SOCIETAL UNEASE WITH MODERN AGRICULTURAL PRODUCTION:

THE CASE OF ANIMAL WELFARE

by

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Abstract

Agricultural intensification has created a great deal of public skepticism. One major area of concern has been the welfare of animals. This thesis explores a diversity of issues centering on perceptions of the welfare of animals. Chapter 1 begins by reviewing the literature on theories of welfare in both humans and animals. After highlighting several challenges for contemporary theorizing about animal welfare, I conclude that philosophical progress on these problems can be enhanced via experimental research. Chapter 2 describes what such an approach might look like by testing the prominent view that animal welfare consists entirely of how an animal feels. Chapter 3 then examines the empirical support for the popular view that there is a negative relationship between farm size and animal welfare. Using a broad conception of welfare, I conclude that farm size and animal welfare exhibit no consistent relationship. Chapter 4 explores how perceived openness and trust affects perceptions of farm animal welfare. I found evidence that attempts to restrict the ability to monitor a farm's inner-workings (operational transparency) diminished trust, led to more negative perceptions of animal welfare and greater support for legislative and regulatory restrictions governing animal care. Chapter 5 is a case study describing the attitudes of different stakeholders regarding the common practice of dehorning dairy calves. After describing the level of support among different stakeholders in my sample, I explore the barriers to adopting pain mitigation strategies by focusing primarily on the reasons given by participants opposed to providing pain relief.

Lay summary

This dissertation explores how the public perceives animal welfare. I begin by comparing public perceptions of animal welfare with those of experts. Taking the broadest possible definition of animal welfare, I next evaluate whether existing evidence supports the popular view that animal welfare is poorer on larger farms. Next, I describe an experiment testing the effect(s) of limiting information access on public concerns about farm animal welfare. Lastly, I describe a case study, examining the views of different stakeholders towards the common (and painful) practice of dehorning dairy cattle. Overall, this dissertation uses a variety of social science methods to deepen our knowledge about societal concerns about the welfare of animals.

Preface

A version of Chapter 1 is in preparation for publication: Robbins, J. A., B. Franks and M. A. G. von Keyserlingk. Some thoughts on the nature of animal welfare. J. Agric. Environ. Ethics. J. A. Robbins developed the main ideas for this research. M. A. G. von Keyserlingk and B. Franks provided input on material and editing drafts. This project did not require ethics board approval.

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Chapter 1: Introduction

At various periods throughout history ethical questions regarding our duties to animals has been a topic of interest to philosophers. However, for most of this history any duties they were owed were thought to accrue indirectly. Philosophers like Kant, Descartes and Aquinas believed that the wrongness of harming animals derived its moral force from the fact that individuals engaged in such actions would eventually graduate to harming the only true bearers of moral consideration - humans (Linzey and Clarke, 1990). McCauley (1849) captured the essence of this position in his famous line, "The Puritan hated bear bating, not because it gave pain to the bear, but because it gave pleasure to the spectators".

The indirect duty view has always been a tenuous position because it hinges on a straightforward empirical question about human psychology; if harming animals does not have the suspected 'moral spillover' effects, then the manner in which we treat animals is of no moral concern (Nozick, 1974). Given the counter-intuitiveness of this conclusion it is not surprising that indirect duty views have fallen out of fashion (see also Carruthers, 1992). Today the modern conversation takes it for granted that animals have a good of their own that should be included in any ethical accounting (Raz, 1992). This conventional social consensus ethic accepts that animal use (including killing) is justifiable provided the animals involved are afforded good lives before they are killed.

The study of animal welfare centres around determining what constitutes a good life. Non-anthropocentric facts about the biology and behaviour of animals obviously play a crucial role in this process and remain central to what many think of as 'animal welfare science'. However, it is increasingly recognized that the barriers to improving the lives of

animals involve social, cultural, political and economic considerations cannot be completely captured by the 'hard sciences' (Lund et al., 2006; Davies et al., 2016). Thus the study of animal welfare must transcend narrow disciplinary boundaries to include not only the animal sciences, physiology, veterinary medicine, ethology, but also philosophy, psychology, sociology, economics and law. In recognition of this fact, let us begin by examining various facets of the central phenomena under investigation – welfare.

1.1 A primer on the nature of non-human (and human) welfare

Much of the modern conversation surrounding our ethical obligations tends to assume that animals are objects of direct moral concern and rights are often invoked to protect their welfare (Raz, 1992). Moreover, it is increasingly the case that limiting unnecessary animal suffering (for the animal's own sake) is a necessary, but not a sufficient, condition for fulfilling our duties to many animals. Talk about the welfare of animals is shifting from simply preventing harm (or having bad welfare), to ensuring animals live truly good lives with good welfare (Tannenbaum, 2002). Much less clear is what exactly it means for an animal to have good welfare.

1.2 The relationship between welfare and ethics

Attention to the welfare of sentient beings is indispensible when discussing the proper ethical course of action. Ethical theories can differ on the question of whether there are additional values beyond welfare (Keller, 2009). For instance, some environmental ethicists argue that the destruction of the environment is intrinsically wrong, regardless of whether or not it harms anyone or anything. Similarly, opponents of abortion might argue that foetuses have intrinsic or sacred value. In contrast, Welfarism is the view that welfare

is the only value relevant to ethical deliberation (Sumner, 1996). This view is most at home within a utilitarian framework, which evaluates the rightness or wrongness of actions according to their likely effects on the welfare of all affected parties. It should be noted that Welfarism is also possible within a non-consequentialist framework as well. For instance, deontological approaches to ethics might hold that moral rules or rights are designed for the express purpose of protecting or improving welfare (Keller, 2009). Regardless of whether or not you think welfare is the only ethical value, or one among many, it is difficult to find an ethical theory where welfare is not a major consideration.

1.3 The 'thickness' of welfare

In the human context, welfare is generally considered as a 'thick' concept (Kirchin, 2013).[1] Thick concepts differ from 'thin' concepts, in that thin concepts are either entirely descriptive or entirely evaluative, while thick concepts contain both descriptive and evaluative components.[2] Descriptive concepts, not unlike beliefs, serve to pick out certain features of the world while evaluative concepts are much more similar to desires in that they involve some sort of pro-attitude. Recognizing welfare's status as a thick concept suggests that theories of welfare must be evaluated according to at least two different criteria - their descriptive and normative adequacy (Sumner, 1996). Meeting the former requirement means that the theory must reflect ordinary usage of the concept.[3] A theory of welfare entirely divorced from people's everyday experience is an inadequate theory.

[1] Instead of 'thick', Fraser (1999) refers to animal welfare as an evaluative concept.
[2] Whether the descriptive and evaluative elements of thick concepts can be meaningful disentangled remains a topic of much philosophical debate (Blomberg, 2007; Kirchin, 2013).
[3] Some interpretations amend the descriptive adequacy requirement to require that theories also make empirically testable predictions (Griffin, 1986).

Fulfilling the requirement of normative adequacy entails providing good reasons or justifications as to why the theory being offered is good and/or action guiding. It is not enough to show that the theory accords to its everyday meaning, it must also include some explanation as to why the components of welfare on offer are something worth aiming at or promoting (Tiberius, 2012).

The dual character nature of the welfare concept has important implications for animal welfare scientists. Since the phenomenon under investigation contains both descriptive and normative aspects, a strictly scientific approach to animal welfare is impossible (Tannenbaum, 1991; Fraser, 1995; 2003; Rollin, 1993; 2006). This means that despite their objective appearances, frequently encountered claims made by scientists along the lines of "X positively/negatively impacts Y's welfare" cannot be purely empirical claims because the concept they are invoking is not purely descriptive (Schmidt, 2011). Alexandrova (2015) summarizes this point nicely stating, "a science organized around the study of a thick concept necessarily inherits the concept's thickness."

1.4 Welfare as prudential value

Within the study of axiology or value theory, well-being, flourishing, happiness, or what I will be referring to as welfare, is typically identified as a form of prudential value (Taylor, 2013). Prudential value differs from other types of value, such as moral and aesthetic, in that it is agent relative or personal. In order for something to count as influencing welfare, it must be good/bad *for* someone or something (from a particular point of view), not simply good/bad in some absolute sense (from the point of view of the universe; Kraut, 2011). Still, we often talk about things like water and sunlight being good for trees, certain events being good for a species or even oil as being good for a car, yet it

somehow seems odd to speak about the welfare of such things because it is difficult to conceive of what it could mean for them to have a particular point of view or interests. Rosati (2009) has argued that this suggests we may actually be dealing with "multiple good for relations" with welfare representing one specific variety that attaches to conscious subjects with a capacity to experience events as positively or negatively valenced. If correct, things may be said to be good/bad for a tree/forest, but nothing can be good/bad for the welfare of a tree/forest, because trees/forests have no conscious interests and thus no welfare (Varner, 2002).

1.5 'One welfare'

Since welfare applies to all sentient creatures, some scholars have suggested that it is important for theories of human and animal welfare to share a similar basic structure (Sumner, 1996, Kraut, 2009). In one of the most influential texts on welfare, *Welfare, Happiness and Ethics,* Sumner (1996) writes:

> "We make welfare assessments . . . concerning a wide variety of subjects. Besides the paradigm case of adult human persons, our welfare vocabulary applies just as readily to children and infants, and to many non-human beings. It is perfectly natural for me to say that my cat is doing well, that having an ear infection is bad for her, that she has benefited from a change of diet, and so on. In making these judgments it certainly seems to me that I am applying exactly the same concept of welfare to my cat that I habitually apply to my friends. A theory of welfare will therefore . . . be incomplete if it covers only them and ignores her."
>
> (Sumner, 1996)

Appleby and Sandoe (2002) have endorsed a similar position, arguing that the best way to develop and test theories of animal welfare is by comparing and contrasting them with prominent theories of human well-being, abstracting away until we arrive at general principles applicable to all sentient beings. In doing so, this unified approach to

understanding welfare allows us to, "gain insights from the debate about human well-being to inform our assessment of various theories of animal well-being and allow examples and arguments concerning animals to inform our views about human well-being" (Rice, 2015).

1.6 A theory of animal welfare

Theories of animal welfare have received much less attention that those developed for humans. Perhaps the most widely cited account of animal welfare comes from Fraser and colleagues (1997) who proposed a three-factor conception based on the major ethical concerns regarding animals. On this view, an animal is said to be faring well when it: "(1) leads a natural life through the development and use of its natural adaptations and capabilities, (2) feels well by being free from prolonged and intense fear, pain, and other negative states, and by experiencing normal pleasures, and (3) when it functions well, in the sense of satisfactory health, growth and normal functioning of physiological and behavioral systems". Different theorists have identified each of these three domains individually as having final welfare value.

1.7 Theories of human welfare

The most widely cited typology of theories of human welfare comes from Derek Parfit's *Reasons and Persons* (1984) where he identifies three broad theories of welfare: Hedonism, Desire Satisfaction and Objective List. These three types of welfare theories all differ with respect to what they consider as having final or ultimate value, or what is non-instrumentally best for an agent (Brulde, 2007). A comparison of prominent theories of human and animal welfare can be seen in Table 1.

Table 1.1 Comparison of Parfit and Fraser's typologies and how they relate with each other. Adapted from Appleby and Sandoe (2002).

Human welfare (Parfit, 1984)	**Animal welfare** (Fraser et al., 1997)
Hedonism	Affective states
Desire Satisfaction	-Preferences
Objective List Theories -Perfectionism	Health and Biological Functioning Natural living (e.g. telos, capabilities approach)

1.8 Hedonism

Hedonistic accounts of welfare can be traced as far back as the Carvaka (600 BCE), through Socrates, Protagoras and Epicurus, although they are most commonly associated with the work of Jeremy Bentham and later his pupil John Stuart Mill (Weijers, 2011). Hedonism posits that, "what is good for any individual is the enjoyable experience in her life, what is bad is the suffering in that life, and the life best for an individual is that with the greatest balance of enjoyment over suffering" (Crisp, 2006). Welfare on this account is sensory-based, comprising a vast array of mental states that all share in common a distinctive qualitative sensation that varies along dimensions of intensity and duration (Bentham, 1789).

Proponents of hedonism in animal welfare science have included Dawkins (1990), Simonsen (1996) and Duncan (2004), who has characterized his position as follows, "...animal welfare is all to do with the secondary, subjective feelings, with the absence of

negative feelings, particularly the strong negative feelings we call suffering and with the presence of positive feelings that we call pleasure". Hedonism, as an account of welfare in humans, fell out of favour in the 20th century after a series of damaging philosophical critiques (Crisp, 2006). Most notable among these was a challenge put forth by Robert Nozick in his book *Anarchy, State and Utopia* (1974) where he proposed the following thought experiment:

> "Suppose there was an experience machine that would give you any experience you desired. Superduper neuropsychologists could stimulate your brain so that you would think and feel you were writing a great novel, or making a friend, or reading an interesting book. All the time you would be floating in a tank, with electrodes attached to your brain. Should you plug into this machine for life, preprogramming your life's experiences? If you are worried about missing out on desirable experiences, we can suppose that business enterprises have researched thoroughly the lives of many others. You can pick and choose from their large library or smorgasbord of such experiences, selecting your life's experiences for, say, the next two years. After two years have passed, you would have ten minutes or ten hours out of the tank, to select the experiences of your next two years. Of course, while in the tank you won't know that you're there; you'll think it's actually happening. Others can also plug in to have the experiences they want, so there is no need to stay unplugged to serve them. Would you plug in?" (Nozick, 1974).

If what ultimately makes life go better or worse is simply a matter of how one feels as the hedonist claims, then we should all be willing to plug in. Since we are unwilling (or at least hesitant), other factors besides mental states must be important for a good life. Nozick's argument is straightforward and persuasive; there are many cases where humans and animals appear motivated to engage in activities for their own sake, not because they are particularly pleasurable.

Another challenge levied against hedonism has been to question the assumption that there exists a sensation common to all pleasurable experiences. After all, many seemingly pleasurable experiences such as reading, conversing with old friends, sex, contact with nature, etc. all seem to be very different from each other. To address this

challenge, Kagan (1992) suggests an analogy between pleasure and acoustic volume. Pleasure, like volume, is best thought of as a dimension along which experiences can vary rather than be a single discrete component common to all pleasurable experiences. In the same way that very different sounds can be categorized and ranked according to their volume, so it is with pleasurable experiences. Other scholars have endorsed a similar view, arguing that ostensibly dissimilar pleasant experiences share in common "feeling tone" (Crisp, 2006) or "positive buzz" (Hurka, 2010).

Another response to this challenge has been to restrict what counts as a pleasant experience to those that are also desired. This view, known as preference or attitudinal hedonism, denies that sensory pleasures have final value, reserving this status only for pleasant sensory pleasures that are also positively evaluated by the individual experiencing them (Feldman, 2004). To experience attitudinal pleasure is to have a pro-attitude toward the object of the experience akin to enjoyment. The applicability of this theory to animals is unclear as it depends on whether or not animals possess the capacity to form the requisite attitudinal states. Feldman (2002) certainly believes that they do, writing "…all sorts of lowly creatures have propositional attitudes all day long." However, many other philosophers maintain that natural language is necessary for the possession of intentional states like attitudes (Davidson, 1982; Dennett, 1995 and Stich, 1979, but see Bermudez, 2003). These sceptics would likely agree that it is appropriate to claim that my dog 'is pleased' when I arrive at home, but they would doubt that it is possible to say that my dog 'is pleased *that* I am home' because this implies a much more complex conceptual framework that includes additional concepts such as truth and falsity (Hurka, 2010). The emphasis on attitudinal endorsement makes this approach difficult to distinguish from

another theory of welfare that has become what is perhaps the most popular theory of human welfare.

1.9 Desire satisfaction

As the name suggests, desire or preference satisfactionism (hereafter, preferentialism) posits that a life goes well to the extent that subjects get what they want and avoid what they do not want. Importantly, any feelings that happen to accompany the satisfaction/frustration of these preferences are irrelevant. Instead of welfare being fully determined by discrete, valenced mental states, preferentialism describes a relation between the object of desire and the subject's perception of their current state of affairs. Preferences are satisfied when the subject's perception of the way the world is matches the object of the desire (i.e. the way they'd like the world to be) (Kagan, 1992).[4] In formal terms Sandoe (1996) describes the preferentialist approach to animals as follows:

> "A subject's welfare at a given point in time, t1, is relative to the degree of agreement between what he/it at t1 prefers…and how he/it at t1 sees his/its situation – the better the agreement the better the welfare."

Although preferentialism as a theory of welfare can be traced back to Hobbes, it did not gain prominence in the 20th century with the rise of welfare economics and decision theory. Frustrated by the difficulty involved in measuring and comparing utility, economists proposed that measuring people's revealed preferences offers a better, more objective approach to the study of welfare (Kahneman and Sugden, 2005). Inspired by

[4]Brulde (2007) makes an interesting case that because it is possible for unsatisfied preferences to exist without any aversion to their absence, welfare will usually only be negatively impacted when aversions (preferences that something not occur) are satisfied.

these changes in economics, animal welfare scientists also began employing their own preference tests as means of assessing animal welfare. The basic premise is that by calculating demand curves - the percentage change in consumption as a function of price (i.e. how much effort the animal is willing to exert to obtain different resources) - we can objectively assess and compare the relative contributions of different factors to welfare. If consumption decreases following an increase in price, the resource is believed to bring about less positive welfare value than if consumption were to remain stable or price insensitive (Dawkins, 1983). The more (and stronger) preferences the animal satisfies the better its welfare is believed to be.

Today preference (and motivation) testing has become one of the most popular and widely utilized methods in animal welfare science (Kirkden and Pajor, 2006; Fraser and Nicol, 2011). Contrary to human theories of welfare, preference testing is generally thought of as a methodology within animal welfare science, rather than a theory in its own right (see Table 1). However, Dawkins (2012) has outlined a theory of welfare that could rightfully be considered a preference satisfaction account.

