all the categorical variables, only farm size (less than or equal to 1499 acres versus greater than 1500 acres) showed a statistically significant association ( $p=0.0289$ ) with learning style in this adult learner population. In view of their size, and the demographics of Illinois farms, these are likely to be the farms in which row crops (corn or beans) are a substantial part of farm income. Other

variables such as gender (male/female), and enterprise diversity (e.g. single vs multiple species) were not significantly associated with learning style in this population.

The relationships between Honey and Mumford-defined learning style (Activist, Theorist, Reflector, Pragmatist) and the continuous, independent demographics descriptors of the livestock producers (including age, highest level of education achieved, length of education lapse, and employment engagement) were evaluated using Pearson's correlation coefficient. In this population of adult learners, educational level was negatively correlated with an activist learning style ( $P= 0.011$ ). In addition, age ( $P = 0.044$ ) and educational lapse ( $P= 0.011$ ) were negatively correlated with a pragmatic learning style. In other words, the older producers, and those with a longer hiatus since their last formal education, were less likely to demonstrate a pragmatic learning style. In addition, the individuals with less schooling were more likely to exhibit an active learning style. While, not statically significant, work engagement was positively correlated with a reflective learning style ( $P=0.063$ ).

### **3.5 Discussion**

The global population is expected to surpass nine billion people by the year 2050, and US agriculture is likely to play an important role in maintaining a safe and secure food production system for this population. This will likely be achieved through evolving technologies, and the equipping of skilled workers to help increase productivity and social capital. The role of education and training in optimizing the efficiency and effectiveness of the food production system has been established for many years. In view of the growing demands on animal agriculture over the next decade, along with the rapidly changing technological landscape, and



the resultant imperative for lifelong learning in the food animal production job sector, the development of evidence based teaching and training programs is essential.

The overall goal of this project was to apply established adult learning tools and theories to identify previously uncharacterized attributes of mature learners currently employed in the Illinois livestock-based food production sector, and to explore the role of these attributes in the potential effectiveness of learning and training programs. The results of this study demonstrated previously undocumented patterns of learning style among livestock producers indicating a preference for a combination of reflective and theoretic learning. While some study participants identified with other learning styles, these were the exception rather than the rule. In addition, our results indicate that demographic variables such as size of farm enterprise, age, level of formal education, and lapse in education were in some way associated with learner preference. While not explored in this project, it is likely that these differences and their associations could be important factors in determining learner receptivity and the effectiveness of training program delivery in achieving the acquisition of desired educational outcomes.

Survey-based research is notoriously difficult, and one of the challenges of this project was to identify a cohort of livestock producers that were representative of the Illinois livestock sector, and from which broader conclusions regarding the national farming population could be made. Our survey population was defined by evaluating historical livestock entry numbers at county fairs throughout the state. Intuitively, this could be seen as a study flaw, since the population could be viewed as skewed towards the livestock show industry and away from commercial production. Despite the fact that county and state shows are commonly attended by a wide

variety of livestock producers in the Midwest, to ensure an appropriate representation of Illinois livestock production, the demographics of this study population were carefully evaluated.

The proportion of male versus female in our study (114 :71) was similar to that reported (70:30) on the Agriculture Census in 2012 (“USDA - NASS, Census of Agriculture - Publications - 2012 - Highlights,” n.d.) . Furthermore, the average age of our survey respondents (45-50 years old) was similar, albeit slightly younger, than the reported overall average age of Illinois farmers (58.3 years). Interestingly, the age of Illinois farmers has continued to rise over the last 30 years (“USDA - NASS, Census of Agriculture - Publications - 2012 - Highlights,” n.d.), which is likely to have a profound impact on the future of farming. The size and type of farm represented in our study showed similar alignment with state and national data averages, and could be characterized as small, diversified livestock enterprises consisting of a blend of show and/or commercial animals. The number of farmers (23%) engaged in extensive row cropping (>1500 acres) in conjunction with raising livestock, was also comparable with national data which classifies 88% of crop and livestock enterprises in the US as small farms. (“2012 Census of Agriculture Small Farms Fact Sheet,” 2016). Interestingly the same census reveals that the majority of US cattle feeding enterprises are very small, with large feedlots (more than 1,000 head of cattle) comprising less than five percent of all cattle feeding units (“USDA ERS - Cattle and Beef Background,” 2017).

This combination of demographic data paints a rich picture of the production animal farming landscape in Illinois, one composed of a large number of older farmers engaged in small livestock enterprises. This picture, in turn, implies a lifestyle driven by tradition and family ties

rather than commercial gain. Once again, this is analogous and compatible with published US national farmer characteristics, which show that while 76% of principle operators live on the farm, less than 25% of household income comes from farming, with 61% of operators occasionally working off the farm and 52.2% holding a primary occupation other than farming (“2012 Census of Agriculture Small Farms Fact Sheet,” 2016) .

This culture of small-scale family farm based livestock production described by the producer demographics was also evident in the results of the engagement survey in which participants indicated a highly favorable level of engagement with their on-farm job responsibilities. This finding is important, as it has been previously demonstrated that work engagement is positively correlated to active learning (Bakker, Demerouti, & Ten Brummelhuis, 2012). In addition, others have indicated that engaged employees are better equipped to build their personal resources and perform well in their job (Demerouti & Cropanzano, 2010). It would seem that the combination of small farm culture and high engagement would provide a strong platform for openness and receptivity of towards education and training in relevant work-based topics.