Preferentialism as a formal theory of welfare has had a significant impact in animal ethics. Peter Singer (2011) famously rejected hedonism arguing that many animals (e.g. primates, dogs, cats, dolphins, elephants, pigs) qualify as persons because they appear to have a sense of themselves existing over time. He then went on to argue that beings capable of projecting themselves into the future must also be able to form desires about their future. If animals can form desires about their future, then it is possible for them to form desires about things that extend beyond their immediate pleasure and pain. All things being equal, Singer reasoned, a life where these desires are fulfilled is better than one in

which they are not, independent of any pleasant feelings they experience. Tom Regan has also endorsed a preferentialist approach to welfare albeit from a deontological standpoint, claiming that animals enjoy welfare when they "pursue and obtain what they prefer" (Regan, 2004). If Singer and Regan are correct that welfare consists of the satisfaction of preferences, the question then becomes a matter of identifying which animals are capable of possessing desires that extend beyond pleasure and pain. This question is beyond the scope of this thesis, but one detailed analysis by Varner (2002) concluded that desires are likely held by a wide array of animal species.[5]

Preferentialism is appealing because it offers a plausible response to some of the major objections to hedonism. Namely, it provides an answer to Nozick's experience machine objection. A life of pleasant dream-like states is unlikely to improve welfare because such a life would likely leave many desires unfulfilled. Preferentialism recognizes that things besides the pleasant experiences are valued. We want to actually achieve certain things, not just the pleasant experiences that might or might not result from them. Preferentialism is also appealing because it is less judgmental that either hedonism of objective list theories. The content of the desire does not matter for welfare, what matters is its strength and whether or not it is fulfilled.

In many cases there may be a close correspondence between the satisfaction of desires and the experience of positive mental states - an animal that gets what it wants will often feel good as a result (Duncan and Fraser, 1997). However, this need not be true in all circumstances. Consider any animal with a strong desire to fight. It seems odd to think that

[5] Varner (2002) concludes that some animals (e.g. some fish) may be capable of experiencing pain without desiring that it end. This phenomenon also occurs in humans with prefrontal lobe damage who report feeling pain, but have no desire for it to stop.

by allowing this animal to fulfil its preference we have somehow improved its welfare. Moreover, many desires in both humans and animals are relatively unstable – varying depending on the context in which they are presented. Lichtenstein and Slovic (1971) famously showed that when people were presented with two options simultaneously they indicated a reliable preference for one of the two options. However, when the very same two options were evaluated individually their preferences reversed. Collectively, these challenges have been referred to as the problem of defective desires (Heathwood, 2005).

These challenges to preferentialism have led to the addition of numerous idealizing conditions. Most often these include the requirement that desires must be informed and presently held in order to affect welfare (Griffin, 1986). For a desire to count as being informed it must persist in being held after considering the likely results of its fulfilment. Varner (2002) argues that this condition cannot apply to animals because, unlike humans, animals will never possess the ability to consider such information. The requirement that desires be presently held is more applicable in the case of animals: "If a dog is frightened of you and would prefer you to leave, it does not contribute to her welfare if you leave secretly (behind a screen, say, so that she thinks you are still present) or if you leave when her fear has ended (perhaps because you feed her)" (Appleby and Sandoe, 2002).

Preferentialism has many advantages over hedonism as a theory of welfare, yet there is something fundamentally odd about the idea of equating the satisfaction of desires with a good life. According to Aristotle, things cannot be made good by the fact that they are desired; they are desired because they are good independent of our desires for them (Crisp, 2008). This observation leads us to our final category of welfare – Objective List theories.

1.10 Objective list theories

On an objective list account of welfare, factors such as autonomy, knowledge, friendship, love, contact with reality and meaningful work may all be independently necessary for a good life, regardless of whether or not they make an object feel good or satisfy their desires. One popular version of objective list theory is the Aristotelian notion of perfectionism, which argues that welfare consists in the exercise and development of one's natural or essential capacities (Hurka, 1993; Dorsey, 2010). Perfectionist accounts of animal welfare are often expressed as concerns about 'naturalness'. Within the field of animal welfare science, perfectionist accounts are most often associated with the work of Bernard Rollin, as exemplified in the following quote (Rollin, 1995):

> "…animals too have natures, genetically based, physically and psychologically expressed which determine how they live in their environments. Following Aristotle, I call this the telos of an animal, the pigness of the pig, the dogness of the dog – 'fish gotta swim, birds gotta fly'. (…) Social animals need to be with others of their kind; animals built to run need to run; these interests are species specific. Others are ubiquitous in all species with brains and nervous systems – the interest in avoiding pain, in food and water, and so forth." [6]

Other, more detailed perfectionist accounts of animal welfare can also be found. Extending her work involving humans, Martha Nussbaum's (2004) capabilities approach proposed a basic list of features that, when realized, improve an animal's welfare. These capabilities are: (i) life, (ii) bodily health, (iii) bodily integrity, (iv) senses, imagination, and thought, (v) emotions, (vi) practical reason, (vii) affiliation, (vii) relation to other species, (ix) play, and (x) control over one's environment. Although certain kinds of pleasure and pain are addressed by (iv) and (v), it is fully possible for many capabilities to contribute to

[6] Rollin is often categorized as an Aristotelian about welfare. However, other work makes it clear that he views essential species-typical capacities as instrumentally valuable (see Verhoog, 1992).

an animal's welfare regardless of whether they are experienced as pleasant or desired. Nussbaum acknowledges the dangers involved in presenting a theory that alludes to the characteristic flourishing of species. Specifically, she is concerned that it leads humans to "worship" and "romanticize" nature. To avoid this risk she makes it plain that not all forms of characteristic functioning improve welfare and discerning which do necessarily involves normative judgments (Nussbaum, 2006).

Rosalind Hursthouse's (1999, pg. 204) account of animal welfare probably represents the purest version of perfectionist theory. Her view is that a well-off animal is one that is, "well-fitted or endowed with respect to four aspects, their: (i) parts, (ii) operations/reactions, (iii) actions, and (iv) desires and emotions; whether it is thus well-fitted or endowed is determined whether these four aspects well serve: (1) its individual survival, (2) the continuance of the species, and (3) its characteristic freedom from pain and characteristic enjoyment, and (4) the good functioning of its social group – in ways characteristic of that species."

Nussbaum and Hursthouse agree that what is good for an animal is pursuing their ends in ways that are characteristic of their species. They also agree that this will, in many cases, not be consistent with the maximization of pleasant psychological experience and the satisfaction of desires. However, Hursthouse differs from Nussbaum in believing that her approach does not depend on human values, but instead relies entirely on biological facts of the type studied by zoologists and ethologists. Upon closer examination it is apparent that value judgments enter into both approaches in the initial process of determining what counts as a species-typical trait. The capabilities approach differs because it allows normative evaluations to enter a second time; namely, when considering

which parts of the animal's nature influence its welfare and which do not. For Hursthouse, this second step is unnecessary because once we have decided what is characteristic of the species we can deduce the welfare of any individual according to how well it reflects these characteristics (Rice, 2015).

Perfectionist approaches to welfare have been widely criticized for being too paternalistic and removed from the individual whose welfare we are supposed to be discussing. They suggest that things can affect welfare regardless of whether or not they are in some sense endorsed by the agent in question and thus strain the agent-relativity requirement of welfare. A chimpanzee that does not enjoy being with its group, grooming others or playing is a 'defective' chimpanzee and thus not well off. An attempt has been made to modify perfectionist approaches to animal welfare so that they are more sensitive to individual, within-species variation. The self-fulfilment alternative outlined by Visak and Balcombe (2013) still considers species-typical characteristics, but allows for individual idiosyncrasies, atypical of the species, to influence welfare. This approach has precedence in the case of humans (Haybron, 2008), but it is too early to tell whether this offers a workable alternative for animals.

Thus far I have referred to philosophical research. In the next section I will critically evaluate the growing body of social science research that has empirically examined how different people understand animal welfare.

1.11 Empirical research on how people conceive of animal welfare

An increasing volume of social science research is now being conducted within animal welfare science (examples given in Table 1.2). A major focus of this work is discerning how different groups of people think about welfare. This research may offer

insights into whether or not the intuitions of specialists are representative of ordinary people. Without this, it is not possible to discern whether both groups are referring to the same concept or not. Because social science research in animal welfare is relatively new (e.g. see review by Weary et al., 2016) most studies have been qualitative case studies.

One such study involved swine farmers from six European countries and found that welfare was defined differently depending on whether farmers were participating in basic (non-animal welfare specific) or specific animal welfare assurance schemes (Skarstad et al., 2007). Interestingly, farmers in the latter category placed greater emphasis on an animal's ability to express natural behaviour and less on the biological health and functioning of their animals. This same study also reported that Norwegian consumers held a more nuanced definition of animal welfare emphasizing freedom, naturalness and care while farmers focused almost exclusively on animals having good health and functioning. Spooner et al (2014) also reported that swine producers largely equated welfare with good biological health and functioning.

Other studies have used quantitative methodologies to examine statistical relations between different groups. One study presented non-farmer and farmer participants with a list of 72 welfare related factors and asked them to rate their importance for obtaining an acceptable level of animal welfare (Vanhonacker et al., 2008). These factors were organized into seven categories (Housing and Climate, Transport and Slaughter, Feed and Water, Human-Animal Relationship, Animal Suffering and Stress, Animal Health and Ability to Engage in Natural Behaviour). The main finding was that farmers and non-farmers largely agreed on which factors "have to do with animal welfare" although the ability to engage

natural behaviour was consistently ranked more highly by non-farmers (Vanhonacker et al., 2008).

Another study, comparing consumer and farmer conceptions of welfare, found that farmers thought of welfare largely in terms of health and functioning. Consumers also mentioned these factors, but went beyond them to include things like the freedom to move and fulfil "natural desires" (Te Velde et al., 2002). Similarly, a Dutch study found that expert and non-farmer beliefs about swine welfare were largely in agreement except that non-farmers held a more complex view of animal welfare than the welfare experts (Lassen et al., 2006).

Tuyttens et al. (2010) asked several different groups: vegetarians, farmers and non-farmers to rate the importance of 12 different welfare-related criteria. Once again, general agreement was high between groups with the exception of vegetarians who gave consistently higher scores than both farmers and citizens on every criterion. Farmers and vegetarians differed most on the perceived importance of "appropriate behavior".

Table 1.2 A sample of studies reporting how different groups conceive of animal welfare.

Study	Country	Population	Sample Size	Design
Vanhonacker et al., 2008	Belgium	Farmers and Non-farmers	663	Quantitative/ correlational
Te Velde et al., 2002	The Netherlands	Farmers and Non-farmers	30	Qualitative
Lassen et al., 2006	Denmark	Non-farmers	36-42	Qualitative
Tuyttens et al., 2010	Belgium	Farmers, Non-farmers farmers and Vegetarians	735	Quantitative/ correlational
Spooner et al., 2014a	Canada	Farmers and Non-farmers	24	Qualitative
Skarstad et al., 2007	Norway	Farmers and Non-farmers	216-237	Qualitative
Vanhonacker et al., 2010	Belgium	Non-farmers	29	Qualitative
Vanhonacker et al., 2012	Belgium	Non-farmers	459	Quantitative/ correlational
Bock and Van Huik, 2007	The Netherlands, France, Norway, Sweden, Britain and Italy.	Farmers	60	Qualitative
Prickett et al., 2010	United States	Non-farmers	1,019	Quantitative/ correlational
Spooner et al., 2014b	Canada	Pig farmers	20	Qualitative
Spooner et al., 2012	Canada	Cattle farmers	23	Qualitative
Frewer et al., 2005	Denmark	Non-farmers	1,000	Quantitative

1.12 Methodological limitations

Objectively evaluating this research is difficult because of inconsistent and inadequate descriptions of methods, particularly with respect to data analyses. For example, Bock and Van Huik (2007) fail to provide any information about their materials other than stating, "researchers agreed upon a basic questionnaire with a common core of semi-structured questions." Te Velde et al., (2002) also give no detailed information about how their data were analysed before moving into a discussion of their results. Moreover, the inclusion of methods designed to enhance reliability are used infrequently. Only Spooner et al. (2014a) described the steps used to validate their analysis. Triangulating qualitative data via repeated analysis by more than a single researcher and 'feeding back' responses to participants would all improve future research in this area (Mays and Pope, 2000).

More generally, relatively few studies have directly focused on the concept of welfare. Those that clearly outline their research aims are often focused on assessing people's attitudes towards animal welfare in general. For example, participants are asked to rate the current state of animal welfare and the extent to which they approve/disapprove of what they perceive of as the status quo (Vanhonancker et al., 2008). Another study asked subjects what they thought about, "…the accusations of animal welfare activists" and then asserted that the responses "…contained information about the way they define animal welfare…" (Te Velde et al., 2002). These approaches may contain useful information about how people think about welfare, but they are also likely to contain information unrelated to what they view as good for animals. Without better

methodological descriptions it is not possible to tell how investigators distinguished signal from noise.

A further limitation of the studies reviewed here is that all of them focused on animal welfare in the context of food consumption. For instance, both Skarstad et al. (2007) and Te Velde et al. (2002) initiated interviews by asking people to talk about their consumption of animal products prior to asking them to define animal welfare. Hall and Sandilands (2007) examining views about poultry welfare, asked subjects to define welfare, but before responding they were encouraged to, "remember, we're talking about chickens bred for meat production" (Hall and Sandilands 2007). This framing is likely to have biased participant responses. Studies have shown that reflecting on meat-eating leads to lower ratings of animal mental abilities and concern for their welfare (Loughnan et al., 2010; Bastian et al., 2012). Again, such data is also likely to be 'noisy' since food animal welfare if often used as, "an indicator of other, usually more important, product attributes such as food safety, quality and healthiness" (Harper and Henson, 2001).

The majority of these studies were limited to a few (mainly European) countries (see examples given in Table 2). Moreover, approximately half of the studies appeared to utilize the same data set (Vanhonacker et al., 2008, 2010, 2012 and Tuyttens et al., 2010). Many studies rely on very small sample sizes and report very little by way of demographic information. For example, Lassen et al. (2006) provide no information about their sample beyond stating that they were "not farmers" and that they "differed in age, gender, education and place of residence (urban/rural)". Te Velde et al (2002) only provided the following information about their sample: "The selected respondents were as different from each other as possible, and at the same time represented others as much as possible." Overreliance on small samples with little attention to their characteristics compromises the

validity of much psychological research (Henrich et al., 2010). Studies using larger samples, in different locations (and cultures) may yield very different conclusions. Thus, caution is warranted when generalizing the results of these studies to different contexts (von Keyserlingk and Hötzel, 2015).

There also seems to be an over-reliance on the use of direct-projective methods of assessment. Direct methods depend on the subject's motivation and ability to access and linguistically express their thoughts. Overreliance on such methods is problematic because, although linguistic expression and thought are closely related, much of our thinking occurs at a level below conscious perception and is never externalized (Greenwald and Banaji, 1995). Similarly, many of our moral judgments occur spontaneously and intuitively without being consciously experienced (Haidt, 2001). In cases where these judgments are externalized, they are often very labile and susceptible to subtle changes in elicitation methods (Fischhoff et al., 1980). In response, social scientists have developed a number of indirect (implicit) psychological methods that "do not destroy the natural form of the attitude in the process of describing it." (Campbell 1950). Research has shown that direct and indirect measures of the same psychological construct can yield drastically different responses within the same individual - often without their awareness (Nosek et al., 2011).

Indirect methods are preferred because they can minimize the influence of a variety of external response-influencing pressures that can reduce data quality. Most commonly, these include demand characteristics, social desirability bias and the problem of non-attitudes (Azjen, 2001). Several studies have found social desirability bias to be much more common in face-to-face interview-based studies (Richman et al., 1999; Leggett et al., 2003; Kreuter et al., 2008), which constitute the bulk of studies reviewed here. The problem of non-attitudes refers to the well-documented fact the many people simply do not have

coherent attitudes about many objects, despite reporting that they do. Phillip Converse (1970) first introduced the notion of non-attitudes as an explanation of the low stability (i.e. low test/re-test reliabilities) of some pubic opinion research. Numerous studies have found people often report having "considered views" about matters that they have never actually considered (Bishop et al., 1980; Sturgis and Smith, 2010). One prominent anthrozoological researcher has suggested that many (if not most) attitudes about animals probably qualify as non-attitudes (Herzog, 2010). A recent study examining views about animal welfare among 6,000 Chinese consumers found that more that two thirds have never even heard of the term 'animal welfare' (You et al., 2014) and Spooner et al. (2012; 2014b) reported that farmers they studied never use the term "welfare". This provides some preliminary evidence that asking people what they think about "animal welfare" may not be an intelligible question.

Complementing and building on existing studies via methodological refinements such as indirect measures and experimental designs that manipulate specific variables of interest, could help us develop a better understanding of how ordinary people understand animal welfare. The lack of hypothesis-driven research examining the ordinary concept of welfare might be a function of the concept itself. As currently formulated, the broadness of this complex concept of welfare makes it difficult to imagine data that would *not* support this concept. For instance, applying the welfare construct outlined by Fraser et al. (1997) makes it difficult to exclude most scientific findings involving animals without invoking additional ad hoc criteria. This is problematic because empirical evidence cannot support a theory, if the theory is formulated in a manner that is consistent with any observations whatsoever (Popper, 2005). Further conceptual work is needed to clarify the constituents of welfare in a manner that would allow for falsifiable hypotheses to be tested. Such work

is especially needed to clarify pervasive claims about naturalness and how they relate to other terms commonly encountered such as autonomy, comfort and integrity (Lassen et al., 2006).

Additional research is also needed to discern whether there might be additional factors that influence welfare beyond those currently identified. For example, some have argued that factors such as death (Yeates et al., 2010; 2011), longevity (Bruijnis et al., 2013) and integrity (Bovenkerk, et al., 2003; Rocklinsberg et al., 2014) can all influence our judgments about an animal's welfare despite not being straightforwardly captured by the three concerns outlined by Fraser et al. (1997). In the case of death, consider philosopher Jerrold Tannenbaum's (2002) thought experiment:

> "A researcher uses radioactive tracer chemicals to study the anatomical structure of the brains of rhesus monkeys. After the chemicals are injected intravenously, the animals are killed painlessly. The brain tissue is then removed for study. At no time do the monkeys experience any pain, distress, or discomfort other than the minimal amount associated with the injections. Does this experiment have a negative impact on the monkey's welfare?"

Tannenbaum claims that when he first began presenting this scenario to diverse audiences more than three decades ago, virtually no one considered it an animal welfare issue. However, he now claims that the question evokes "immediate and substantial laughter" because it was "patently obvious to everyone" that the monkey's welfare is negatively affected by when his or her life is terminated. Whether Tannenbaum's intuition is widely-shared or not remains to be seen. If correct, this would have significant practical implications. If death negatively impacts an animal's welfare then this would mean that the routine killing of animals at the end of experiments, even if done painlessly, constitutes a welfare issue (DeGrazia, 2016).

Despite these limitations, the research reviewed here generally appears to support the hypothesis that people hold a complex notion of animal welfare involving concern for: 1) the animal's biological functioning, 2) how the animal feels and 3) the animal's ability to live a natural life. Many studies have found that responses to various animal welfare-related questions yield responses that can be categorized according to at least one of these three domains described by Fraser at al. (1997). There are however some possible exceptions. For instance, people often mention factors such as freedom, integrity and care as being constitutive of welfare.

Given that the concerns about the quality of life of animals under our care are increasingly being brought to the forefront, particularly by the lay (folk) public, efforts must continue to focus on understanding the perceptions, values and attitudes of all citizens on the issue of animal welfare. This is particularly true for farm animals, which make up the greatest proportion of animals under human care. Failure to understand how people think about these issues will likely lead to mismatched response strategies that may further undermine trust.

1.13 Thesis aims

This thesis thus aims to elucidate the perceptions, concerns, and values of North American industry and lay stakeholders on matters pertaining to animal welfare, with a large but not exclusive emphasis on the food animal industries. Building on the review of conceptual work on the concept of welfare, Chapter 2 describes the first attempt to experimentally investigate the folk concept of animal welfare. It addresses the fundamental philosophical question of whether or not welfare is ultimately a matter of an animal's subjective experience. This chapter proceeds from the premise that better and worse

conceptualizations of welfare can be adjudicated (at least in part) by how well they track ordinary intuitions. I hypothesized that unlike popular technical theories, features of the animal's life beyond their mental states would influence folk judgments of welfare. Since one prominent aspect of farm animal's lives consist of the farm where it its raised, Chapter 3, explores the empirical support for the widespread perception that animal welfare (broadly defined) is inversely related with farm size. I suggest that the discordance between beliefs about the welfare of animals on large farms and common scientific indicators of welfare may be the result of the folk holding a more expansive, life-focused conception what it means to flourish. Chapter 4 explores how the social perception of openness and trust might mediate these perceptions of farm animal welfare. Given the unlikelihood that people possess clear attitudes about highly technical industry practices, focusing on trust may provide a more valid indicator of public support. Using a real world example, I hypothesized that attempts to limit access to information coming from farms would increase negative perceptions of animal welfare and decrease trust in farmers. Finally, Chapter 5 functions as a case study focused on a specific management issue, dehorning of young dairy calves. This chapter seeks to gain further insights into the factors that ordinary people perceive as relevant to welfare using a novel methodological approach that better mimics social decision-making. Taken together these chapters serve to demonstrate how various methods borrowed from the social sciences can deepen our knowledge of how animal welfare in construed and evaluated by the public.

Chapter 2: An empirical challenge to hedonistic accounts of welfare

2.1 Introduction

A variety of evidence suggests that concern about the welfare of animals is increasing (Pinker, 2011). In response to these concerns the field of animal welfare science emerged to provide empirical answers to questions about how different factors affect an animal's welfare. Scientists working in this field typically draw inferences about welfare based on changes in behavior and physiological functioning. Although still a relatively new field, the number of scientific papers addressing animal welfare has increased 10-15% annually over the last 20 years (Walker et al., 2014). This research has been incorporated into veterinary and animal science curricula around the world (Broom, 2011) and is increasingly used to inform legislative and regulatory policies, as well as private accreditation schemes (Croney and Millman, 2007).

However, despite its growing influence, there is still no universally accepted definition of welfare (Hewson, 2003). Among animal welfare scientists there appears to be strong support for one particular theory known as welfare hedonism (Table 2.1). Welfare hedonism is the view that subjective experience is the only non-instrumentally valuable constituent of welfare (Petersen and Ryberg, 2014). On this view, an animal's welfare is diminished if, and only if, the animal experiences negatively-valenced feelings (referred to generally as pain, but also including various other negative emotions such e.g. fear, depression, boredom) and enhanced if, and only if, the animal experiences positively valenced feelings (referred to generally as pleasure) (Duncan, 2004; Sandoe and Simonsen, 1992). By extension, concepts such as 'quality of life' are said to refer to the net balance of

positive over negative psychological states over an extended period of time (Mench, 1998; McMillan, 2000; Yeates, 2011; 2016; UFAW, 2016).

Table 2.1 Select quotations representing welfare hedonism.

"To be concerned about animal welfare is to be concerned with the subjective feelings of animals."	Dawkins, 1988
"…animal welfare is dependent solely on the mental, psychological and cognitive needs of the animals concerned…as long as the mental state is protected (i.e., as long as the animal "feels" all right) then its welfare will be all right…animal welfare is dependent solely on the cognitive needs of the animals concerned"	Duncan and Petherick, 1991
"…something can only affect the welfare of an animal if it affects the conscious experiences of the individual."	Sandoe and Simonsen, 1992
"…the animals perception of its condition must serve as the basis for well-being…"	Gonyou, 1993
"Animal welfare consists of the animal's positive and negative experiences."	Simenson, 1996
"…welfare will depend on the relative preponderance of positive over negative experiences during the animal's lifetime."	Mench, 1998
"Quality of life refers to a state of mind; it is conscious, subjective, mental experience."	McMillan, 2000
"Welfare is a characteristic of animals, i.e. it is a descriptive property of animals…The welfare state of an animal is determined by all the emotional states and only the emotional states insofar as they are experienced subjectively by that animal….Per definition, a drugged animal that is kept in a permanently euphoric state has high welfare status even though it may be questioned whether this is morally acceptable."	Bracke, 2001

"Welfare is fulfilled when the animals do not feel any long lasting negative emotions and when they can experience positive emotions."	Desire, et al., 2002
"...animal welfare is all to do with the secondary, subjective feelings, with the absence of negative feelings, particularly the strong negative feelings we call suffering and with the presence of positive feelings that we call pleasure."	Duncan, 2004
"An individual's overall welfare depends on the combination of all its current experiences…Like overall welfare, Quality of Life is a matter of the animal's mental experiences. It is effectively a balance of all experiences within a specific period."	Yeates, 2011
"Animal welfare is a state within the animal…how the animal feels now."	Hemsworth et al., 2015
"Animal welfare is a state that is subjectively experienced by an animal; it is a state within the animal."	Mellor, 2016
"The welfare of any sentient animal is determined by its individual perception of its own physical and emotional state."	Webster, 2016
"Welfare is net happiness (enjoyment minus suffering)."	Ng, 2016
"…an animal's welfare state reflects what the animal itself experiences subjectively, i.e., its affective experiences or affects."	Littlewood and Mellor, 2016

Importantly, the hedonist position construes welfare as a descriptive concept (Haybron, 2008). Determining whether or not an animal is happy is seen as solely a matter of accurately representing or describing the animal's mental states. If the animal is perceived as meeting the requisite psychological criteria (i.e. low negative affect and high positive affect) then the concept is said to apply and the animal is happy. External,

normative considerations of the sort commonly associated with objective list theories (e.g. physical health, naturalness, bodily integrity) are not directly relevant.

We believe that there is good reason to question this account of welfare. An alternative possibility suggests welfare cannot simply be a matter of experiencing certain mental states, because the concept itself is not purely descriptive (Fraser, 1995). This alternative view sees welfare as a 'thick concept' containing both descriptive and normative content (Tiberius, 2013). When we ascribe happiness we are not simply representing or describing their mental state - we are evaluating their life circumstances more generally; we are deciding whether it is a life we would endorse, encourage or recommend (Kagan, 1994).

One way to adjudicate between these competing analyses is to determine which of them best reflects ordinary, common sense usage (Sumner, 1996, Taylor, 2013). By investigating patterns in how ordinary people apply or do not apply their concepts in particular situations we can gain insights into their fundamental structure and function (Knobe and Nichols, 2013). In the case of animal happiness, this criterion resonates with calls for closer correspondence between theories of animal welfare and public values (Dawkins, 2008; Fraser, 2008).

In what follows we describe the first attempt to systematically study the folk concept of animal happiness. Contrary to popular hedonistic conceptions of animal welfare put forth by many scientists, we hypothesized that judgments of animal happiness would be influenced by factors other than the animal's subjective experience. Specifically, we predicted that normative judgments about the life the animal was living would influence folk attributions of happiness.

2.2 Methods

This study received ethics approval from the Behavioural Research Ethics Board (H15-03053) at the University of British Columbia.

Participants (n=502) were recruited using Amazon Mechanical Turk and randomly assigned to read one of four vignettes (See Table 2.2) describing the life of a hypothetical chimpanzee. Following the general principles outlined in the Contrastive Vignette Technique, (Burstin et al., 1980), scenarios were designed to systematically manipulate the descriptive mental states (positive affect vs. negative affect) the chimpanzee was described as experiencing, as well as the normative value of her life (good life vs. bad life) thereby, creating a fully-crossed 2 (affect) x 2 (life value) experimental design.

Table 2.2 Vignettes for each experimental condition

Feels good/good life. Sally is a female chimpanzee living in the jungle. She lives in a troop with six other chimpanzees and often interacts with them. She spends most of her days roaming the jungle and foraging for food. She is in good physical health and has many healthy offspring who also live with her. Along with her food, Sally eats Aspilia leaves every day. These leaves serve as a natural stimulant that promotes mental health. A team of neuropsychologists and primate experts, using state-of-the-art technology, has recently determined that Sally spends almost all of her time feeling excellent.	*Feels bad/good life.* Sally is a female chimpanzee living in the jungle. She lives in a troop with six other chimpanzees and often interacts with them. She spends most of her days roaming the jungle and foraging for food. She is in good physical health and has many healthy offspring who also live with her. Along with her food, Sally eats Aspilia leaves every day. These leaves serve as a natural stimulant that promotes mental health. Nonetheless, a team of neuropsychologists and primate experts, using state-of-the-art technology, have recently determined that Sally spends almost all of her time feeling terrible.
Feels good/bad life. Sally is a female chimpanzee living in a primate research facility. She lives alone apart from any other chimpanzees and seldom interacts with her caretakers. She spends most of her days in her indoor enclosure, waiting for food to be delivered. She is in poor physical health and has never had any offspring. Along with her food, Sally is given a dose of psychoactive drugs every day. These drugs serve as an artificial stimulant that promotes mental health. A team of neuropsychologists and primate experts, using state-of-the-art technology, has recently determined that Sally spends almost all of her time feeling excellent.	*Feels bad/bad life.* Sally is a female chimpanzee living in a primate research facility. She lives alone apart from any other chimpanzees and seldom interacts with her caretakers. She spends most of her days in her indoor enclosure, waiting for food to be delivered. She is in poor physical health and has never had any offspring. Along with her food, Sally is given a dose of psychoactive drugs every day. These drugs serve as an artificial stimulant that promotes mental health. Nonetheless, a team of neuropsychologists and primate experts, using state-of-the-art technology, have recently determined that Sally spends almost all of her time feeling terrible.

Our primary dependent variable consisted of a single item asking participants to indicate how much they agreed/disagreed with the following statement, "Sally is happy" using a seven-point response scale (1 = *Strongly disagree* through 7 = *Strongly agree*). Participants subsequently responded to several other items about other commonly

encountered prudential adjectives presented in random order (e.g. 'well-being', 'welfare', 'quality of life').

After indicating the extent to which they thought the chimpanzee was happy, participants responded to a 'true-false' manipulation check ("Sally spends almost all of her time feeling terrible") followed by basic demographic questions. To preempt concerns that participants might not use the concept of 'happiness' when referring to non-humans, we also included an item asking: "Do you think it makes sense to talk about a chimpanzee as being happy?" Response options consisted of a seven-point response scale anchored at 1 with "Definitely not", at 4 with "Not sure", and at 7 with "Definitely yes". Lastly, participants were thanked and compensated ($0.50).

Prior to data collection it was decided that subjects would be excluded from analysis for any one of the following reasons: a) missing responses, b) indicating that English was not their native language, c) having an IP address originating outside the US, or d) failing the manipulation check. In total, responses from 29 participants were excluded from our analyses.

Multiple regression analyses using R language (R Core Team, 2015) were conducted for each concept (e.g. happy, welfare, well-being, quality of life, etc.) using subjective experience (high positive affect/low negative affect and low positive affect/ high negative affect), life value (good versus bad life) and the interaction between them as predictors.

2.3 Results

Our final sample consisted of 473 participants (51% female, Age: mean= 38, *SD* = 12). Participants appeared comfortable referring to chimpanzees as being happy (mean = 6.12, *SD* = 1.34). Main effects on judgments of happiness were observed for both subjective

experience and life value. Subjects in the feels good condition viewed Sally as happier (mean = 5.25, *SE* = 0.12) than those in the feels bad condition (mean = 1.81, *SE* = 0.07; $t(471) = 24.31$, $p \leq .0001$). Subjects in the good life condition believed Sally was happier (mean = 4.35, *SE* =0 .15) than those in the bad life condition (mean = 2.69, *SE* =0.13; $t(471) = 8.42$, $p \leq .0001$).

The interaction between experience and life value was significant for all concepts tested (Table 2.3). The effect of subjective experience on judgments of happiness depended on the life the animal was described as living, and vice versa. When Sally was described as feeling bad, the evaluation of the life she was living had less of an effect on happiness judgments then when she was described as feeling good.

Table 2.3 Effect of treatment by concept including interaction term

Concept	*β*	*SE*	*t-value*	*P*
HAPPY				
Intercept	1.46	0.12		
Feels good (*vs* Feels bad)	2.54	0.17	15.30	<.0001
Good life (*vs* Bad life)	0.72	0.16	4.39	<.0001
Feels good x Good life	1.64	0.23	7.04	<.0001
UNHAPPY				
Intercept	6.35	0.12		
Feels good (*vs* Feels bad)	-2.23	0.18	-12.56	<.0001
Good life (*vs* Bad life)	-0.68	0.18	-3.84	<.0001
Feels good x Good life	-1.72	0.25	-6.90	<.0001
WELFARE				
Intercept	2.11	0.13		
Feels good (*vs* Feels bad)	0.92	0.18	5.00	<.0001
Good life (*vs* Bad life)	1.83	0.18	10.06	<.0001
Feels good x Good life	1.57	0.26	6.08	<.0001
WELL-BEING				
Intercept	1.83	0.12		
Feels good (*vs* Feels bad)	1.56	0.18	8.88	<.0001
Good life (*vs* Bad life)	1.75	0.17	10.07	<.0001
Feels good x Good life	1.43	0.25	5.81	<.0001
QUALITY OF LIFE				
Intercept	1.88	0.12		
Feels good (*vs* Feels bad)	0.99	0.18	5.54	<.0001
Good life (*vs* Bad life)	2.13	0.18	11.98	<.0001
Feels good x Good life	1.44	0.25	5.74	<.0001
GOOD LIFE				
Intercept	1.88	0.12		
Feels good (*vs* Feels bad)	1.11	0.17	6.68	<.0001
Good life (*vs* Bad life)	2.24	0.16	13.61	<.0001
Feels good x Good life	1.20	0.23	5.15	<.0001

2.4 Discussion

Our results replicate and extend previous research showing that the concept of human happiness is not restricted to describing mental states. One cross-cultural study of historical trends of language use found that happiness has most commonly been equated with favorable external conditions and not internal feelings (Oishi et al., 2013). An extensive series of experimental studies by Phillips et al. (2011; 2014) showed that judgments of human happiness were heavily influenced by normative evaluations about the life the person was described as living. Our results therefore support the conjecture that the concept of happiness functions similarly when applied to some non-human animals (Sumner, 1996; Foot, 2003; Kraut, 2009). This suggests that further conceptual insights into animal welfare might be found by attending more closely to the much more developed philosophical and scientific literatures on human welfare (Degrazia, 1996; Nordenfelt, 2011).

Although we showed that the concept of happiness can function similarly in the case of some non-humans, it seems likely that this effect may vary from species to species depending on their moral status. While it is generally the case that moral concern for animals is growing, the strength of these concerns varies widely by species (George et al., 2016). Some studies have shown such concerns increase proportionally with perceived biological and behavior similarity with humans (Batt, 2009). Other work paints a more complex picture whereby factors such as emotional attachment to individual animals as well as historical and cultural influences mediate this relationship (Amiot and Bastian, 2017). Including covariates that take into account variations in moral attitudes would provide a more nuanced picture of the role they play in shaping and influence judgments of animal welfare.

Interestingly, the interaction effect we observed indicated that the influence of these evaluative considerations was less pronounced when the chimpanzee was described as feeling bad as opposed to when she was described as feeling good. This was also the case with respect to judgments of unhappiness, which were less influenced by evaluative considerations. This is consistent with previous findings by Phillips (2014; experiment 4) who reported that unlike happiness, when deciding whether or not someone was unhappy, people did in fact seem to be representing the target's mental states. This asymmetry between the seemingly polar opposite concepts of happiness and unhappiness may have important implications for animal welfare science. As the field shifts its focus from the prevention of negative welfare to the promotion of positive welfare (Tannenbaum, 2002; Yeates and Main, 2008) the role of evaluative judgments may become relatively more prominent.

Our methodological approach offers several advantages over previous research examining how different groups conceptualize animal welfare. Unlike these earlier studies, which have been largely exploratory in nature (Te Velde and Van Woerkum, 2002; Lassen et al., 2006; Skarstad et al., 2007; Spooner et al., 2014a), our experimental design allowed us to systematically manipulate key variables and test a specific hypothesis. Moreover, instead of simply asking people to define animal happiness, we inferred their concept of happiness based on concept usage. This indirect approach to studying concepts respects the fact that people can possess a concept while being mistaken, and/or unable to express information about its properties (Laurence and Margolis, 1999).

Unfortunately, we cannot comment on the extent to which animal welfare scientists adhere to welfare hedonism. Our assumption of its popularity was based on the written statements of animal welfare scientists (Bracke, 2001; Duncan, 2004; Mellor, 2016) and

our own personal experiences working in the field. The only research involving animal welfare experts that we are aware of reported finding that animal welfare experts equated welfare with subjective feelings while lay participants held a more complex view (Lassen, et al., 2006). We encourage future research that more closely examines the views of welfare scientists and how they compare with ordinary people.