In view of the increasing age and part-time vocational nature of Illinois farmers in this study, the educational background of this survey population of producers was also explored. Historically, many farmers were not afforded the opportunity to attend college for a variety of reasons. However, since 1983, the number of farmers who have received a college degree has increased by over 50% (Ilg, 1995). This trend towards more frequent and accessible education was mirrored in our study, as 57% of those surveyed reported holding post-secondary degrees. In view of the maturity and high engagement of this adult population, we expected a large

proportion of the farmers to have participated in recent educational activities. Surprisingly, only one-third of participants had been involved with some type of formal education in the last 15 years, and more than 50% of respondents indicated an educational lapse of greater than 20 years. In combination, this data provides strong evidence for the need of additional effective education programs to inform and upskill this important cohort of livestock producers.

Once the need for additional work-relevant training for Illinois livestock producers was evident from the demographic and educational data described above, the optimal means and mode of content access and presentation for this learner population was explored by looking at resource preference and learner styles in the survey participants. Understanding the preferred methods of access or receipt of educational materials by an audience is vital to the development and delivery of appropriate training resources (Miller, 2001). Previous studies have shown that agricultural producers' preferences for receiving information depend on a variety of demographic features such as age, income, level of formal education achieved, and farm size (Iddings & Apps, 1992). In this study, producers indicated a tendency to access information from multiple sources, including farming colleagues, veterinarians, magazines, and internet articles. While the first three of these can be viewed as long-standing, traditional and reliable methods of acquiring beneficial information, the use of the internet for 'on demand' education is a relatively recent advance. The use of technology in learning is actually becoming quite commonplace, even in rural communities, as 70% of principle farm operators have access to the internet ("USDA - NASS, Census of Agriculture - Publications - 2012 - Highlights," n.d.). As educators continue to construct training platforms, technology will likely play a larger role in reaching more people with fewer resources (Mirando et al., 2012). According to a survey of beef cattle and peanut

farmers, higher levels of education are related to earlier adoption of technology (Hall, Dunkelberger, Ferreira, Prevatt, & Martin, 2003). However, results of our study support the findings of other investigators (Vergot III, Isreal, & Mayo, 2005) and highlight the importance of more traditional methods of program delivery, in combination with developing technology-based resources, for achieving optimal learning outcomes, particularly in the context of the unique pattern of learning styles in this adult population.

A learning style is a concept derived from psychology that describes the way people process and remember information (Biggs, 2001; Brown, 1998), or an individual's characteristic approach in handling new knowledge, and their tendency towards specific emotions and behaviors during the learning process (Smith & Renzulli, 1984). Learning styles have also been referred to as 'a particular set of behaviors and attitudes related to the learning context' and 'the cognitive, affective, and physiological factors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment' (Swanson, 1995). There has been a widespread effort by educational psychologists to categorize learning styles. Kolb identified four basic learning styles (Diverging, Assimilating, Converging, Accommodating), which he believes are shaped by a learner's personality, educational specialization, professional career, current job role, and adaptive competencies (D. A. Kolb & Kolb, 2016). In 1982, Anthony Gregorc developed The Gregorc Style Delineator, which is based on "phenomenological research [that] identifies the three levels of existence: the essence/spirit of something, the nature of the driving forces that emanate from it, and the outer appearance, characteristics, behaviors and mannerisms that are the signatures of the spirit and invisible driving forces" (A. Gregorc, 2016). Honey and Mumford believed that people prefer different

styles of learning depending on the situation and on their prior experiences, so they created a learning styles model that allowed for movement in between their four modes of learning and developed a learning style questionnaire (LSQ) which was used to characterize the livestock producers in this study.

The LSQ provided assessment of Honey and Mumford's four learning styles (Activist, Theorist, Reflector, Pragmatist). This method characterizes theorists as perfectionists who like to analyze and synthesize information using rationality and logic to think problems through with a logical, step-by-step, manner. Their approach to problems is centered on the question "Does it make sense?" Theoretic learners prefer to maximize certainty and often feel uncomfortable with subjective judgements. Individuals who strongly associate with an activist style of learning are generally gregarious, open-minded people that tend to abide by the philosophy of "I'll try anything once". They tend to act first and consider the consequences afterwards. These type of learners often tackle problems by brainstorming and thrive on the challenge of new experiences, but are bored with implementation. This is in contrast to reflective learners, who prefer to stand back and observe experiences. These learners are cautious and thoughtful individuals who desire collecting and analyzing data thoroughly from all angles before coming to a conclusion. In group situations, reflective learners tend to sit back and observe others in action. The last category of learner that Honey and Mumford describe are pragmatists. Adult learners who are classified as pragmatists are generally interested in trying out new ideas to see if they work in practice. These individuals act quickly and confidently on ideas that attract them and tend to be impatient with open-ended discussions. They are essentially down-to-earth people who like

making practical decisions and solving problems. Their philosophy is: “There is always a better way,” and “if it works, it’s good.”

As with any group of learners, there was not a universal learning style present amongst the diverse population of livestock producers represented in our data set. A large portion of the Illinois livestock producers surveyed indicated a preference for learning styles that combined reflective and theoretic attributes. This categorization would imply that a significant proportion of this population are logical thinkers, and are thorough and methodical when assimilating information. It would also suggest that they are likely to have a disciplined approach to most activities. This approach would prevent them from jumping to conclusions prematurely, would imply that their behavior would likely be assertive or direct. It would also suggest that they may have a tendency to be flustered by uncertainty and ambiguity, leading to cautious tendencies and decision-making.

As stated earlier, an understanding of learning style is a means of predicting how an individual, or population of learners, might ‘perceive, interact with, and respond to a specific learning environment’. Our long-term goal in characterizing Illinois livestock producer learning styles, is to provide a framework of evidence that can be used to inform the design of new teaching and learning platforms. It is anticipated that this model can help educators deliver engaging and effective training experiences that will ultimately impact practice and behavior for improved and sustainable food production in the livestock-based food production landscape.