The current research is consistent with the classification of happiness and its cognates as 'thick concepts'. Thick concepts have the dual function of simultaneously describing and evaluating (Tiberius, 2013). When people are deciding whether or not an animal is happy they are not to simply trying to determine whether some factual state of affairs obtains or not (i.e. was the animal experiencing positive affect?), they are making an evaluation about the life the animal is living. The idea that life evaluation is an important aspect of welfare has been noted elsewhere but never before considered with respect to animals (Kagan, 1994; Mulnix and Mulnix, 2015).

Our life evaluation manipulation emphasized two previously suggested non-subjective aspects of welfare - physical health and natural living. The bad life condition consisted of having poor physical health and living in an animal research facility whereas the good life condition consisted of having excellent physical health and living in the wild. Objective list theories of welfare often include but are not limited to, these specific features. Some theorists include other non-subjective factors besides these as constituents of animal flourishing (Nussbaum, 2006). Our goal here was not to arbitrate among specific list items, but rather to test the specific claim that subjective experience is the only item on that list.

Viewing animal welfare as a thick concept may help explain some of the skepticism expressed towards animal welfare research, especially by those with more deontological inclinations (Haynes, 2012). If one is of the opinion that some forms of animal use are

morally illegitimate, perhaps because animals are being used as mere means, then the very notion that animals can be happy in such conditions may seem incoherent. This might also explain the controversy surrounding the relationship between death and animal welfare. Animal welfare scientists have often dismissed the notion that death is welfare relevant (Webster, 1994). However, if the concept of welfare contains an evaluative dimension focused not simply on the animal itself but the broader circumstances and conditions in which the animal exists, then judgments about the moral acceptability of killing animals may in fact influence the animal's welfare (Tannenbaum, 2002). The thick conception of welfare makes the prediction that moral views about the legitimacy of different forms of animal use influence the determination of whether an animal is flourishing or not.

This thick concept status is not compatible with the pure science model of animal welfare, which posits that welfare can be scientifically studied without invoking any value judgments (Broom, 1991). In principle, such a position might be tenable if the concept under investigation were purely descriptive, but as we have seen this does not appear to be the case. Our results support Tannenbaum's (1991) contention that, "it is impossible to use the term welfare as it is ordinarily employed by people without committing oneself to certain ethical judgments." What exactly this all means for the field of animal welfare science is not immediately clear. Discussions along these lines are beginning to occur in the context of the science of human happiness and may provide a useful model moving forward (Alexandrova, 2015).

2.5 Conclusion

Previously it has been suggested that the study of animal welfare and ethics will benefit from experimental philosophy research (Persson and Shaw, 2015). Here we have

described the first attempt to systematically examine the folk concept of animal happiness. We found folk judgments of animal happiness were not consistent with the predictions of welfare hedonism which asserts that happiness is a solely a matter of possessing the right psychological states. It appears that it is possible to distinguish between how one's life goes from the inside based on how they feel, and how their life is evaluated as going from the outside.

Chapter 3: Farm size and animal welfare

3.1 Introduction

Historically, livestock production has been predominantly small scale and extensive, and it still remains this way throughout much of the world. However, in the last century many countries have intensified their livestock production. Agricultural intensification is characterized by many changes (Thompson, 2008): increased automation and specialization, changes in the nature and quantity of inputs (e.g., non-renewable vs. renewable, off farm vs. on farm, and high input vs. low input), confinement of livestock in more controlled and restrictive environments, consolidation of ownership, substitution of capital for labor, vertical integration and supply contracts, increased reliance on nonfamily labor, and—the focus of this paper—increased farm size.

Many members of the public believe that animals raised on larger farms have poorer welfare than those reared on smaller farms (Lassen et al., 2006; Krystallis et al., 2009; Tonsor et al., 2009). A representative sample of U.S. citizens found that most (57%) agreed or strongly agreed with the statement, "farm animals raised on small farms have a better life than those raised on large farms" (Lusk et al., 2007). Farmers, however, seem to view farm size as much less related to animal welfare (Vanhonacker et al., 2008).

Judging the accuracy of these perceptions is difficult because size is a complex variable. The categorization of farms as "small" or "large" depends greatly on context. What is considered a large dairy farm in Norway, where mean herd size is 26 cows (Statistics Norway, 2015), is likely different than in New Mexico, where mean herd size exceeds 2,000 cows (USDA-NASS, 2015). Size categorizations also depend on the species of livestock.

Although a dairy farm with 5,000 cows is likely to be considered large by almost any standard, a poultry farm with the same number of birds would be too small to be commercially viable in many countries.

The aim of this paper is to review and critically assess the literature relevant to the relationship between farm size and the welfare of farm animals. Given that we are most familiar with the work on dairy cattle, we have focused on those animals, but where applicable, we also cite literature on other farmed animals. To provide context, we begin with a brief review of recent changes in farm size.

Increases in average farm size have occurred as a result of many operators exiting the industry, with those that remain increasing in size. For example, between 1970 and 2006 the number of both U.S. and Canadian dairy farms decreased by approximately 88% (Singbo and Larue, 2014). Despite the precipitous decline in the number of livestock farms, global demand for animal products continues to increase, especially in developing and emerging economies (Thornton, 2010). To meet this growing demand, remaining farms have increased the size of their operations considerably.

This increase is apparent for virtually all commonly farmed species but is most pronounced in species and stages of production that rely heavily on concentrate feeding (Fraser, 2008). In Canada, the average number of pigs per farm increased 32% between 2006 and 2011 (Statistics Canada, 2015). In China, the number of swine farms with more than 1,000 head increased by 55% between 2007 and 2009 (USDA-FAS, 2011), and the number of dairy farms with 500 to 999 cows has increased by 72% from 2008 to 2009 (Sharma and Zhang, 2014). Between 1974 and 2013, mean dairy herd size in New Zealand

increased by 258% from 112 to 402 cows (Dairy New Zealand, 2014). Similarly, the average size of Australian dairy herds increased by 230%, from 86 in 1979 to 284 in 2014 (Dairy Australia, 2015). Between 1995 and 2008 the average size of dairy and poultry farms in the Netherlands doubled, and the average size of pig farms tripled (De Bakker et al., 2012).

These figures likely understate the extent to which farm size has increased since they come from skewed distributions containing many very small farms, whereas production is disproportionally concentrated on larger farms. For instance, MacDonald et al. (2016) compared mean changes in U.S. dairy farm size between 1987 and 2012 with weighted median herd size, the point at which half of all cows, as opposed to farms, are in larger herds and half are in smaller herds. They found that the mean herd size grew from 50 to 144 cows (+188%) during this period, but the weighted median herd size increased from 80 to 900 (+1,025%; Fig. 1).

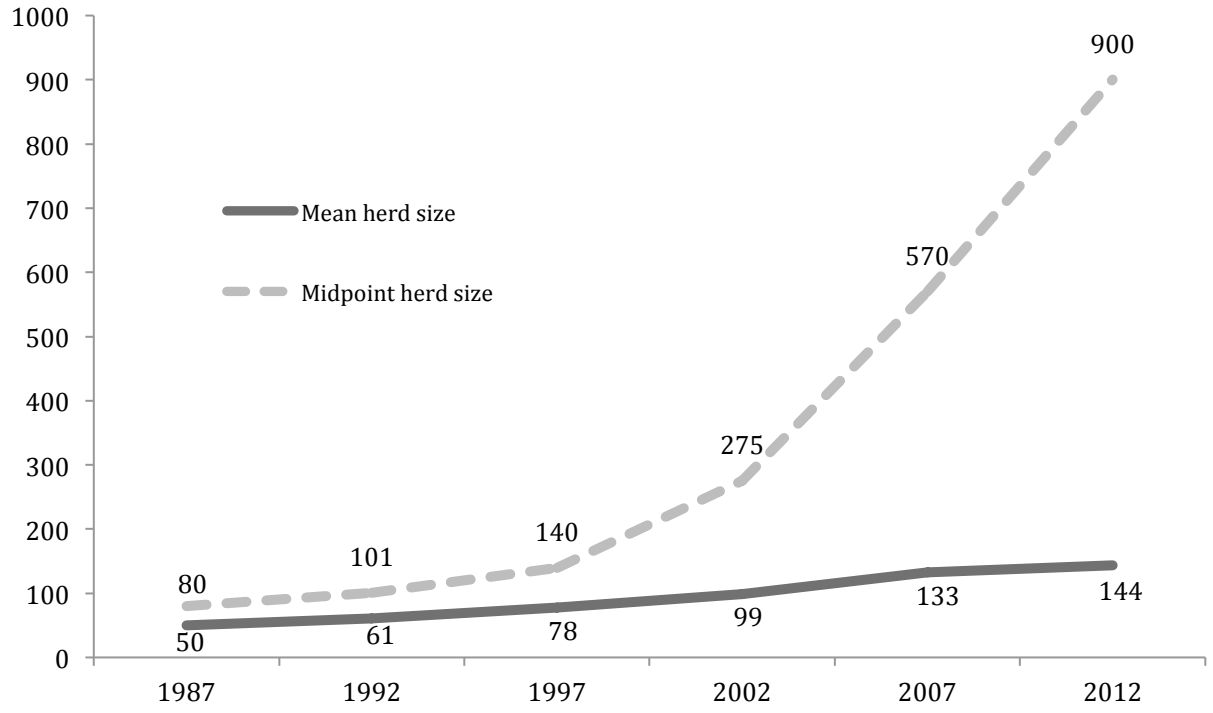

Figure 3.1 Comparison of mean and midpoint herd size changes for U.S. dairy farms (1987-2012). Redrawn from MacDonald et al. (2016).

Multiple factors contribute to these increases in farm size. Those most often cited include economies of scale, learning curve effects, technological advancements, increased labor mobility, and an increasing urban-rural income gap, as well as increasingly competitive markets.

Economies of scale refer to the ability to spread fixed costs over a larger number of animals, thereby reducing production costs per unit of output. Economies of scale also permit farmers to reduce variable costs by taking advantage of volume discounts via bulk purchasing (Duffy, 2009). Learning curve effects describe the tendency for productivity per unit time to increase with experience (Gehani, 1998). Such effects are accentuated by a

growing scientific understanding of the processes underlying livestock production. Technological innovations like climate-controlled housing, veterinary pharmaceuticals, and individual animal monitoring systems make it more feasible to raise large numbers of animals with less labor (Fernandez-Cornejo et al., 2007; Russell and Bewley, 2013).

Moving beyond the farm, a variety of studies have found that the availability of higher-paying urban employment opportunities encourage people to leave the sector (Todaro, 1969; Fields, 1975; Mazumdar, 1976; Seeborg et al., 2000; Zhang and Song, 2003). Last, increasingly competitive agricultural markets have reduced profit margins, which in turn have strengthened incentives to reduce per-unit production costs and have required operators to increase herd or flock size to maintain incomes (Reardon and Barrett, 2000; Fraser, 2008).

Many critics contend that increased farm size has been injurious to the environment, food safety, food quality, human health, rural communities, and animal welfare (Harrison, 1964; Berry, 1977; Schlosser, 2001; Pollan, 2006; Foer, 2010, Kirby, 2010). This has led to popular support for legislative and regulatory restrictions on farming practices such as confinement livestock housing (Centner, 2010) and increased demand for agricultural products produced using alternative methods such as organic (Sahota, 2009). Survey data suggest that U.S. consumers believe larger farms are "less likely to share their values" and are "more likely to place profit ahead of public interest" (Center for Food Integrity, 2013). Strong opposition to larger farms has been found not only in the United States (Darby et al., 2008) but also in Belgium, Denmark, Germany, Greece, and Poland (Verbeke et al., 2010; Sørensen et al., 2012). Some countries, such as the Netherlands, have

even considered legislation that would place caps on the size of farms (Government of the Netherlands, 2013).

3.2 Methods

We reviewed published, peer-reviewed studies that reported differences in farm size and some aspect of animal welfare. To minimize subjective distinctions regarding absolute size, we simply compared "larger" and "smaller" farms within each study on the basis of herd or flock size. Studies that relied on non-animal-based measures of farm size (e.g., land base, income, employees, etc.) were not included. Studies were excluded if they involved very small group sizes (2 to 12 animals) created for experimental purposes and not reflective of commercial farms in that region. We also did not include studies that considered species other than cattle, chickens, turkeys, sheep, goats, and pigs.

During our literature search we used specific key words, and combinations of keywords, including "farm size," "herd size," "flock size," "group size," "risk factor(s)," "large farm(s)," "small farm(s)," "large herd(s)," "small herd(s)," "large flock(s)," "small flock(s)," "management practices," "animal welfare," "animal well-being," and "animal health." To increase our coverage, we systematically repeated this search using Web of Science and Google Scholar search engines, as well as directly searching journals that specialize in applied animal science research, including *Acta Veterinaria Scandinavica*, *Animal Science*, *Animal Welfare*, *Anthrozoos*, *Applied Animal Behaviour Science*, *Applied Animal Welfare Science*, *Dairy Science*, *Livestock Science*, *Preventative Veterinary Medicine*, *Preventative Veterinary Medicine,* and *Veterinary Record*. We then searched forward and backward in time by examining the papers cited in the studies we identified and any paper that cited

these papers. Governmental reports containing information of management practices, such as the USDA National Animal Health Monitoring System (NAHMS), were also reviewed.

In line with a widely cited interpretation of animal welfare (Fraser et al., 1997), we construed indicators of welfare broadly as any measure related to the animal's biological functioning (health and mortality), affective state (including painful procedures and positive interactions with people), and the ability of the animal to live a reasonably natural life. Evidence regarding the amount or quality of care provided by farm workers to the animals was also reviewed. The effects of this "care" on the animal's welfare may be uncertain, but considerations of the care provided to animals can be an important component in citizen appraisals of livestock welfare (Ventura et al., 2015).

Below we describe the results of our review, describing how different animal welfare factors are associated with farm size. We then discuss the various relationships, including how farm size may be associated with different measures of welfare.

3.3 Results

Health

Various studies have recorded between-herd disease prevalence (the percentage of farms where at least 1 animal is diagnosed with the condition in a given herd) and within-herd prevalence (the proportion of animals diagnosed with the condition in question). Between-herd prevalence typically increases with herd size for obvious reasons: the more animals you assess, the greater the probability is that at least 1 of them will test positive. For example, dairy farms with more than 100 milking cows were more likely to have calves that tested positive for cryptosporidium (Garber et al., 1994). Indeed, a large, stratified

random sample representing 21 states and approximately 86% of U.S. dairy cattle showed that between-herd disease prevalence for several common diseases affecting dairy cattle tended to increase with herd size, even though the proportion of affected cows within a herd decreased (Hill et al., 2009). From the perspective of animal welfare, within-herd prevalence is the more relevant measure and is the focus of the studies reviewed below.

Many studies have examined the relationship between health outcomes and herd size, with some studies showing a positive relationship between herd size and health outcomes, others finding a negative relationship, and yet others reporting no relationship (Table 3.1). These measures are discussed by order of the number of studies available.

Table 3.1 Empirical research on dairy cattle examining a) health and b) mortality indicators in relation to herd size. Indicators are listed in order of the number of studies available, and then listed alphabetically within each measure. The methods used to collect data on the indicator (e.g. self-reports by the farmer, scored by the researcher, etc.), association with herd size (positive, not significant, and negative), number of farms used to derive the relationship (separately by region and year if appropriate), the country where the study was performed and the citation are provided. Missing values indicate the variable was not reported.

Indicator	Detection Method	Assoc. w/ herd size	# of farms	Country	Reference
A) Health					
Lameness					
	Self report	Pos.	165	Denmark	Alban, 1995
	Scored	N.S.	205	Britain	Barker et al., 2010
	Scored	Pos.	194	Netherlands	de Vries et al., 2014
	Self report	Pos.		Ireland	Arkins, 1981
	Scored	Neg.	40 & 39	U.S.	Chapinal et al., 2013
	Scored	N.S.	50	U.S.	Espejo & Endres, 2007
	Scored	Neg.	34	China	Chapinal et al., 2014
	Self report, Scored	Neg.	222	U.K.	Leach et al., 2010a
	Self report	N.S.	45	U.S.	Groehn et al., 1992
	Self report	Pos.	486, 341 & 248	Britain	Whitaker et al., 2004
	Self report	Neg.	91	Britain	Whitaker et al., 2004

Indicator	Detection Method	Assoc. w/ herd size	# of farms	Country	Reference
	Self report	Pos.	73	Australia	Harris et al., 1988
	Self report	Pos.	80	France	Faye & Lescourret, 1989
	Scored	N.S.	19	Norway	Amory et al., 2006
	Scored by hoof trimmer	N.S.	703	Finland	Kujala et al., 2009
	Scored	Neg.	141	Canada	Solano et al., 2015
	Scored	Pos.	103	Austria	Dippel et al., 2009
	Vet. report	Neg.	1822	Britain	Rowlands et al., 1983
	Scored	N.S.	59	N.Z.	Fabian et al., 2014
	Scored	Pos.	34	Turkey	Yaylak et al., 2010
	Scored	N.S.	152	Switzerland	Busato et al., 2000
	Scored	Pos.	40	Greece	Katsoulos & Christodoulopoulos, 2009
	Scored by hoof trimmer	N.S.	57	Norway	Sogstad et al., 2005
Hock lesions					
	Scored	N.S.	80	U.K.	Rutherford et al., 2008
	Scored	Pos.	63	U.K.	Potterton et al., 2011
	Scored	N.S.	38 & 38	U.S.	Barrientos et al., 2013
	Scored	N.S.	152	Switzerland	Busato et al., 2000
	Scored	N.S.	34	China	Chapinal et al., 2014
	Scored	N.S.	232	Norway	Kielland et al., 2009
Claw lesions					
	Scored	N.S.	112	Norway	Sogstad et al., 2005
	Scored by researcher	N.S.	117	Netherlands	Frankena et al., 1992
Digital dermatitis					
	Self report	Pos.		U.S.	Wells et al., 1999
	Scored	N.S.	383	Norway	Holzhauer et al., 2006
	Scored	N.S.	37	Netherlands	Somers et al., 2005a
	Scored	N.S.	46	Netherlands	Somers et al., 2005b
	Scored by researcher	N.S.	22	Chile	Rodriguez-Lainz et al. 1999
	Scored by researcher	Pos.	123	Netherlands	Frankena et al., 1993
Mastitis					
	Records	Pos.	7551 & 2128	U.K.	Archer et al., 2013
	Records	Pos.	274	Norway	Barkema et al., 1998
	Records	Neg.		Norway	Waage et al., 1998b
	Records	Neg.	11719	U.S.	Oleggini et al., 2001
	Records	Neg.	23431	Norway	Sviland & Waage, 2002
	Records	Neg.	3450	U.S.	Allore et al., 1997
	Records	N.S.	340	England	Whitaker et al., 2000
	Records	N.S.	91	Britain	Whitaker et al., 2004
	Records, Self	Neg.	273	Britain	Wilesmith et al., 1986

Indicator	Detection Method	Assoc. w/ herd size	# of farms	Country	Reference
	report				
	Researcher tested	N.S.	92	Australia	Hoare & Roberts, 1972
	Records	N.S.	144	England	Kossaibati et al., 1998
	Samples	Neg.	501	Britain	Wilson & Richards, 1980
	Producer/Vet. diagnosed	Pos.	50	U.S.	Bartlett et al., 1992
	Records	Neg.	812	Norway	Simensen et al., 2010
Salmonella spp.					
	Fecal sample	Pos.	105	U.S.	Huston et al., 2002
	Fecal sample	Pos.	110	U.S.	Fossler et al., 2005
	Self report	Pos.	126	Netherlands	Vaessen et al., 1998
	Fecal sample	Pos.	91	U.S.	Kabagambe et al., 2000
	Fecal sample	Pos.	46	U.S.	Warnick et al., 2001
	Fecal sample	Pos.	831	U.S.	Cummings et al., 2009
	Fecal sample	Pos.	91	U.S.	Wells et al., 2001
	Fecal sample	Pos.	449	U.K.	Davison et al., 2006
	Fecal sample	Pos.	12	U.S.	Warnick, et al., 2003
	Fecal sample	Pos.	97	U.S.	Blau et al., 2005
	Fecal sample	Pos.	97	U.S.	Evans & Davies,1996
Ketosis					
	Self report	Neg.	1268	Sweden	Bendixen et al., 1987
	Blood samples	Neg.	25	Jordan	Al-Rawashdeh, 1999
	Vet. records	Neg.	17793	Norway	Solbu, 1983
	Milk samples	Pos.		Finland	Lindstrom et al., 1984
	Vet. records	Neg.	306	Norway	Rieman et al., 1985
	Vet. diagnosis	Pos.	283	Finland	Saloniemi & Roine, 1981
	Records	Neg.	812	Norway	Simensen et al., 2010
Diarrhea, calves					
	Vet. records	Pos.	100	Austria	Klein-Jöbstl et al., 2014
	Self report	Pos.	92	U.S.	Frank & Kaneene, 1993
	Self report	Pos.	906	U.S.	Wells et al., 1996a
Crypto. spp.					
	Fecal sample	Pos.	1103	U.S.	Garber et al., 1994
	Fecal sample	N.S.	44	U.S.	Szonyi et al., 2012
Metritis					
	Self report	Pos.	97	U.S.	Kaneene & Miller, 1994
	Records	N.S.	2144	Denmark	Bruun et al., 2002
	Vet. diagnosis	Pos.	283	Finland	Roine & Saloniemi, 1978
Dystocia					
	Records	N.S.	2627	Ireland	Mee et al., 2011
	Vet. diagnosis	N.S.	283	Finland	Roine & Saloniemi, 1978
Displaced abomasum					
	Records	Pos.	60	Sweden	Stengarde et al., 2012

Indicator	Detection Method	Assoc. w/ herd size	# of farms	Country	Reference
Milk fever					
	Vet. Records	Pos.	17793	Norway	Solbu, 1983
Respiratory disease					
	Vet. diagnosis	Pos.	431	Norway	Norstrom et al., 2000
	Self report	Pos.	906	U.S.	Wells et al., 1996a
Prolapses					
	Vet. diagnosis	N.S.	283	Finland	Roine & Saloniemi, 1978
B) Mortality					
Calves					
	Self report	Pos.	247	U.S.	Hartman et al., 1974
	Self report	Pos.	104	Canada	Waltner-Toews et al., 1986
	Records, Self report	Pos.	379	U.S.	Spreicher & Hepp, 1973
	Self report	Pos.	477	U.S.	Oxender, 1973
	Records	Pos.	14474	Norway	Gullikesen et al., 2009
	Records	Pos.	4103	U.S.	Silva del Rio et al., 2007
	Records	Pos.	93727	France	Raboisson et al., 2014
	Records	Pos.	407	U.S.	James et al., 1984
	Self report	Neg.	140	U.S.	Jenny et al., 1981
	Records	N.S.		Ireland	Mee et al., 2008
	Records	N.S.	4337	Denmark	Nielsen et al., 2010
	Self report	N.S.	416	U.S.	Walker et al., 2012
	Self report	N.S.	906	U.S.	Wells et al., 1996b
	Self report	Pos.	16	U.S.	Martin et al., 1975
	Self report	Pos.	48	U.S.	Lance et al., 1992
	Self report	Pos.	122	Sweden	Svensson et al., 2006
	Self report	N.S.	28	Italy	Zucali et al., 2013
	Records	N.S.	95	Italy	Lora et al., 2014
	Records	Neg.	2555	Ireland	Jago & Berry, 2011
	Records	Neg.	99221 & 94676	France	Raboisson et al., 2013
	Self report	N.S.	1539	US	Losinger and Heinrichs, 1997
Cows					
	Self report	N.S.	1306	N. Ireland	Menzies et al., 1995
	Records	N.S.	2534	Canada	Batra et al., 1971
	Records	Pos.		Denmark	Norgaard et al., 1999
	Records	Pos.	11259	U.S.	Smith et al., 2000
	Records	Pos.	186	U.S.	Weigel et al., 2003
	Records	Pos.	78178	U.S.	Hadley et al., 2006
	Records	Pos.	2574	U.S.	Dechow & Goodling, 2008
	Records	Pos.	953	U.S.	McConnel et al., 2008
	Records	Pos.	2815	Denmark	Thomsen & Sorensen, 2009
	Records	Pos.	2054	U.S.	Pinedo et al., 2010
	Records	Pos.	99200	France	Raboisson et al., 2011
	Records	Pos.	6898	Sweden	Alvasen et al., 2012
	Records	Neg.	45032	U.S.	Miller et al., 2008
	Records	Pos.	7188	U.S.	Shahid et al., 2015

Indicator	Detection Method	Assoc. w/ herd size	# of farms	Country	Reference
	Records	Pos.	145	Sweden	Alvasen et al., 2014
	Records	Pos.	6839	Denmark	Thomsen et al., 2006

Lameness

This is a chronically painful condition, with prevalence exceeding 20% in many herds (von Keyserlingk et al., 2012). Of 23 studies that addressed the relationship between herd size and lameness in dairy cattle, 9 found a higher prevalence in larger herds, 8 reported no difference, and the remaining 6 studies found that lameness prevalence was lower on larger farms. At least some of these differences may be explained by the differences in herd sizes considered in the different studies. For example, studies where herd size was relatively small (ranging from a low of 10 cows per farm to a high of about 200 cows) have tended to report increased lameness in larger herds (e.g., Rowlands et al., 1983; Alban, 1995; de Vries et al., 2014). In contrast, studies focused on larger herds (ranging from a low of about 150 cows to a high of more than 8,000 cows per farm) have reported the opposite relationship (e.g., Chapinal et al., 2013, 2014). These results suggest that the risk of lameness may have some curvilinear relationship with herd size, with lameness initially increasing and then declining with increasingly large herds.

In addition to these studies that have directly assessed lameness by evaluating the gait of cows, other studies have examined hock injuries that can contribute to lameness. Of 5 studies that measured hock lesion prevalence and farm size, 2 reported a positive relationship with farm size (i.e., more lesions on larger farms), and 3 others reported no

relationship. In summary, the available evidence suggests that there is no consistent relationship between farm size and lameness on dairy farms.

Udder Health

Mastitis (acute inflammation of the udder) is common in milking cows and is associated with infections due to a range of pathogens (see review by Barkema et al., 2009). In some studies mastitis cases are identified using clinical assessments of the cows, but in other cases infections are inferred on the basis of high somatic cell counts. Of 14 studies, 3 found higher rates of disease on larger farms. Seven studies found evidence of better udder health on larger farms, and the remaining 4 studies reported no relationship with farm size. For example, Kossaibati et al. (1998) followed 144 dairy herds over 3 yr and found no association between herd size and incidence of mastitis. We conclude that there is no consistent relationship between farm size and udder health on dairy farms.

Salmonella

Salmonella infections on dairy farms are a risk for consumers and farm workers, but the welfare consequences for the animal are less clear. All 11 of the studies that examined the prevalence of *Salmonella* infection and herd size reported higher prevalence in larger herds. Thus, the preponderance of studies finds increased risk in larger herds. In swine, evidence of an association between herd size and *Salmonella* is more mixed (Gardner et al., 2002).

Other ailments

Of 7 studies that examined within-herd prevalence of ketosis and herd size, 5 found lower rates of this disease in larger herds, whereas 2 found the opposite relationship. In

contrast, of 3 studies that examined diarrhea (a nonspecific sign of gastrointestinal disease), all found higher rates in larger herds. For the other ailments (i.e., metritis, dystocia, displaced abomasum, milk fever, and respiratory disease) we identified too few published studies to determine whether there is any consistent relationship with farm size.

Mortality

In addition to the specific conditions described above, poor health and welfare may also be reflected in higher rates of mortality. Of 16 studies that compared cow mortality rates across farms of different sizes, 13 reported higher mortality on larger farms, 1 reported lower mortality, and 2 reported no difference. Another 21 studies assessed differences in mortality of dairy calves across a range of farm sizes; 11 of these reported higher calf mortality on larger farms, 7 reported lower mortality on larger farms, and the remaining 7 studies reported no difference. This evidence suggests that cows are at a higher risk of dying on larger farms but that there is no consistent relationship between farm size and mortality for calves. These mixed results are also consistent with the few studies that have examined mortality on swine farms of differing sizes (Gardner et al., 2002).

The relationship between mortality, culling, and welfare is not easily interpretable. For example, in 2003 U.S. federal legislation was passed prohibiting the slaughter of nonambulatory cattle. This change likely resulted in many cows that would have previously been shipped for slaughter being euthanized on farm, thereby increasing on-farm mortality (Miller et al., 2008). High culling rates may reflect the aggressive removal and replacement of lower-producing cows (Fetrow et al., 2006); this may be welfare neutral or be associated

with welfare to the extent that low production is a result of disease or other problems with the animals' biological functioning. Other reasons for culling may be welfare neutral, for example, high beef prices (Maher et al., 2008). The decision when to euthanize (versus cull) may be important. One study reporting data collected in 2004 showed that the likelihood of having cull dairy cows condemned before slaughter increased with herd size, suggesting that the larger farms did a poorer job of assessing the suitability of cattle for transport (Hoe and Ruegg, 2006). However, more recent data indicate that a higher percentage of nonambulatory cows died (and were not euthanized) on farms with 30 to 99 cows (23.6%) than on operations that had more than 500 cows (14.8%; USDA-NAHMS, 2016).

Future studies should distinguish between animals that are found dead on the farm (likely related to poor welfare conditions) vs. those that were euthanized to prevent animal suffering as well as the reason why animals were culled. Many of the studies we reviewed provided too little detail on mortality measures to distinguish these events.

Of large farms (>500 cows) that reported having to euthanize a nonambulatory cow, approximately 72% did so within 2 d compared to only 59% in the case of small farms. Moreover, 6.4% of the small farms reported having waited more than 6 d before euthanizing nonambulatory cows; this is approximately 3 times longer than the value reported for large farms. The majority of large operations (57%) have standard operating procedures in place for caring for nonambulatory cows, which was not the case for smaller operations (16% to 24%; USDA-NAHMS, 2016). Overall, 2.6% of cows became nonambulatory during 2013, with large operations (>500 cows) reporting the lowest percentage (2.1%) compared to all other farm sizes, e.g., 4.7% on very small farms (<30 cows; USDA-NAHMS 2016).

We encourage future work to develop and record measures that better capture how much suffering cows experience in the final days of their lives and how this varies in relation to early culling decisions, on-farm euthanasia protocols, and other factors.

Painful Procedures

Many farmed animals experience painful surgical procedures like castration and dehorning, but farms vary in whether, when, and how the procedures are performed and thus how much pain the animals are likely to experience. There are few published data on the relationship between painful procedures and the size of dairy farms. However, the USDA-NAHMS (2009) survey of practices on U.S. farms did address dehorning practices and found that larger farms performed this procedure at younger ages, arguably providing some welfare benefit for the calves. Pain due to dehorning can be more meaningfully addressed by using pain control methods such as local anesthetics and postoperative analgesics (see review by Stock et al., 2013). Unfortunately, the provision of these treatments is still rare on U.S. farms, and there is no clear relationship between herd size and the provision of pain control (USDA-NAHMS, 2009).

Positive Interactions with Humans

It is almost inevitable that human interactions with the animals decrease as herd size increases, and several studies have reported this relationship. The majority of studies to date have focused on positive interactions. For example, Waiblinger and Menke (1999) reported that Austrian dairy farmers were less likely to take the time to brush their cows as herd size increased. Similarly, a study of French veal farms found that the frequency of positive interactions was lower on larger farms (Lensink et al., 2000). Although few studies

to date have addressed the topic in dairy cattle, the frequency of negative interactions may also decrease on larger farms. One study of pig farms showed that the percentage of stockpersons displaying predominately negative behaviors toward pigs was 57% on smaller farms vs. 43% on larger farms (Hemsworth and Coleman, 2010).

Measures of avoidance of humans have been used as an indicator of fear in farm animals. The smaller the avoidance distance (the closer you can get to an animal without it fleeing) is, the less fearful the animal is believed to be. Mattiello et al. (2009) measured avoidance distances on dairy farms and found that cows on smaller farms could be approached more readily. Similarly, veal calves on smaller farms were more willing to approach a passive experimenter (Leruste et al., 2012). However, a large study looking at both dairy cattle and dairy goats found that goats were less likely to avoid people on smaller farms, but that was not the case with dairy cattle (Mattiello et al., 2010). The authors attributed this species difference to the limited variation in management among dairy cattle farms in their study.

'Naturalness'

People often refer to the animal's ability to live a reasonably natural life as a necessary condition for good welfare, and many equate having access to pasture as essential for a good life in dairy cattle (Cardoso et al., 2016). Recent survey data indicate that the use of pasture decreases with increases in farm size; farms having fewer than 100 cows are far more likely (>70%) to incorporate pasture, particularly during the summer months, compared to medium (100 to 499 cows; 32%) or large farms (>500 cows; 5%; USDA-NAHMS, 2016). However, pasture use is often associated with tie stall and stanchion housing, where cows are restrained for the majority of each day and may be turned out to

pasture for exercise. Tie stalls are still common on farms with fewer than 100 cows, whereas larger farms more typically use free stall and open lot housing where cows are not restrained (USDA-NAHMS, 2016).

Evidence from other farmed species suggests that smaller farms are at an advantage in terms of an animal's ability to live a reasonably natural life. Small poultry operations (when defined as between 1,000 and 9,999 birds) are more than 10 times as likely to provide birds with outdoor access compared to larger flocks (USDA-NAHMS, 2008). Even within alternative housing systems for poultry, flock size is inversely associated with outdoor access (Green et al., 2000; Bestman and Wagenaar, 2003). Smaller U.S. swine operations tend to wean later, which more closely approximates the natural weaning process (USDA-NAHMS, 2015). Smaller swine operations are also more likely to provide rooting substrate for pigs (Czekaj et al., 2013), an enrichment believed to improve welfare by decreasing abnormal behavior and increasing play (Bolhuis et al., 2005; Tuyttens, 2005). In summary, smaller farms appear more likely to provide outdoor access and some other management practices that allow animals to express more natural behavior.

Other Assessments of Welfare

Given the multidimensional nature of animal welfare, assessments that take into account multiple indicators may be more helpful than those that consider just a single dimension. To our knowledge there are no comprehensive studies on dairy cattle examining multidimensional assessments of welfare in relation to farm size. A few studies have taken this type of comprehensive approach on other animals. For example, 1 Irish study (Mazurek et al., 2010) evaluated welfare in 194 beef herds using 33 environmental and resource-based indicators covering 5 categories (locomotion, social interactions,

flooring, environment, and stockpersonship) and found that overall welfare scores decreased as farm size increased. Another study of 20 commercial sheep farms in Great Britain, using qualitative welfare assessment, found no relationship between flock size and overall animal welfare scores (Stott et al., 2012). A third study of pig farms in Croatia reported that larger farms did a better job of meeting the 5 freedoms (Wellbrock et al., 2010).

Violations of animal care regulations may provide another method of evaluating welfare. Countries vary in the extent to which farm practices are codified in law, but in some countries where farm animal welfare is more highly regulated, studies have looked at how noncompliance varies with farm size. A study of 73 Danish dairy farms found no effect of herd size on the likelihood of welfare violations (Otten et al., 2014). Similarly, a study of Danish pig farmers found no relationship between farm size and welfare violations (Czekaj et al., 2013). A Swedish study reported that violations were more common and severe on smaller, more diverse farms (Hess et al., 2014). The authors attributed this finding to differences in the degree of specialization and higher opportunity costs associated with smaller farms. A Danish study analyzing government records also reported no association between animal care violations and farm size (large farms were defined as having more than 150 cows or more than 2,000 pigs) and concluded that most violations resulted from a combination of socioeconomic and psychiatric risk factors (Andrade and Anneberg, 2014). Several studies have shown that farmers on smaller farms are more stressed (Simkin et al., 1998) and at increased risk for suicide (Gregoire, 2002), which in turn may also put animals at greater risk.

More studies are needed to assess multidimensional estimates of welfare, but work to date shows no consistent relationship with farm size. Also, the number of legal violations is not consistently related to farm size, although some evidence suggests that smaller farms may be at greater risk.