With regard to educational program design, it was interesting to find that many of the producers in this study exhibited a theoretic-reflective learner style. This observation would support the notion that they would learn best in structured learning environments with a focused purpose, by observing others (e.g. lecture or videos), by thoughtful preparation prior to attending an educational session (e.g. by reading), or in which they were allowed to perform research or investigation (e.g. case studies). This cohort of learners would also likely be interested in ideas and concepts and enjoy exploring associations, particularly through opportunities to question and understand the logic underlying a particular topic (e.g. Q & A sessions).

The propensity towards distinct patterns of learning style in this population of livestock producers was marked and unequivocal, and was clearly linked to specific demographic descriptors (including age, highest level of education achieved, length of education lapse, and employment engagement). We hypothesize that age and educational parameters were correlated with learning style because of the experiences that older individuals had likely encountered during their life. Over time, in combination with background, education, and prior experiences, adults tend to become self-reliant, which in turn, guides their learning preferences. In addition, the science of learning continues to evolve over time, creating new educational approaches which are likely to play a role in shaping their learning style preferences.

Under the demands of expanded livestock production over time, the industry can be viewed as having evolved in to a two-tiered system, broadly categorized as (i) small, traditionally managed family farms, and (ii) large, integrated production systems. These two tiers can be differentiated in terms of work culture and environment, by having distinct approaches to management and



decision making, and disparate views on technology, production efficiency and staff development. For instance, many of the large scale, corporate agriculture stakeholders have recognized the importance of educational resources and have worked to incorporate robust training and continuing education programs in to their companies (e.g. Beef Quality and Pork Quality Assurance programs). These programs have been created to help standardize best practices and optimize management techniques in order to raise consumer confidence (“Beef Quality Assurance,” n.d.). It would be unusual for small-scale, owner-operator units to demonstrate a similar commitment to the adoption and implementation of similar training on a regular basis. In recognition of the reality of this two-tiered system in the livestock industry we attempted to use our data set to understand how potential influences, such as workplace culture, employer expectations, previous exposure to workplace training, may influence learning style patterns. While we did not include specific questions on these topics in our survey, we tried to use several categorical variables (gender, farm size, enterprise diversity) that could influence and differentiate the farms by ‘work culture’ or ‘work environment’. Unfortunately this could only be accomplished to a limited degree in this study, but the data does seem to provide an initial insight in to some of the potential and alternative determinants of learning style.

In our evaluation of ‘work culture’, only a single subgroup of demographic descriptors, namely farm size (>1500 acres), was associated with statistically significant differences in operator learning styles. It would seem that the parameter of farm size, while simple, could be a robust indicator of operational and cultural differences in an Illinois livestock enterprise, and supports the notion that learning style is associated with different management approaches. For example, 50% of those who are work in agriculture consider it an ancillary career and 70% of principle

operators disclose that less than 25% of their household income comes from farming (“USDA - NASS, Census of Agriculture - Publications - 2012 - Highlights,” n.d.). This contrasts with those involved in large-scale agriculture operations, who often do so as a primary occupation, providing a sole source of income to their households. In Illinois, these large farm operations are unlikely to be specialized livestock enterprises, but are almost certainly associated with intensive row crop (corn or soybean) production. These large, vertically integrated crop-producing enterprises are likely to employ more advanced technology in their agronomical production systems and will invariably promote efficiency as a priority. It is logical to assume that they would adopt a similar management style, focused on technology and efficiency, to their livestock endeavors. Additional studies are required to substantiate the hypothesis that farm culture is strongly associated with different learning styles. This could be achieved in a prospective study applying similar tools to the ones described in this project to evaluate learning styles between large, vertically integrated, livestock operations (e.g. swine and poultry) and more diverse population of small, family farms. This information would be particularly useful in designing training programs that are individualized based on farm culture.

It is evident from the observed differences in learning style between ‘sub-groups’ of producers, that there is unlikely to be a ‘one style fits all’ approach to teaching and learning in this population of adult learners. For example, older individuals, and those with a longer lapse in educational activities, were identified as less pragmatic than others within the population. Perhaps these producers would benefit most from learning activities that offer opportunities to sit back, observe, reflect, and plan. This would be in marked contrast to younger livestock producers, or those with less concrete, formal, educational experiences, who demonstrated a

more active approach to learning. The latter population of adult learners would presumably benefit more from participating in practical, problem-solving type activities, in which the trainers demonstrated new approaches, and during which the participants were able to brainstorm novel solutions. If both types of learner (identified by their demographic descriptors) were present, then a multimodal-delivery format would be preferable and probably more effective.

In summary, this study has shown that while Illinois livestock producers are largely theoretical and reflective learners, there are a range of different learning styles related to personal demographics and farm culture. At the present time, we understand that this discovery of differences in learning style has significant implications for the teaching and learning of adults involved in different sectors of agriculture. Future studies are needed in order to investigate how the learning styles differ between these specific populations and to explore how the alignment of educational practice can incorporate the considerations of these differences in learning style.

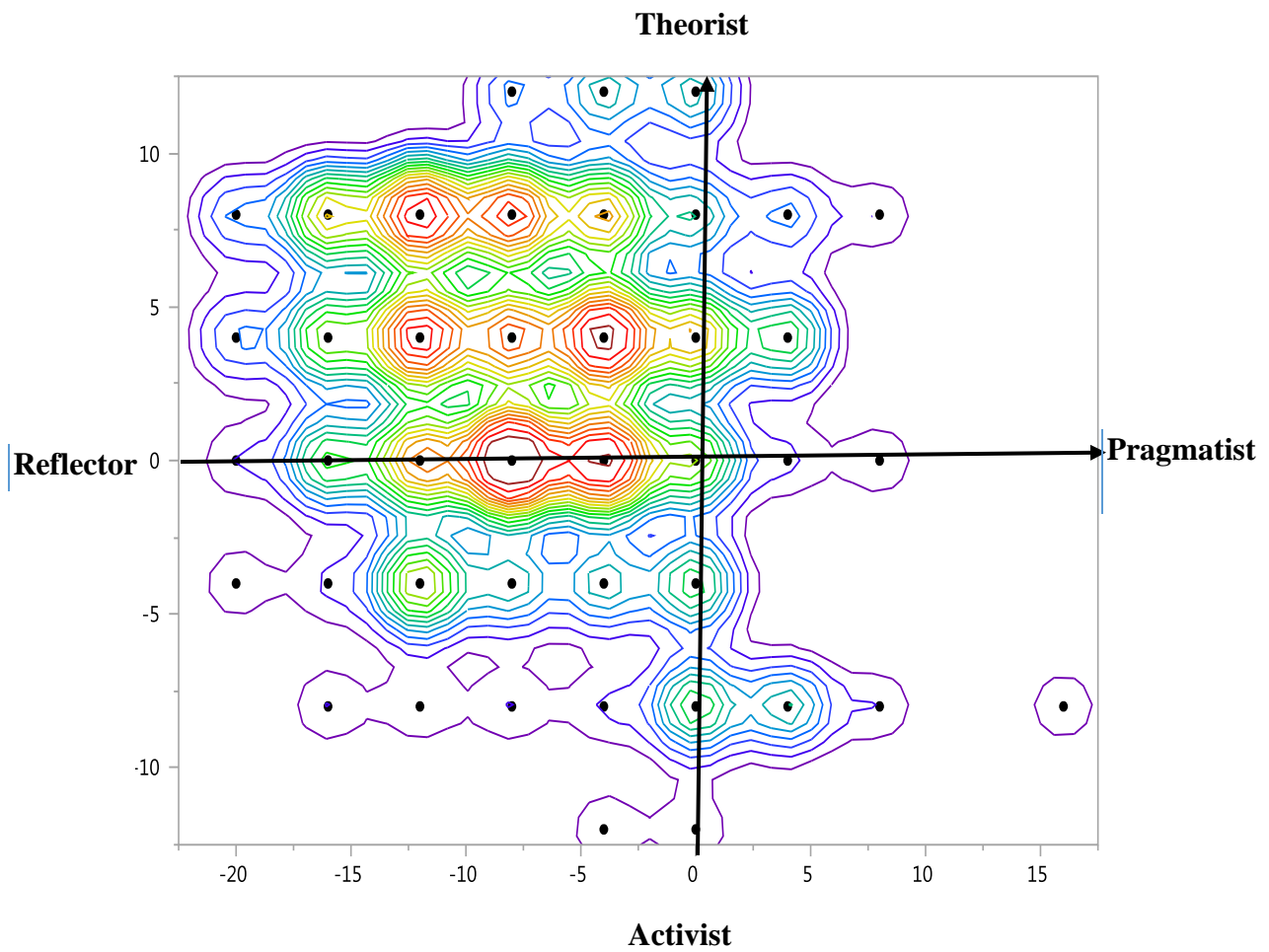
### **3.6 Conclusion**

Overall, livestock producers in Illinois are a dynamic group of individuals with a broad range of educational backgrounds and learning styles that have been uniquely shaped, in part, by existing knowledge and previous experiences. The preferred learning style of farmers in this study is reflector/theorist. This category of learners relate best through educational opportunities that allow them to listen and observe rather than demonstrate and practice. This study also demonstrated that the learning styles varies between sub-populations defined by demographic features (age, educational level, education lapse, engagement), and that farm size, probably reflective of farm culture, is associated with differences in learning style. For educational