Farm Size and Farmer Attitudes Relative to Animal Welfare

Farmer attitudes about animal welfare are correlated with animal welfare outcomes on farms (Kielland et al., 2010), and farmer beliefs and attitudes about animal welfare are known to vary with production system (e.g., organic vs. conventional; Dockès and Kling-Eveillard, 2006; Sørensen and Fraser, 2010; Bracke et. al., 2013). Opponents of larger farms assert that as farms increase in size, profitability-oriented values come to replace nonuse values such as animal welfare (Hess et al., 2014). We are unaware of research examining a broad range of dairy farmer attitudes about animal welfare in relation to farm size, although a few studies have examined specific issues. For example, 2 studies (Hoe and Ruegg, 2006; Wikman et al., 2013) examined farmer perceptions about the ability of cattle to feel pain and found no effect of farm size. Another study of Kentucky dairy producers found no association between farm size and the likelihood of a farmer defining "success" in terms of animal well-being. However, larger farms were more likely to define success in terms of milk production per cow, suggesting greater emphasis on economic aspects of dairy production as farm size increased (Russell and Bewley, 2013). On the other hand, a study of Turkish sheep farmers (Kilic and Bozkurt, 2013) found that what they called "perceptions of animal welfare" were lower on larger farms and that these lower perceptions correlated with providing less space per animal and poorer air quality. It is worth noting that a number of studies have found that larger farms are more likely to

participate in environmental conservation programs and implement practices designed to minimize environmental impacts (Knowler and Bradshaw, 2007).

Farm Size and Professionalization

Animals raised within the same production system can have different levels of welfare depending on how the system is managed, and management structures and practices vary with farm size (Fraser, 2005). Mirroring the general process of industrialization, as farm size increases, the relative importance of family labor decreases, and managerial positions focused on coordinating and supervising workers become more common (Hadley et al., 2002). Larger farms are more likely to require and benefit from standard operating procedures and employee training intended to improve consistency and minimize human error. Division of labor (i.e., specialization) also tends to increase with farm size. Whereas workers on smaller farms may be responsible for a variety of tasks ranging from fieldwork to accounting, employee supervision, equipment repair, and animal care, tasks on larger farms are often much more specialized (Hyde et al., 2011).

Larger farms also appear to be more receptive to science-based recommendations. For instance, larger dairy farms are more likely to implement recommended best management practices for colostrum feeding and adhere to biosecurity recommendations (Hoe and Ruegg, 2006; USDA-NAHMS, 2009; Ellis-Iversen et al., 2010). Russell and Bewley (2013) found that smaller farms (1 to 49 cows) were less likely than larger farms (>200 cows) to use the advice of nutritionists, veterinarians, and consultants in making management decisions. A German study of 429 dairy farms found that routine veterinary visits were more common in larger herds (Heuwieser et al., 2010). The percentage of U.S.

dairy farms that consulted a veterinarian increases with herd size, as does the frequency of these visits (USDA-NAHMS 2016). A study of nearly 900 Australian dairy farms found that larger herds had a higher proportion of workers with formal qualifications and industry training (Beggs et al., 2015). There is also evidence suggesting that smaller producers are more likely to take off-farm employment, thus reducing the amount of time spent on the farm (Fernandez-Cornejo et al., 2007).

Farm worker satisfaction is thought to be important in ensuring a high degree of animal welfare (Rushen and de Passillé, 2010). One correlate of job satisfaction is compensation (Judge et al., 2010), and several studies of U.S. dairy farms have found that employee compensation is positively correlated with farm size (Mugera and Bitsch, 2005). Similar results were found in the U.S. swine industry, where larger operations pay workers more and provide more and better benefits than smaller operators, even after controlling for worker skill (Hurley et al., 1999). These findings are consistent with the wider business literature that finds a positive relationship between establishment size and employee compensation (Brown and Medoff, 1989).

In summary, these results indicate that farm workers tend to be better paid, better trained, more specialized, and more satisfied on larger farms. These differences may contribute to better quality of care provided to animals on larger farms.

3.4 Discussion

Our review does not support the contention that there is a consistent relationship between farm size and welfare on dairy farms or, indeed, other types of livestock farm. Moreover, the differences that exist are unlikely to be caused directly by size but by other

factors associated with size such as economic viability, staffing level, awareness of and exposure to emerging issues, professional management, and access to resources (e.g., time, capital, expert consultants, scientific information, etc.). Smaller farms are more likely to raise animals outdoors in extensive conditions, which some people view as integral to high welfare. However, many smaller farms use the same controversial practices as their larger counterparts (e.g., gestation stalls, painful surgery without analgesia) and in some cases do so to an even greater degree; for example, tie stalls, which greatly restrict movement, are more common on smaller dairy farms. New research is required to tease apart the different aspects of intensification to determine their relative importance to the quality of life of animals.

Larger farms tend to have fewer workers per animal (Bewley et al., 2001), so they are at a disadvantage in terms of providing individualized care. This is a problem if, as Anthony (2003) argued, farmers should be able to "form bonds with all their animals." However, there is little evidence to suggest that the ratio of caretakers to animals is a useful indicator of this bond or of animal welfare. Simply considering the frequency of possible interactions fails to recognize that such interactions can be positive, negative, or neutral (Hemsworth and Barnett, 1992; Hemsworth et al., 1993; Zulkifli, 2013). Animal care is likely to be affected by other factors, including the nature of the group being managed (e.g., newborn or adult, healthy or ill, wild or tame, aggressive or docile), the skill and disposition of the stockperson, and the degree to which technology is used to enhance, extend, or replace traditional husbandry activities. Intuitively, positive interactions should contribute to improved welfare on these farms, but the literature also suggests that many farm

animals are naturally fearful of humans, thus making contact aversive (at least initially) despite the positive intentions of the caregiver (Rushen et al., 1999; Boivin et al., 2003).

Other variables related to farm size, including production style (e.g., extensive vs. intensive), profitability, degree of specialization, technology, and stocking density, may better explain variation in animal welfare. For example, Barker et al. (2010) reported that the strong association between herd size and lameness on dairy farms ceased to be significant when other factors such as breed, production type, and milk yield were added to their model. Along similar lines, Leontides et al. (1994) also found that the relationship between pig farm size and pseudorabies ceased to be significant when factors such as stocking density were taken into account.

Perhaps most notably, Alban (1995) found that cows belonging to farmers who were uncertain about continuing as dairy producers had a 1.6-fold increase in the odds of lameness. USDA census data show that larger dairy farms tend to be more economically viable (returns exceed operating expenses on average) and are thus more likely to report that they would still be in business in the next 5 yr (MacDonald et al., 2007). Longer planning horizons and greater access to resources may make farms more willing and able to adapt to changing social values and scientific evidence (Waddock and Graves, 1997).

We argue that any reported association between farm size and animal welfare should be accompanied by some plausible explanation of the mechanism by which the relationship occurs and a discussion of the intervening variables. If farm size is used as a surrogate for a broader range of concerns about intensification, then adopting more holistic measures of intensification, rather than size, is likely to be more appropriate. For

instance, a recent European Food Safety Authority report (EFSA Panel on Animal Health and Animal Welfare, 2015) incorporates aspects such as source of workforce, level of input use, use of breeds, and production style, in addition to farm size. This more sophisticated analysis is likely to better reflect social concerns and thus be more useful to farmers and others in developing industry policy by more accurately identifying the causal factors that result in better and worse welfare outcomes.

3.5 Conclusion

Farm size and animal welfare exhibit no consistent relationship. Although larger farms are more likely to adopt some practices (such as worker training and standard operating procedures) that benefit animal welfare, they are less likely to use other practices (such as pasture access) that may also be beneficial. The oversimplified view that animal welfare is better on smaller farms may create complacency among small farmers (allowing welfare problems to persist) and fails to focus efforts on specific welfare challenges that need to be resolved on farms of all sizes.

Chapter 4: Effect of openness on trust and perceptions of animal welfare

4.1 Introduction

In January 2008, an undercover investigation at the Hallmark-Westland Meat Packing Company in Chino, California, captured video footage of workers dragging, kicking and electrically-shocking dairy cattle unable to walk. At one point, a worker attempts to force a prostrate cow to stand by repeatedly ramming her with the blades of a forklift. These graphic scenes sparked a great deal of controversy[7], leading to the largest meat recall in U.S. history (more than 64 million kg of beef); a multi-million dollar civil lawsuit, multiple felony animal cruelty convictions (Flaccus, 2009); and a federal ban on the slaughter of non-ambulatory cattle (USDA, 2009). Since 1998, there have been approximately 117 such undercover investigations of livestock farms conducted in North America (Animal Visuals, 2015).

In response to what they believe to be extreme and unfair representations of their industries, many livestock groups have supported legislation designed to restrict these undercover investigations. Commonly referred to as 'ag-gag' laws, this legislation contains provisions that prohibit intentionally deceiving employers and taking or possessing photographs, video, or audio recordings without farmer consent (Landfried, 2013; Broad, 2014; Shea, 2014). Such legislation has been introduced in at least 16 U.S. states – having been passed into law in eight (Marceau, 2015).

The results of several polls show that when informed, a significant majority of the public are opposed to 'ag-gag' laws (Jacobs, 2011; ASPCA, 2012). Opposition is also found within the agricultural community. One poll conducted by a prominent cattle industry

[7] As of March 25 2015, this video has received approximately 1.3 million views on YouTube.

publication asked its readership, “Are ‘ag gag’ laws a good idea for the livestock industry to pursue?” and found that of the more than 500 responses, more than 60% of respondents said “No” (Radke, 2012). Opponents of these laws often argue that such laws create the impression that animal agriculture has something to hide which leads to distrust (Broad, 2014).

Rousseau et al. (1998) put forth a widely accepted definition of trust as, “a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behaviors of another.” The decision of whether or not to trust depends not only on the dispositions of the trustor, but crucially on the perceived trustworthiness of the trustee (Mayer et al., 1995). A number of factors have been proposed to influence judgments of trustworthiness including the extent to which individuals or organizations are perceived to be transparent about their practices (Peters et al., 1997; Fisman and Khanna, 1999; Maeda and Miyahara, 2003; Rawlins, 2008). In turn, transparency has been found to be positively associated with purchasing intentions, loyalty and willingness to share positive information about a particular company with others (Chaudhuri and Holbrook, 2001; Kang and Hustvedt, 2014). Evidence also suggests that transparency may be especially important following a crisis, which is precisely the time when the temptation to limit transparency is greatest (Jahansoozi, 2006; Auger, 2014). Thus, the trust literature points to an interesting paradox: policies intended to prevent reputational damage by restricting information flow may, in fact, further undermine trustworthiness.

Despite its importance, trust has received relatively little scientific attention within the context of agriculture. Using a current, real-world policy initiative, we conducted an experiment to determine whether the perceived intention to limit transparency impacts

trust. We predicted that learning about 'ag-gag' laws would result in: 1) lower levels of trust in farmers; 2) more negative perceptions about the welfare of farm animals and; 3) greater support for more laws protecting animal welfare.

4.2 Methods

This study received ethics approval from the Behavioural Research Ethics Board (H13-01466) at the University of British Columbia.

After conducting a power analysis on a similar pilot study, we determined that we would need approximately 750 participants to achieve 90% power and recruited 758 participants via Amazon's Mechanical Turk (AMT). AMT participants have been shown to be more diverse than standard samples (e.g. internet, college student, community) whilst also providing data of equally reliable quality (Buhrmester et al., 2011; Goodman et al., 2012; Paolacci and Chandler, 2014). Participants were invited to participate in "a short survey about human psychology and public policy". Participation was limited to U.S. residents 18 years of age or older. After consenting, participants were randomly assigned to either the Control or Law (treatment) condition.

Subjects in the Law group were told that, *"Several U.S. states are considering a new law regarding the flow of information from livestock farms."* and that we were looking for their honest opinion of this law. Participants were then presented with three features common to ag-gag legislation:

> 1. *Restricts or bans video/audio recording and photographing of farms, or the possession of any such materials, without permission from the owner.*
>
> 2. *Makes it illegal to obtain employment at any farm under false pretenses (i.e. using a fake name or not disclosing your plan to film/record).*

3. *Requires any documented evidence of farm animal abuse be turned over to authorities within a specific amount of time (e.g. within 48-120 hours).*

Next, participants were provided with a counterbalanced list of three common arguments provided by supporters and opponents of these laws. To limit potential negativity bias (Rozin and Royzman, 2001), the labels 'supporters' and 'opponents' were avoided. Instead the phrases, "those in favor of this law" and "those not in favor of this law" were used. Participants were then asked to indicate their level of support for the law on a 7-point likert scale (1 = *strongly oppose*, 7 = *strongly support*) followed by a question asking whether or not they were aware of this legislation before taking our survey. As a buffer between stimuli and dependent measures, participants completed two unrelated psychological inventories that will not be discussed here further (complete materials can be found in the supplementary online materials).

Our primary dependent variable was self-reported trust measured using a 10-item scale developed and validated by Frewer et al. (1996) to assess trust regarding food-related hazards. In addition to being respondent generated, this scale was selected because it is sensitive to different sources (e.g. farmers) and topics (e.g. animal welfare) of trust. These items asked participants to indicate their level of agreement with a variety of statements about farmers as sources of information on the subject of farm animal welfare on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*) (e.g. *"Information about farm animal well-being from farmers is trustworthy."*). Using the same Likert scale, participants then answered several questions designed to gauge their perceptions of farm animal welfare (e.g. *"In general, farm animals have good lives."*). To obscure our intent, these items were intermixed with items reflecting a variety of controversial agricultural

issues not involving animal care and welfare (e.g. *"Agricultural chemicals and pesticides are causing human health problems."*). These items also allowed us to test the specificity of any effects of ag-gag legislation on perceptions of farm animal welfare being versus agriculture in general. Finally, participants completed basic demographic questions including: age, gender, political affiliation, rural-urban living, dietary preference, etc.

Participants in the Control condition did not read about ag-gag legislation; instead they were provided generic information modified from the Wikipedia entry for "hay". This material was selected as it was loosely related to the study focus (agricultural issues) and was edited to approximate word count and cognitive load requirements of the treatment condition (e.g. *"Hay is grass, legumes or other herbaceous plants that have been cut, dried, and stored for use as animal fodder, particularly for grazing livestock such as cattle, horses, goats, and sheep."*). Subjects in the Control condition then completed the identical buffer, the modified farmer trust inventory, general perceptions items and demographics, all in the same order as the Law condition.

Upon completion, all participants were debriefed, thanked and paid $0.50.

4.3 Results

Participants were excluded from analysis (n = 42) for invariant responding or failure to pass an attention check (Oppenheimer et al., 2009) leaving a final sample of 716 participants.

Subjects included in this study consisted of a nationally diverse sample of 716 U.S. adults. The sample was 49% female with the majority (78%) of respondents between 18 and 44 years of age. Complete demographic information can be seen in Figure 4.1. Demographics were consistent with large body of literature showing that M-turk

participants are significantly more representative than standard convenience samples. Of participants who received information about the law (n = 324), few (9%) reported being aware of such legislation before participating in the current study. A majority of those who received information about the law were opposed to it (64% opposed vs. 24% support).

Table 4.1 Demographic characteristics of sample and test of condition independence.

Demographics (%)	**Total n = 716**	**Control n = 392**	**Treatment n = 324**	**P value**
Age				
18-24	123(17.2)	65(16.6)	58(17.9)	.884
25-34	316(44.1)	175(44.6)	141(43.5)	
35-44	121(16.9)	66(16.8)	55(17.0)	
45-54	73(10.2)	43(10.1)	30(9.3)	
55-64	68(9.5)	38(9.7)	30(9.3)	
65 or Above	13(1.8)	4(1.0)	9(2.8)	
Female	348(48.6)	195(49.7)	153(47.2)	.509
Education				.970
Some high school	8(1.1)	4 (1.0)	4(1.2)	
High school graduate	65(9.1)	37(9.4)	28(8.6)	
Trade or vocational degree	16(2.2)	13(3.3)	3(0.9)	
Some college	196(27.4)	93(23.7)	103(31.8)	
Associate degree	86(12.0)	59(15.1)	27(8.3)	
Bachelors degree	256(35.8)	138(35.2)	118(36.4)	
Graduate or profess. degree	87(12.2)	47(11.0)	40(12.3)	
Living Environment				.523
Urban	209(29.2)	108(27.6)	101(31.2)	
Suburban	364(50.8)	201(51.3)	163(50.3)	
Rural	136(19.0)	79(20.2)	57(17.6)	
Total Household Income				.386
Less than 60,000	475(66.3)	267(68.1)	208(64.2)	

Demographics (%)	Total n = 716	Control n = 392	Treatment n = 324	P value
$60,001 – $199,999	197(27.5)	99(25.3)	98(30.2)	
≥ $200,000	11(1.5)	9(2.3)	2(0.6)	
Political Party Affiliation				.222
Democrat	293(40.9)	151(38.5)	142(43.8)	
Republican	118(16.5)	69(17.6)	49(15.1)	
Independent	280(39.1)	157(40.1)	123(38.0)	
Religious	277(38.7)	150(38.3)	127(39.2)	.736
Pet Owner	457(64)	246(62.8)	211(65.1)	.519
Vegetarian/Vegan	56(8)	27(6.9)	29(9.0)	.320

Negatively-worded items measuring trust were reversed scored and then combined to form an index of trust ranging from 1 (complete distrust) to 7 (complete trust). The 10-item trust inventory showed high internal reliability ($\alpha = 0.91$, CI_{95} [95% Confidence Interval] 0.89, 0.93). The mean trust score in the control condition was 4.47 (*SD* = 1.02); participants in the Law condition had lower trust, with a mean trust rating of 3.59 (*SD* = 0.98). Thus, learning of the restriction to information flow proposed by ag-gag legislation lead to 0.88 (CI_{95} 0.73, 1.03) point drop in trust ($t(714) = 11.72$, $p < 0.0001$); Fig. 4.1). This effect remained significant after controlling for all demographic characteristics (0.83; CI_{95} 0.68, 0.98; $t(662) = 10.88$, $p < .0001$ (Table 4.2).