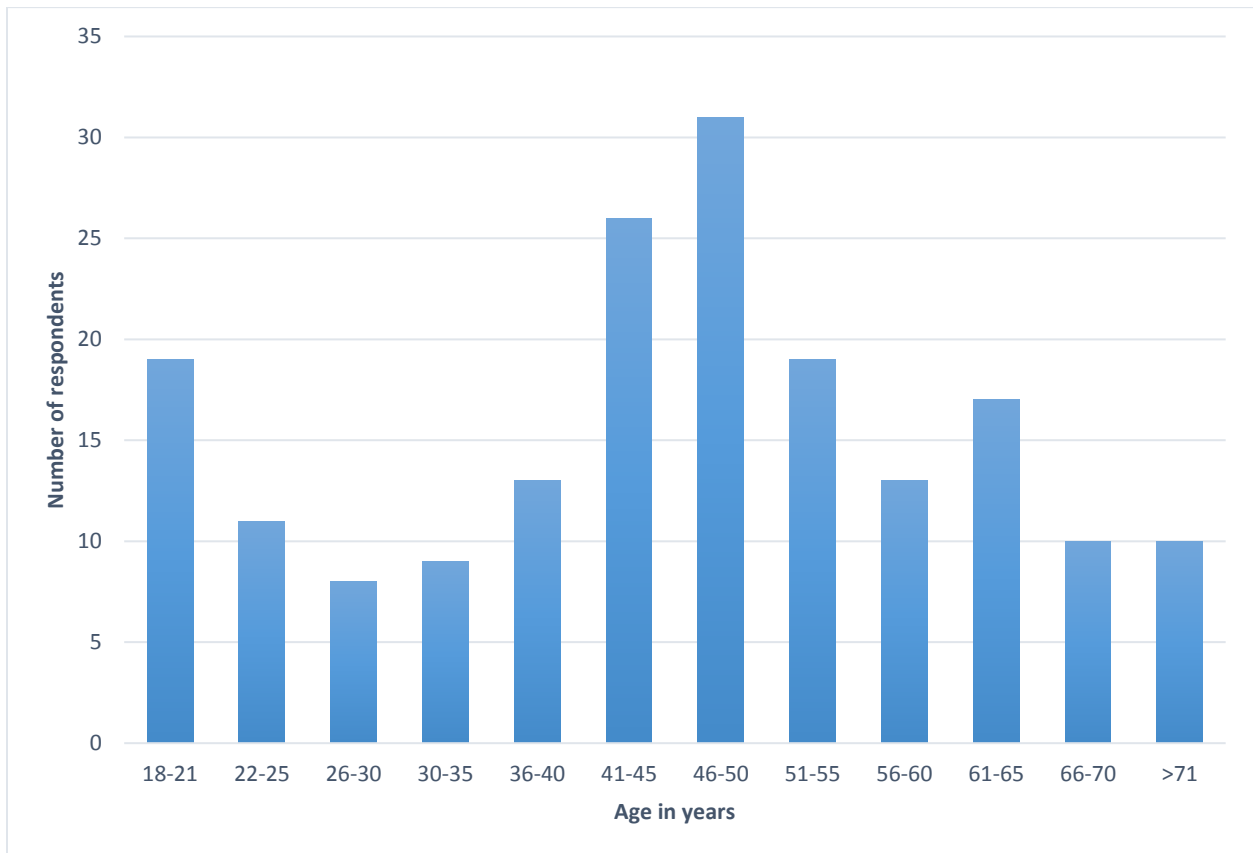
programs centered on adults in the workplace to be effective, presentation and learning experiences must be differentiated based upon the learning styles of the participants (Baker, Hoover, & Rudd, 1998). Understanding how to leverage this resource and facilitate an atmosphere for effective adult learning is paramount for the transfer of information to improve on-farm livestock practices. Future studies are needed to examine the impact of these differences in adult learning styles on the design and delivery of effective training programs in the livestock production sector.

## FIGURES AND TABLES

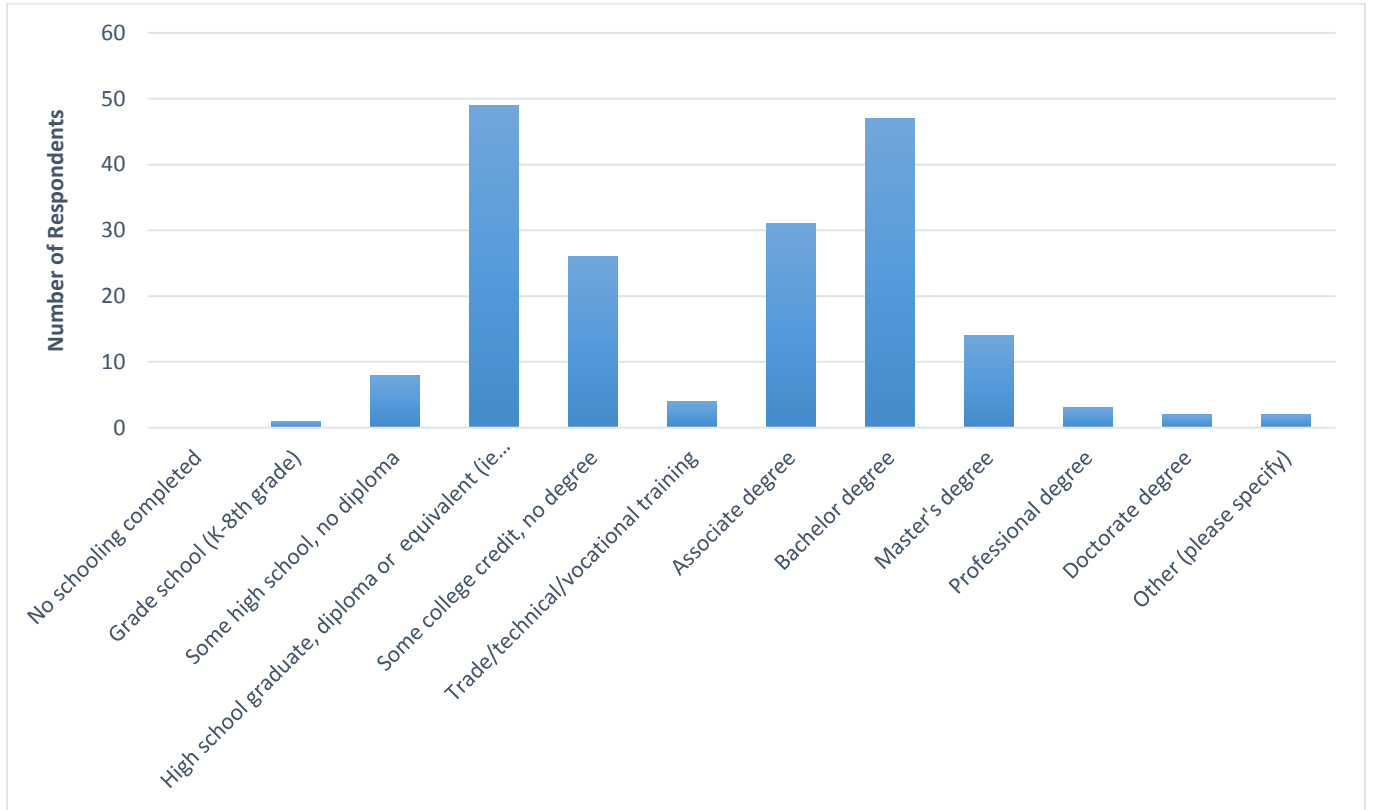
**Figure 3.1: Principle Coordinate Analysis Map of Livestock Producers' Learning Style Preference** quantifies the population at each data point on the graph. The more intense the color (e.g. red), the more respondents at that point. The results of the LSQ indicate that Illinois livestock producers primarily identify with a combination of reflective and theoretic learning styles



**Figure 3.2: Age of Surveyed Livestock Producers in Illinois:** The age distribution of survey respondents (n=185) shows a bell-shaped curve centered on 45-50 years, and ranging from 18 to >71 years of age.

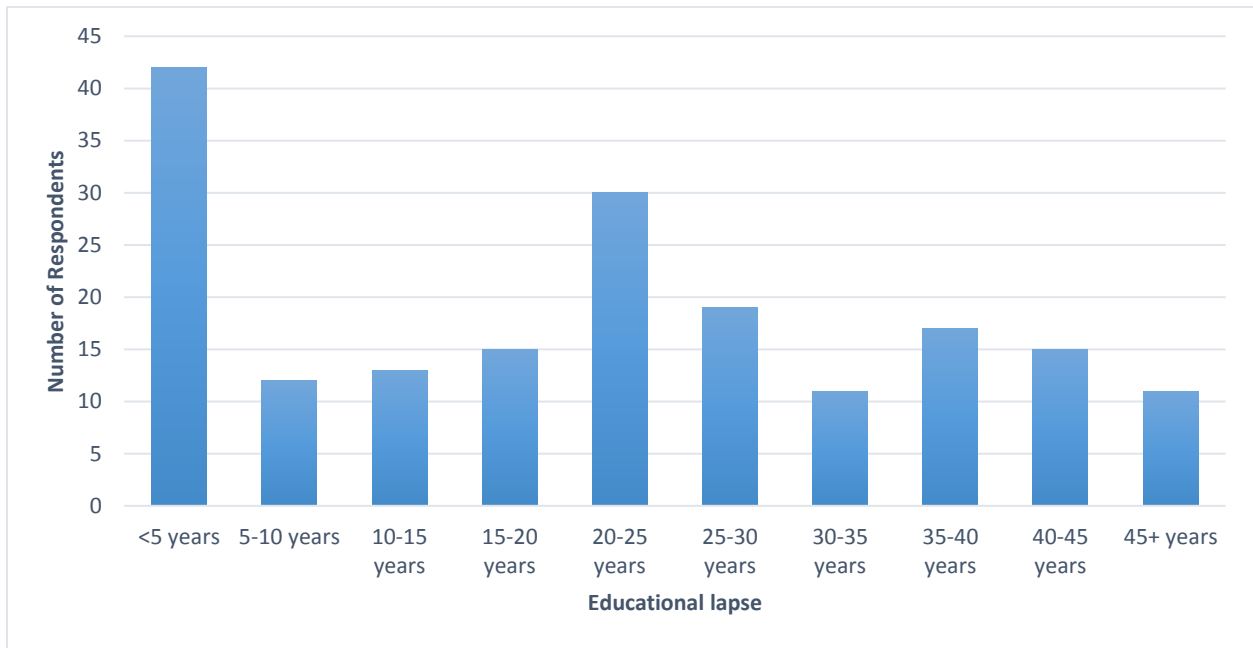


**Figure 3.3: Highest Education Level Achieved by Surveyed Livestock Producers in Illinois**  
 All participants (n=185) completed some level of schooling. Twenty six percent (n=49) of survey respondents completed high school as their highest level of formal education, and an additional 57% (n=105) reported holding post-secondary degrees.



**Figure 3.4: Lapse in Education of Surveyed Livestock Producers in Illinois**

Forty-two (23%) individuals indicated a time lapse of less than 5 years since their last formal education, and 30 (16%) participants had not received formal training in 20-25 years. The educational hiatus for the remainder of the population (n= 133) were evenly distributed.





**Table 1.1: Critique of Selected Learning-Style Instruments<sup>2</sup>**

<b>LS Instrument</b>	<b>Developed for Adults?</b>	<b>Adult norms available?</b>	<b>Evidence of Validity</b>	<b>Evidence of Reliability</b>	<b>Strength of Research Base</b>	<b>Cost per Instrument</b>	<b>Overall Instrument Usability</b>
Barbe-Milone	Yes	No	1	1	1	Public domain	3
MMPALT II	Yes	No	2		2	Not available	1
Swassing-Barbe	No	No	1	2	2	Available as kit	1
Grasha-Riechmann	College students	Yes	2	3	3	2	3
Gregorc	Yes	Yes	2	2	2	2	3
Hemispheric Mode Indicator	Yes	Yes	2	2	2	2	3
Herrmann	Yes	Yes	3		3	3	2
Kolb	Yes	Yes	1	2	2	2	3
Schmeck	Yes	Yes	3	3	3	Not available	2
Witkin	Yes	Yes	2	2	3	2	3
Canfield	Yes	Yes	2	3	2	3	2
Honey and Mumford	Yes	Yes	2	2	2	3	3
Keirsey	Yes	Yes	2	0	2	1	3
Myers-Briggs	Yes	Yes	3	3	3	2	2
Silver-Hanson LSI	Yes	Yes	2	2	3	2	3
Sternberg	Yes	Yes	2	2	2	1	2
CITE	No	No	1	1	2	Public domain	3
PEPS	Yes	Yes	2	2	3	2	2
Hill	Yes	No	1	1	2	Public domain	1
NASSO	No	No	2	0	3	2	1

<sup>2</sup> Adapted from James, W. & Blank, W (1993) Review and Critique of Available Learning-Style Instruments for Adults.