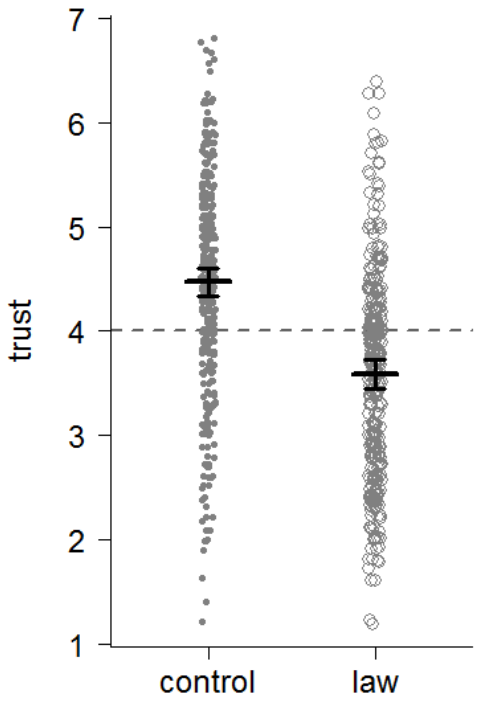

Figure 4-1 Trust in farmers significantly decreases after learning about ag-gag laws ($p < .0001$). Filled points (·) represent participants in the Control condition; open circles (o) represent participants in the Law condition; error bars correspond to 99% confidence intervals of the mean.

Table 4.2 Effect of treatment by demographic category.

Variable	**β**	**SE**	**t-value**	**P**
Intercept	5.03	0.22		
Law	**-0.83**	**0.08**	**-10.88**	**<.001**
Female	-0.05	0.08	-0.61	.541
Age	0.00	0.03	0.07	.948
Education	-0.02	0.03	-0.75	.453
Income	0.07	0.08	0.94	.347
Democrat (*vs.* Republican)	**-0.30**	**0.11**	**-2.73**	**.006**
Independent (*vs.* Republican)	**-0.33**	**0.11**	**-2.97**	**.003**
Urban (*vs.* rural)	**-0.36**	**0.11**	**-3.21**	**.001**
Suburban (*vs.* rural)	**-0.22**	**0.10**	**-2.12**	**.034**
Pet owner	-0.16	0.08	-1.92	.056
Religious	0.14	0.08	1.73	.084
Vegetarian	**-0.52**	**0.14**	**-3.61**	**<.001**

Further analysis showed that the effect of reading about the law was similar across important demographic groups. For participants on the Control condition, Republicans held the highest levels of trust in farmers (mean = 4.82, SD = 0.98) compared to Democrats (mean = 4.42, SD = 1.02) and Independents (mean = 4.35, SD = 1.02). The drop in trust after reading about the law did not vary by political affiliation ($p > 0.9$) and the magnitude of decline was such that Republicans who had read about the law reported less trust in farmers than Democrats who had not read the law (Fig. 2a.).

Similarly, people living in rural areas were more trusting in farmers than those living in the suburbs or urban environments. Again, the drop in trust after reading the law did not vary by living environment (urban-rural) ($p > 0.6$) and was so large that people living in rural environments who had read about the law reported less trust in farmers than people living in urban environments who had not read about the law (Fig. 2b.)

Finally, omnivores reported more trust in farmers than did vegetarians (see Table 1). Again, the drop in trust after reading about the law did not vary with diet ($p = 0.139$). Omnivores who had read about the law reported less trust in farmers than vegetarians who had not read about the law (Fig. 2c.).

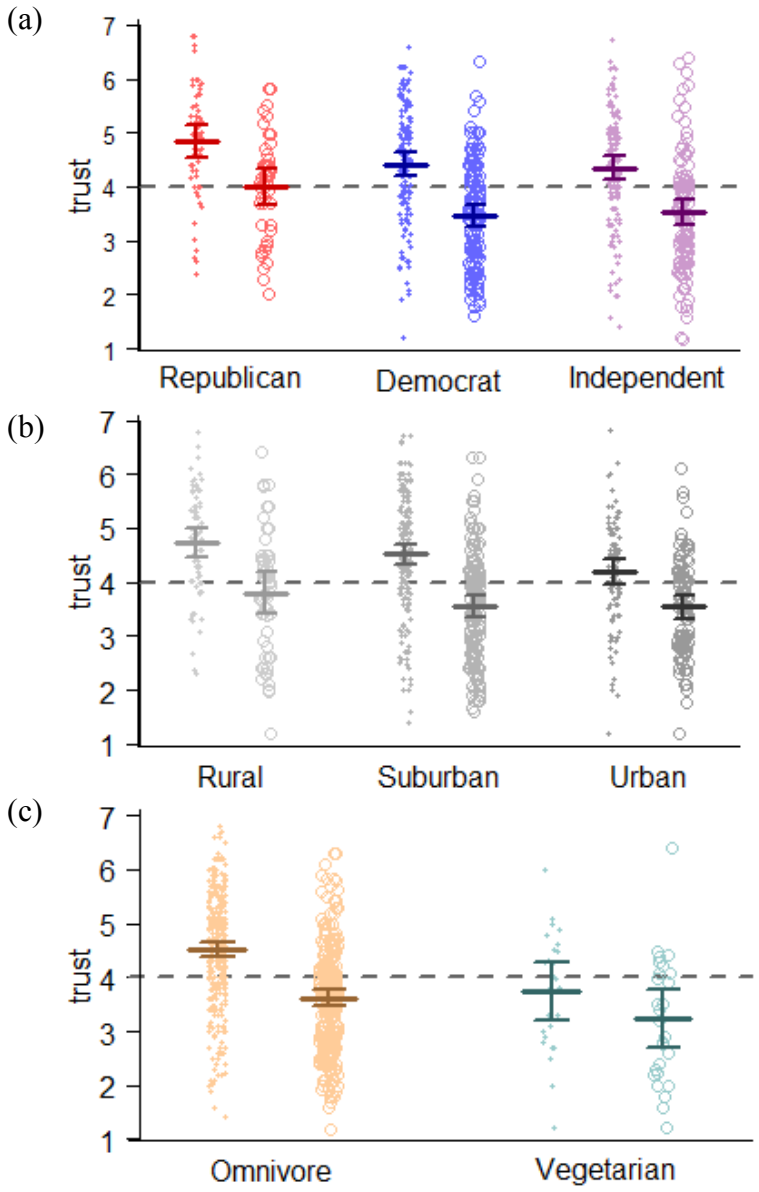

Figure 4-2 Regardless of (a) political affiliation, (b) living environment and (c) dietary preference - trust in farmers significantly decreased after learning about ag-gag laws ($p < .001$). Points (·) represent participants in the Control condition; open circles (o) represent participants in the Law condition; error bars correspond to 99% confidence intervals of the mean.

Learning of ag-gag legislation also reduced perceptions of farm animal welfare by 0.73 points (CI_{95} 0.50, 0.95; $t(714) = 6.42$, $p < .0001$) and reduced how comfortable participants reported feeling about farm animal welfare by 0.31 points (CI_{95} 0.08, 0.54; $t(714) = 2.62$, $p = .009$). Learning of the law increased support for stricter laws protecting

farm animals by 0.23 points (CI_{95} .01, 0.44; $t(714) = 2.07$, $p = .038$) and, interestingly, decreased the perception that farmers do a good job of protecting the environment by 0.50 points (CI_{95} 0.29, 0.72; $t(714) = 4.49$, $p < .0001$). Reading about the law did not affect perceptions of food safety or worker's rights (p's > 0.15).

4.4 Discussion and conclusion

Results of this study showed that learning about ag-gag legislation, which restricts the flow of information coming out of farms, reduced trust in farmers. This finding is consistent with previous predictions that have, until now, remained empirically untested (Adam, 2011: Negowetti, 2014). The reduction in trust we observed was as pronounced among the most initially trusting demographic categories (rural, conservative, omnivores) as it was among the least trusting (urban, liberal, vegetarians). Importantly, the overall decrease in trust represented a shift from slightly trusting, to slightly distrusting farmers.

Consistent with previous research showing that low levels of trust are associated with increased support for sanctions (Balliet and Van Lange, 2013), exposure to information about ag-gag legislation also increased support for more regulations aimed at protecting farm animals. Animal welfare regulations increase industry-operating costs (Brouwer, 2012) that are then passed down to consumers. Following California's implementation of voter approved animal welfare regulations governing space requirements for laying hens, consumer egg prices increased by 33-70% (Malone and Lusk, 2016). This range is commensurate with estimated per unit cost increases borne by producers (Sumner et al., 2010). Regulations also affect non-consuming taxpayers in the

form of increased taxes for administrative and enforcement activities associated with new regulations (Antle, 1999).

Lending support to the view that ag-gag laws foster the impression farmers have something to hide (Broad, 2014), we found perceptions of the current status of farm animal welfare were more negative among participants exposed to information about ag-gag laws compared with subjects in the control group. Notably, this effect was limited to perceptions relating to the care and welfare of animals; it did not affect perceptions of worker rights or food safety. Learning about the law did affect perceptions of farmers' care of the environment, however. After reading about ag-gag laws, fewer participants agreed with the statement, *"Farmers do a good job of protecting the environment (water, air, soil, wildlife etc.)"*. Taken together these results suggest that blocking access to information about one domain of activity (e.g. treatment of animals), may cause people to form negative impressions of activities in closely related domains (e.g. treatment of the environment, etc.), but not in more distantly related domains (e.g. food safety).

Previous research has found animal protection groups are considered to be more credible sources of information sources than livestock industry groups (McKendree et al., 2014) and that this positive perception tends to increase following animal abuse scandals (Scudder and Bishop-Mills, 2009; Tiplady et al., 2013). This reaction is consistent with the general societal tendency to view whistleblowers favorably (Callahan and Dworkin, 2000), despite their destabilizing social impacts (Hersh, 2002). Thus, it is possible that in addition to harming their own reputations, individuals or organizations attempting to block access to information may also be bolstering the credibility of their antagonists. While we were unable to test this hypothesis in the current research, these findings suggest intriguing follow up studies investigating the ramifications of reducing transparency.

The communication and conflict resolution literatures point towards more productive reactions to crises. Responses previously identified as resulting in more positive evaluations of transgressors have included acceptance of responsibility (Nadler and Liviatan 2006), apology (Ohbuchi et al., 1989), expressions of empathy and remorse for victims (Schwartz et al. 1978; Pace et al., 2010) and corrective action (Dutta and Pullig 2011). Our results provide initial support that increasing operational transparency also merits consideration for inclusion with these other accommodative responses.

These findings indicate that restricting access to information can have negative reputational consequences for the interested parties. Indeed, it is possible that the intention to reduce transparency erodes trust more than awareness of the negative events they seek to inhibit. The relevance of this dynamic becomes especially important when one considers that the majority of legislation introduced in the U.S. never becomes law, yet can still receive significant public attention.

Chapter 5: The case of dehorning young dairy calves – a painful procedure.

5.1 Introduction

Disbudding and dehorning are common management practices on dairy farms performed to reduce the likelihood of injury to cattle and farm workers (AVMA, 2012). The term 'disbudding' refers to the destruction or excision of horn producing cells before skull attachment; 'dehorning' entails the excision of the horn after this tissue has attached to the skull. The time of attachment varies by breed and individual animal, but is thought to occur around 8 weeks of age when the horn bud is approximately 5-10 mm long (Stafford and Mellor, 2005).

Disbudding is usually achieved by burning the innervated tissue immediately surrounding the bud either using a hot iron (~600 °C) or caustic paste, while dehorning is typically done surgically using a mechanical gouger, wire or saw. Since disbudding is performed at an earlier age and entails less tissue damage, it is generally considered less invasive and therefore preferable to dehorning (AVMA, 2012). Several U.S. studies have found a substantial proportion of calves are dehorned rather than disbudded (Fulwider et al., 2008; USDA-NAHMS, 2009).

Regardless of timing or method, there is considerable behavioral, physiological and cognitive research indicating that all forms of disbudding and dehorning are painful (Stafford and Mellor, 2011). To address the pain caused by these procedures, a variety of pain management strategies have been investigated. The administration of local anesthesia (e.g. lidocaine) in combination with non-steroidal anti-inflammatory drugs (e.g. meloxicam) has been shown to provide effective pain control throughout the intra- and

post-operative periods (McMeekan et al., 1999; Milligan et al., 2004; Stewart et al., 2009; Heinrich et al., 2010; Stilwell et al., 2012; Huber et al., 2013). Distress associated with the handling and restraint required for administration of anesthetics and analgesics can be mitigated with the use of a sedative (e.g. xylazine) administered before the procedure (Faulkner and Weary, 2000).

These findings have informed a number of policies. The Council of Europe, that represents 47 member countries including all of the European Union member states, recommends the use of pain relief when disbudding calves more than 4 weeks of age (ALCASDE, 2009). In Sweden, Denmark and the Netherlands pain relief is legally required when disbudding/dehorning regardless of age (ALCASDE, 2009). There are no such legal requirements in the U.S. or Canada. However, the recently revised U.S. National Milk Producers Federation Farmers Assuring Responsible Management animal welfare program (NMPF-FARM) recommends calves be disbudded before 8 weeks of age using pain mitigation (NMPF, 2013). The Canadian Code of Practice for Care and Handling of Dairy Cattle states, "Pain control must be used when dehorning or disbudding" (NFACC, 2009). Regulations regarding pain control for disbudding and dehorning are also in place in New Zealand (NAWAC, 2005) and Australia (PIMC, 2004).

Despite evidence these procedures are painful, use of pain mitigation remains low in many parts of the world. For example, multiple U.S. surveys indicate that less than 18% of dairy farms reported using pain relief when disbudding or dehorning (Hoe and Ruegg, 2006; Fulwider et al., 2008; USDA, 2009). In a survey of more than 600 Italian dairy farmers less than 20% reported using some form of pain relief (Gottardo et al., 2011), and a survey of over 400 French dairy farms found that only 8 farms used local anesthesia for these procedures (Le Cozler et al., 2012). In Canada, the reported use of local anesthesia

was 22% in Ontario (Misch et al., 2007) and 45% in Quebec (Vasseur et al., 2010). Smaller farms appear somewhat more likely to provide pain relief (Gottardo et al., 2011), perhaps because veterinarians are more likely to perform these procedures on smaller farms (USDA, 2009). That said, involvement of a veterinarian is no guarantee pain relief will be provided; 37% of veterinarians in the United States (Fajt et al., 2011) and between 8-15% of veterinarians in Canada (Hewson et al., 2007; Misch et al. (2007) reported not using analgesia when dehorning dairy calves (< 6 months of age).

Analyzing the views of stakeholders may aid in identifying barriers to adoption of pain mitigation when disbudding/dehorning dairy calves. The goals of this study were to: 1) assess the normative beliefs of various stakeholders with respect to disbudding and dehorning and, 2) identify and reconcile discrepancies between these beliefs and available evidence.

5.2 Methods

This study received ethics approval from the Behavioural Research Ethics Board at the University of British Columbia.

The University of British Columbia's (UBC) "Your Views" web site (www.yourviews.ubc.ca) was created to engage people on ethical issues regarding science and technology. The "Cow Views" section focused on animal welfare topics related to dairy production. We used the N-Reasons platform designed to improve public participation in ethically significant social decisions (Danielson, 2010), including contentious issues facing the dairy industry (see Weary et al., 2011; Ventura et al., 2013; Schuppli et al., 2014).

The N-Reasons platform allowed for the collection of responses to close-ended questions (Yes, No and Neutral) and open-ended comments (the participant's reasons for

their choice). Participants were able to see votes and reasons put forward by previous participants, creating a virtual 'town-hall' environment. Self-administered, internet surveys such as this have been shown to minimize social desirability bias relative to more traditional, direct methods (Tourangeau and Yan 2007; Chang and Krosnick 2009; Heerwegh 2009).

Data were collected from November 30, 2010 until July 12, 2012. The survey was made available on the worldwide web, so anyone with access to the Internet could participate. Internet surveys result in diverse samples comparable to more traditional survey methods (Gosling et al., 2004). We preferentially targeted individuals working in the United States and Canadian dairy industry via advertisement at producer meetings, contacts at the United States Department of Agriculture, livestock feed companies, and a livestock pharmaceutical company. Additionally, we targeted animal advocates via a posting in the newsletter of the British Columbia Society for the Prevention of Cruelty to Animals. Broader public input was gathered from participants recruited via Amazon's Mechanical Turk crowd sourcing service (www.mturk.com). This combined sample should not be considered representative of any particular population. Rather our intent was to describe the range of themes that participants provide to support their views on this issue.

Participants taking the survey were provided with the following information on the practice of disbudding and dehorning dairy cattle:

> "The developing horns of dairy calves are typically removed to reduce the risk of injuries to farm workers or other cattle that can be caused by horned cattle. Horns of calves three months of age or older are normally removed surgically ("dehorning") by scooping, shearing or sawing. Horn buds of younger calves are typically removed ("disbudding") using a caustic paste or a hot iron.

> There is considerable scientific evidence that all of these procedures cause pain. The immediate pain can be reduced using a local anesthetic to provide a nerve block – this procedure has been used safely for decades and costs just pennies a shot. Pain can persist 24 hours or more; this longer lasting pain can be reduced using non-steroidal anti-inflammatory drugs (like the ibuprofen you take for a headache). Providing calves a sedative before the procedure can reduce handling stress and make the procedure easier to carry out.
>
> In many countries some pain relief is required. For example, Canada's new Code of Practice for the Care and Handling of Dairy Cattle requires that pain control be used. Approximately 18% of dairy farms in the United States report using pain relieving drugs for disbudding or dehorning dairy calves."

Participants were then asked:

> "Should we provide pain relief for disbudding and dehorning dairy calves?"

As people joined the discussion they were randomly assigned into one of eight groups (virtual 'town halls') with a mean size of 44 participants. Within each group, subsequent participants could see all previous participant's responses (yes/no/neutral vote, reasons and number of votes earned for each reason), but not responses from other groups. This way, each group provided an independent assessment and ensured that an especially articulate or persuasive reason could only influence votes within a single group.

Participants were asked to provide basic demographic information including gender (male or female), age (19-29, 29-39, 39-49, 49-59, 60+), educational attainment (secondary, college/university, masters/doctorate, other) or country of origin (U.S., Canada, other). Participants were also asked, "Which best describes your involvement with dairy production?" Choices included: no involvement, dairy producer/worker, student, veterinarian, dairy industry professional (e.g. nutritionist), or animal advocate. Differences among groups, and the effect of each demographic variable, on quantitative responses were tested separately using a Chi-square test, with significance declared at $P < 0.05$ (2-tailed).