**Table 2.1: Relationship between antimicrobial choice and FDA regulations in Illinois Dairy Producers:** Overall, the majority of antimicrobials (61%, 33/54) were used in an extra-label fashion. In addition, 13% (7/54) of antimicrobial selections would be classified as illegal, especially in cases of calf diarrhea.

	<i>Number of producers using antimicrobials according to the manufacturer label</i>		<i>Number of producers administering prohibited antimicrobials</i>	
	<i>On label</i>	<i>Off label</i>	<i>Yes</i>	<i>No</i>
<b>Calf respiratory(n=12)</b>	12	0	0	12
<b>Calf scour (n=9)</b>	2	7	3	6
<b>Adult lameness (n=8)</b>	3	5	1	7
<b>Metritis (n=8)</b>	4	4	1	7
<b>Mastitis (n=17)</b>	0	17	2	15

**Table 3.1: Gallup’s Q<sup>12</sup> Workplace Engagement Questionnaire:** Analyzes a specific set of respondent perceptions that have been demonstrated to be reliably predictive of attitudinal outcomes in the workplace.

Question	Response options
I know what is expected of me at work	Yes or No
I have the materials and equipment I need to do my work right	Yes or No
At work, I have the opportunity to do what I do best every day	Yes or No
In the last seven days, I have received recognition or praise for doing good work	Yes or No
My supervisor, or someone at work, seems to care about me as a person	Yes or No
There is someone at work who encourages my development	Yes or No
At work, my opinions seem to count	Yes or No
The mission or purpose of my company makes me feel my job is important	Yes or No
My associates or fellow employees are committed to doing quality work	Yes or No
I have a best friend at work	Yes or No
In the last six months, someone at work has talked to be about my progress	Yes or No
This last year, I have had opportunities at work to learn and grow	Yes or No

**Table 3.2: Survey Questions Related to Demographics and Preferences**

Category	Question	Response options
Demographics	What is your gender?	Male or Female
	What is your age?	12 age categories spanning 18- >71 years
	What is the highest level of formal education you have completed?	11 categories ranging from no schooling completed to doctorate degree
	How many years have elapsed since your last formal education?	10 categories spanning < 5 years to 50+ years
	What is your role on the farm	Laborer, animal health care provider, financial decision maker
	How many and what kind of livestock are included in your operation?	Beef cattle, dairy cattle, dairy goats, meat goats, sheep, swine
	Do you row crop in conjunction with raising livestock? If so, how many acres?	Yes or No <1500 acres or > 1500 acres
Receiving Information	Please select all methods you currently use to receive information regarding production related topics	Information categories include internet, magazines/mailers, veterinarians, focus groups, expo events, continuing education classes, and fellow producers

**Table 3.3: Honey and Mumford’s Learning Style Questionnaire** was selected because of its low cost and ease of use and interpretation of results. Additionally, it was developed around real work activities, which enhances its use for practical application in the workplace.

<b>Question</b>	<b>Response options</b>
I often act without considering the possible consequences	Yes or No
When I hear about a new idea or approach I immediately start working out how to apply it in practice	Yes or No
I am good at self-discipline such as watching my diet, exercising regularly, sticking to a fixed routine, etc.	Yes or No
I take pride in doing a thorough job	Yes or No
I get along best with logical, analytical people and less well with spontaneous, ‘irrational’ people	Yes or No
I’m attracted more to novel, unusual ideas than to practical ones	Yes or No
In discussions I like to get straight to the point	Yes or No
I am careful not to jump to conclusions too quickly	Yes or No
I prefer to respond to events in a spontaneous, flexible way rather than to plan things in advance	Yes or No
I think that decisions made on a thorough analysis of all the information are more sound than those based on intuition	Yes or No
I tend to be a perfectionist	Yes or No
More often than not, rules are there to be broken	Yes or No
I can often see a better, more practical ways to get things done	Yes or No
If I have a report to write I tend to produce lots of drafts before settling on the final version	Yes or No
In discussions I often find I am the realist, keeping people to the point and avoiding wild speculations	Yes or No
In discussions with people I often find I am the most dispassionate and objective	Yes or No
When things go wrong I am happy to shrug it off and ‘put it down to experience’	Yes or No
It’s best to think carefully before taking action	Yes or No
I don’t mind hurting people’s feelings so long as the job gets done	Yes or No
I like meetings to be run on methodical lines	Yes or No

**Table 3.4: Statistical Tests:** The multiple survey approach generated layers of data that was analyzed statistically to identify significant relationships between learning style profile, learner demographic features and work engagement.

<b>Type of data</b>	<b>Statistical test</b>	<b>Purpose of test</b>
Continuous	Pearson's correlation coefficient	To identify significant relationships between learning styles and independent variables
Categorical	MANOVA	To identify differences in learning style between groups described by categorical variables (e.g. gender, production type, size of farm)

**Table 3.5: Information Source Preferences** to understand current trends in self-education and training, survey participants were asked to select methods and frequency of information dissemination that were currently being used to receive education or training in production related topics. Respondents employed multiple information sources, utilizing fellow producers, magazines, veterinarians, and internet articles most frequently.

	Always	Sometimes	Never
Internet - articles	67	95	6
Internet - videos	27	86	30
Internet – chat forums	14	37	81
Magazines	73	95	5
Mailers	29	87	35
Veterinarian	68	90	5
Focus groups	15	59	64
Expo events	19	94	28
Continuing education classes	12	54	67
Fellow producers	75	79	5

**Table 3.6: Honey and Mumford Learning Style Questionnaire Results Summary:** Of the 185 livestock producers surveyed, the majority of participant scores (45%, n=84) indicated a preference for a combination of reflective and theoretic learning styles.

	Number of Responses
Activist	2 (0.01%)
Activist/Reflector	7 (0.04%)
Reflector	13 (7%)
Reflector/Theorist	84 (45%)
Theorist	43 (23%)
Theorist/Pragmatist	18 (10%)
Pragmatist	9 (0.05%)
Pragmatist/Activist	5 (0.03%)
Universal	4 (0.02%)
Total	<b>185 (100%)</b>



**Table 3.7: Association of Illinois livestock producer Learning Style with gender, farm size, and enterprise diversity.** A MANOVA test was performed to determine if producer sub-groups, as defined by the categorical, independent variables, differed in their learning styles. Of all the categorical variables, only farm size (less than or equal to 1499 acres versus greater than 1500 acres) showed a statistically significant association with learning style in this adult learner population. Other variables such as gender (male/female), and enterprise diversity (e.g. single vs multiple species), were not significantly associated with learning style in this study population.

Variable	P-value	Pillai's Trace	F	df
Gender	0.2649	0.0146	1.338	1
Farm Size	0.0289***	0.0384	3.614	1
Producer Type	0.5418	0.0811	0.924	8

\*\*\* Denotes statistical significance ( $P < 0.05$ )

**Table 3.8: The relationship between the learning style of Illinois livestock producers and their educational attributes and work engagement.** The relationships between Honey and Mumford-defined learning style (Activist-Theorist-Reflector-Pragmatist) and the continuous, independent demographics descriptors of the livestock producers (including age, highest level of education achieved, length of education lapse, and employment engagement) were evaluated using Pearson’s correlation coefficient. A significance value of  $P < 0.05$  was used to identify statistical significance.

In this population of adult learners, educational level was negatively correlated with an activist learning style ( $P > 0.05$ ). In addition, age and educational lapse was negatively correlated with a pragmatic learning style ( $P > 0.05$ ). While, not statically significant, work engagement was positively correlated with a reflector life style ( $P = 0.063$ ).

	Activist		Pragmatist		Theorist		Reflector	
	Correlation	P value	Correlation	P value	Correlation	P value	Correlation	P value
Age	-0.042	0.571	-0.148	0.044	-0.004	0.044	0.139	0.060
Education Level	-0.187	0.011	0.082	0.270	0.096	0.270	-0.077	0.302
Education Lapse	0.032	0.668	-0.187	0.011	-0.076	0.011	0.078	0.294
Engagement	0.056	0.447	0.074	0.319	-0.006	0.319	0.137	0.063

**Table 3.9: Honey and Mumford Learning Style Characteristics<sup>3</sup>**

<b>Learning Style</b>	<b>Strengths</b>	<b>Weaknesses</b>	<b>Teaching Methods</b>
<b>Activist</b>	<ul style="list-style-type: none"> <li>• Flexible and open-minded</li> <li>• Ready to take action</li> <li>• Likes to be exposed to new situations</li> <li>• Optimistic about anything new and therefore unlikely to resist change</li> </ul>	<ul style="list-style-type: none"> <li>• Tendency to do too much themselves and hog the limelight</li> <li>• Often takes unnecessary risks</li> <li>• Rushes into action without sufficient preparation</li> <li>• Gets bored with implementation</li> </ul>	Anything with activity: <ul style="list-style-type: none"> <li>• Demonstrations</li> <li>• Field trips</li> <li>• Group work</li> <li>• Brainstorming</li> </ul>
<b>Theorist</b>	<ul style="list-style-type: none"> <li>• Logical, vertical thinker</li> <li>• Rational and objective</li> <li>• Good at asking probing questions</li> <li>• Disciplined approach</li> </ul>	<ul style="list-style-type: none"> <li>• Restricted in lateral thinking</li> <li>• Low tolerance for uncertainty, disorder, and ambiguity</li> <li>• Intolerant of anything subjective or intuitive</li> <li>• Full of ‘shoulds, oughts, and musts’</li> </ul>	Prefer to grasp concepts correctly: <ul style="list-style-type: none"> <li>• Lecture</li> <li>• Reading</li> <li>• Q &amp; A sessions</li> </ul>
<b>Reflector</b>	<ul style="list-style-type: none"> <li>• Thorough and methodical</li> <li>• Thoughtful</li> <li>• Good at listening to others and assimilating information</li> <li>• Rarely jumps to conclusions</li> </ul>	<ul style="list-style-type: none"> <li>• Tendency to hold back from direct participation</li> <li>• Slow to make up their minds and reach a decision</li> <li>• Tendency to be too cautious and not take enough risks</li> <li>• Not assertive or particularly forthcoming; doesn’t make small talk</li> </ul>	Anything observational: <ul style="list-style-type: none"> <li>• Reading</li> <li>• Videos</li> <li>• Seminars</li> </ul>
<b>Pragmatist</b>	<ul style="list-style-type: none"> <li>• Eager to test things out in practice</li> <li>• Practical, down to earth, realistic</li> <li>• Business-like – gets straight to the point</li> <li>• Technique-oriented</li> </ul>	<ul style="list-style-type: none"> <li>• Tendency to reject anything without an obvious application</li> <li>• Not very interested in theory or basic principles</li> <li>• Impatient with indecision</li> <li>• On balance, task-oriented not people-oriented</li> </ul>	Like to put ideas into practice: <ul style="list-style-type: none"> <li>• Demonstration</li> <li>• Practical workshops</li> <li>• Field trips</li> </ul>

<sup>3</sup> Adapted from Honey, P. & Mumford, A. (1995) Learning Styles Questionnaire

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