Similar to previous studies using the N-Reasons platform (Weary et al., 2011; Ventura et al., 2013), participants were not required to write their own reason for their vote. They could select reasons submitted by other participants within their group. There was no limit as to how many unique reasons participants could select; however each selection was discounted by the total number of selections made by that individual; in this way, each participant could contribute just one 'vote' in total. Reasons were coded following the methods described by Knight and Barnett (2008). Two evaluators (J. A. Robbins and C. A. Schuppli), blind to demographic information, independently examined each reason line-by line, breaking them down into smaller 'chunks'. They then met to compare results and reconcile any discrepancies. Finally, these 'chunks' were compared and organized into common themes.

5.3 Quantitative results

A total of 354 individuals participated in this study (Table 5.1). Of these, 65% were female, 53% were >30 years old, 91% were from either the U.S. or Canada, and 22% had graduate degrees. Participants self-identified their involvement in the dairy industry as: dairy producer/worker (10%); veterinarian/industry professional (7%); student (16%); animal advocate (9%); or no involvement (57%).

Table 5.1 The number (and %) of participants (n =354) who supported ("Yes"), opposed ("No") or were "Neutral" regarding the provision of pain relief for disbudding and dehorning dairy calves.[1,2]

	Yes	**No**	**Neutral**
All participants (n = 354)	320(90.4%)	16(4.5%)	18(5.1%)
Gender (n =339)			

	Yes	No	Neutral
Female	207(93.2%)	5(2.3%)	10(4.5%)
Male	99(84.6%)	11(9.4%)	7(6.0%)
Age (n =339)			
19-29	143(89.9%)	9(5.7%)	7(4.4%)
30-39	71(89.9%)	1(1.3%)	7(8.9%)
40-49	51(92.7%)	3(5.4%)	1(1.8%)
50-59	25(89.3%)	2(7.1%)	1(3.6%)
60 +	16(88.9%)	1(5.6%)	1(5.6%)
Country of Origin (n = 339)			
Canada	110(89.4%)	8(6.5%)	5(4.1%)
U.S.A	168(90.8%)	6(3.2%)	11(5.6%)
Other	28(90.3%)	2(6.5%)	1(3.2%)
Dairy background (n =336)			
Producer/Worker	29(82.9%)	6(17.1%)	0(0.0%)
Veterinarian/Industry Professional	22(91.7%)	1(4.2%)	1(4.2%)
Student	48(87.3%)	4(7.3%)	3(5.5%)
No Involvement	176(91.7%)	4(2.1%)	12(6.3%)
Animal Advocate	28(93.3%)	1(3.3%)	1(3.3%)
Education (n=339)			
Secondary	34(91.9%)	2(5.4%)	1(2.7%)
College	197(91.6%)	7(3.3%)	11(5.1%)
Masters/Doctorate	64(85.3%)	6(8.0%)	5(6.7%)

	Yes	No	Neutral
Other	11(91.7%)	1(8.3%)	0(0.0%)
Group (n = 354)			
1 (n=51)	46(90.2%)	3(5.9%)	2(3.9%)
2 (n=43)	38(88.4%)	3(7.0%)	2(4.7%)
3 (n=47)	38(80.9%)	6(12.8%)	3(6.4%)
4 (n=32)	30(93.8%)	0(0.0%)	2(6.3%)
5 (n=69)	66(95.7%)	2(2.9%)	1(1.5%)
6 (n=73)	65(89.0%)	0(0.0%)	8(11.0%)
7 (n=18)	17(94.4%)	1(5.6%)	0(0.0%)
8 (n=21)	20(95.2%)	1(4.8%)	0(0.0%)
Responses[3] (n = 354)			
Single	245(89.4%)	15(5.5%)	14(5.1%)
Multiple	75(93.8%)	1(1.3%)	4(5.0%)

[1] Categories where n = < 354 reflect participants not providing demographic information.
[2] Percentages have been rounded up so may not equal 100%.
[3] Participants selecting one, or more than one, unique reason to justify their vote.

The majority (90%) of individuals believed that pain relief should be provided when disbudding and dehorning dairy calves, with 5% voting "No" and 5% voting "Neutral". The level of support tended to vary among groups, from a low of 81% to a high of 96% (χ^2 = 23.0, d.f. = 14, P = 0.06). Support also varied in relation to involvement in the dairy industry, from a low of 83% for dairy producers and farm workers to a high of 93% for animal advocates (χ^2 = 17.9, d.f. = 8, P = 0.02). Females were more supportive of providing

pain relief than males (93% vs. 85%; $\chi^2 = 9.3$, d.f. = 2, $P = 0.01$). There was no effect of education, country of origin or participant age on support for pain relief.

5.4 Qualitative results

Participants provided 101 unique reasons in support of their positions. These written reasons averaged (± SD) 23 ± 18 words and 130 ± 106 characters in length. The dominant themes, and the % of unique reasons corresponding to these themes, were as follows: pain and suffering (67%), concerns about drug use (20%), ease and practicality (12%), alternatives (12%) and cost (11%). Participants from every demographic selected reasons that cited each of these themes. For example, reasons containing the theme pain and suffering were selected by the majority of participants in each of category of dairy industry involvement (i.e. by farmers, industry professionals, students, animal advocates, and those claiming no involvement with dairy).

Participants in favor of pain control suggested that dehorning was painful and that pain mitigation was effective and practical to implement. They also believed pain relief was beneficial to the physical health and productivity of calves in terms of reduced stress and recovery times and that the use of pain relief makes the task of dehorning easier for the workers to perform. Reasons given in support were often phrased as moral claims; e.g. "this is just the right thing to do", "it's the most humane thing to do" and "we have a moral obligation…" (see Table 5.2), and used terminology like "cruel" and "inhumane" to describe dehorning without pain relief.

Table 5.2 The most popular reason cited within each of the 8 groups expressed as a total number of times the reason was voted for, divided by the total number of participants within the group, in response to the question "Should we provide pain relief when disbudding and dehorning dairy calves?"

Group	n	Percent	Reason
1	51	61	Yes because ... "there is pain involved and the means are readily available to address the pain. We have the responsibility to treat production animals as co-existent beings. It is valuable to the farmer/persons individual soul to have compassion for living beings animal and human."
2	43	58	Yes because ... "we should try to alleviate pain in animals whenever possible."
3	47	51	Yes because ... "if we have a way to reduce pain without many side-effects then we should use it!"
4	32	50	Yes because ... "providing pain control should be standard practice on farms. Withholding pain control for such a painful procedure is unacceptable and inhumane."
5	69	55	Yes because ... "it's the most humane thing to do."
6	73	79	Yes because ... "the procedure produces pain."
7	18	61	Yes because ... "it is only fair. Nothing should needlessly suffer."
8	21	62	Yes because ... "while animals are useful for food production, they should not suffer in the process."

Opponents of pain relief also referenced pain, but expressed doubts about the intensity and duration of the pain, arguing, "the pain is only temporary", "the pain is short term" and "I don't believe the pain is excessive or long-lasting". Opponents also suggested that the young age of calves was a reason for not providing pain relief stating, "young calves are less sensitive to pain…" and "I hope to get it done as quickly as possible". They

also expressed doubts about the efficacy of pain control modalities, commenting "pain relief suggested is topical and has minimal impact on the calf". Opponents also identified the additional cost as a reason why pain relief should not be provided.

Concerns about drug use were mentioned across all possible vote categories ("Yes", "No" and "Neutral"). One participant stated, "non-steroidal anti-inflammatory drugs can have negative side-effects for the animals, including cardiovascular, gastrointestinal, liver, and kidney effects. The effect on humans who consume this meat should also be taken into account." Another said, "I would wonder what, if any, long term effects there are on the animal and the milk they produce. To give medicine that only causes greater problems later for a short term pain would be unwise." Similarly, another participant questioned, "will giving medication impact organic status?" and another asserted that recommendations "might have to be more flexible for organic farmers…"

Reference to possible alternatives also emerged across vote categories with one participant suggesting, "the debate could be shifted to dehorning or not dehorning. Polled genetics can be used to reduce the number of animals requiring dehorning. Horns could be left on, cut farther from the skull where they don't cause pain. They continue to grow, but aren't pointy." Others questioned the assumption that horns are inherently dangerous and therefore must be removed. As one participant stated, "Yes, certainly we should not want to cause pain. However, the original problem is a mistaken premise. We should not be dehorning or disbudding dairy calves in the first place. We should not be putting the animals in such close contact with each other that they will damage each other with their horns. Animals with enough room to move around would not require such cruel interventions."

5.5 Discussion

Previous research has characterized attitudes towards painful procedures including disbudding and dehorning of those closely allied with the dairy industry including: dairy producers (Hoe and Ruegg, 2006; Gottardo et al., 2011; Wikman et al., 2013) veterinarians (Huxley and Whay, 2006; Laven et al., 2009; Fajt et al., 2011) and university animal science faculty (Heleski et al., 2004). This study is the first to include non-industry stakeholders in an interactive manner while also allowing for open-ended responses. Rarely do industry and non-industry perspectives directly interact to discuss animal welfare issues despite the fact that long-term sustainability depends heavily on this type of engagement (Boogaard et al., 2008; Miele et al., 2011).

The reasons provided by opponents of pain relief (4.5%) were especially interesting. These appeared to reflect a variety of misconceptions that may contribute to calves being left untreated. Opponents of pain relief tended to downplay the intensity and duration of the pain and use this as justification for not providing pain relief. Previous work has shown a positive association between perceived painfulness and likelihood of analgesic use (Hewson et al., 2007). There is ample behavioral and physiological evidence that both dehorning and disbudding cause pain and distress regardless of timing or method used (Stafford and Mellor, 2005; Stafford and Mellor, 2011). Plasma cortisol concentrations remain elevated for approximately 7- 9 h (Sutherland et al., 2002) and differences in behavior such as grazing have been detected 48 h after dehorning (Stafford and Mellor, 2005). More recent work by Neave et al. (2013) has shown calves dehorned without pain relief exhibit a pessimistic cognitive bias indicative of anxiety or depression. Unlike opponents of pain relief who mentioned specific features of pain such as duration and intensity, proponents never mentioned these specific features. For proponents of pain

relief, the mere presence of pain and the ability to control it seemed sufficient to make an ethical judgment.

The structures and mechanisms necessary to perceive pain are present shortly after birth in farmed species (Mellor and Diesch, 2006), yet opponents of pain relief suggested young animals experience pain less acutely. This view may arise from the common recommendation to perform painful procedure at the earliest age practicable (AVMA, 2012). While younger animals may be easier to handle and recover more quickly there is, however, no evidence to indicate that they experience less pain (Anil et al., 2002). Histological examinations of innervation surrounding the horn region have found few differences between newborn and 4 month old calves (Taschke and Folsch, 1997). The view that neonates are less able to experience pain was once common in pediatric medicine, with human babies denied pain relief on the assumption that they lacked the anatomical and cognitive apparatuses thought necessary to experience pain (McGrath, 2011). There is even evidence that pain experienced earlier in life may be more, not less intense (Anand and Hickey, 1987), resulting in long-term changes in central nervous system functioning and behavior (Shimada et al., 1990; Sternberg et al., 2005).

Additional cost was also expressed as a reason why pain relief should not be provided. Previous work has found that willingness of the farmer to pay was a strong predictor of analgesic use (Hewson et al., 2007). The use of the phrase "just pennies a shot" used in our introductory statement, may have biased participants, but we believe this to be fair description given that the price per calf for lidocaine treatment is estimated to be $0.46 (Misch et al., 2007). The estimated cost of providing comprehensive, multi-modal pain management for disbudding/dehorning (including an analgesic and sedative) is less than $4.00, representing approximately 0.004% of the total estimated cost of raising a

replacement dairy heifer (Gabler et al., 2000). These costs will vary by region, method used and the involvement required by the herd veterinarian.

Some opponents argued correctly that gastrointestinal pathologies can result from non-steroidal anti-inflammatory drugs, however, this risk is associated with high dosages and prolonged use (Wallace, 1997), both of which seem unlikely to occur in food animals. Moreover, selective cyclooxygenase-2 inhibitors (e.g. meloxicam) reduce this risk even further (Donnelly and Hawkey, 1997). Concerns about the risk of drug residues in meat consumed by humans also seems remote given that dairy calves are unlikely to enter the food chain for months or years following treatment. "Bob" calves may be sent for slaughter at less than 4 weeks of age, but for these animals there is no reason for disbudding. The uncertain risks of using NSAIDS for pain relief in dairy calves at the time of disbudding/dehorning must be weighed against the certainty of allowing preventable pain as a result of not using them.

Participants also indicated uncertainty about how the use of analgesics might affect organic dairy production. These concerns seem unfounded; regulations governing U.S. organic dairy production allow the use of most commonly recommended anesthetics and analgesics (CFR, 2012). Canadian organic standards explicitly mandate pain control be used when disbudding and dehorning (CGSB, 2006) as does EU Commission Regulation (EC) No 889/2008 governing organic production.

Participants also indicated a desire for long-term solutions to disbudding and dehorning, including the introduction of polled (hornless) genetics. The potential of polled genetics to replace the need to dehorn cattle has been suggested elsewhere (Long and Gregory, 1978; Hoeschele, 1990). This approach has been adopted in the U.S. beef industry where in 2007 more than 85% of beef calves were born without horns - up 17% from 1992

(USDA, 2008). The recently revised National Milk Producers Federation (NMPF) animal care manual recognizes the potential of polled dairy genetics to supplant dehorning (NMPF, 2013). Given the obvious benefits of this approach for both dairy producers (i.e. reduced labor and improved public image) and dairy cattle (i.e. reduced pain), greater investment in this option seems prudent.

Some participants also suggested that the need for hornless cattle resulted from a mismatch between housing and management. Instead of modifying the animal to fit the environment, they thought it preferable to change the environment to fit the animal (e.g. more extensive rearing, reduced stocking densities, less mixing, more stable group structures). Responses of this type may stem from beliefs about respecting the integrity or 'telos' of the animals, of which dehorning may be seen as a violation (Bovenkerk et al., 2002; Gavrell-Ortiz, 2004). Among dairy farmers who did not dehorn, Gottardo et al. (2011) found that the majority (74%) reported no difficulties in managing horned animals. Menke et al. (1999) found that horned cattle engaged in fewer agonistic behaviors than those without horns. However, some of the problems associated with keeping horned cattle may not arise until cattle are transported and/or mixed with unfamiliar animals (Shaw et al., 1976; Wythes et al., 1979), events that occur with increasing frequency on many modern dairy farms and at the end of the production phase.

Participants in the current study did not voice concerns about regulatory restrictions limiting the availability of analgesic drugs, but these have been raised elsewhere (Schwartzkopf-Genswein et al., 2012). To date, the U.S. Food and Drug Administration has not approved any drugs labeled for pain relief in food animals (Schwartzkopf-Genswein et al., 2012), but veterinarians can prescribe drugs in a manner not specified on the label ("Extra Label Drug Use" or "ELDU") provided certain conditions

are met (Smith et al., 2008; Smith, 2013). Extensive ELDU for purposes other than pain relief has been documented elsewhere (Dewey et al., 1997; Sawant et al., 2005). In the U.S., ELDU legislation was enacted so that veterinary practitioners could exercise their professional judgment to protect animal health and reduce suffering (USDA, 1994). Controlling the pain associated with dehorning and disbudding would appear to justify such use.

5.6 Conclusion

A large majority of respondents in every group and across every category - including those closely affiliated with the dairy industry – believed pain relief should be provided when disbudding and dehorning dairy calves. The reasons put forth by those who disagreed or were neutral on the issue were largely unsupported by available evidence. Despite this consensus provision of pain relief for dehorning remains low.

Collectively our results point to the need for increased outreach efforts targeted at veterinarians and producers that promote awareness of the relevant science, regulations and pain management protocols. These efforts should address misconceptions surrounding the availability, safety, and costs associated with pain mitigation. Although veterinarians are able to provide pain control under extra-label drug use, approval of additional analgesics for use in food animals is also needed. Collaborative efforts to increase the availability and adoption of polled dairy genetics should be pursued as this avoids the need for dehorning.

Chapter 6: Overview, limitations, and next Steps

In Chapter 1 I summarized different theories of both human and non-human welfare and reviewed the growing literature describing different conceptualizations of animal welfare. I argued that welfare is best classified as a thick concept – one that contains both descriptive and normative content. A number of conceptual questions regarding the nature of animal welfare were also identified and it was suggested that progress on these issues might be enhanced by the application of empirical methods adapted from the cognitive sciences. The lack of conceptual clarity surrounding important concepts such as naturalness and death were suggested as high priority candidates for such an approach. Naturalness is frequently cited among the most important factors influencing folk judgements about animal welfare, despite playing almost no role in discussions of human well-being (Nordenfelt, 2006). In fact, a strong case has been made that the concept itself is incoherent (Mill, 1885). Similarly, some have argued that death is in fact welfare issue despite not being viewed as such by many scientists (DeGrazia, 2016; Tannenbaum, 2002).

Chapter 2 provided an example of how empirical methods can be used to inform philosophical questions at the heart of animal welfare and ethics. Contrary to the predictions of mental state accounts of welfare, moral judgements about the life the animal was living exerted significant influence on attributions of welfare. This suggests that many animal welfare scientists may hold a peculiar concept of welfare. It could also be the case that explicit theoretical definitions of welfare endorsed by animal welfare scientists contrast with their actual understanding as determined by how they apply the concept to specific cases. One recent study, involving a sample of positive psychologists, found that

their attributions of happiness were affected by non-psychological factors despite having explicitly endorsed a definition of purely psychological definition of happiness (i.e. a net balance of positive over negatively-valenced mental states; Phillips et al., in press). Regardless, animal welfare scientists are a population worthy of closer scientific attention.

This chapter also raised important questions about the role identity plays in discussions of animal welfare and ethics. It is generally assumed that for something to affect an animal's welfare it must in some way affect the animal itself. However, this seemingly non-controversial assumption depends on how we construe the nature of an animal. If we think of them as nothing more than collections of mental states, then physical damage or dysfunction cannot directly impact their welfare. However, if we take the view that animals are more than just minds, perhaps that they are embodied minds, then such factors may affect their welfare independent of any associated psychological effects. Another interesting possibility suggested by this research is that judgments of welfare can take on two distinct objects of evaluation - the individual animal and its life. Some philosophers have observed that individual happiness and living a good life are not necessarily the same thing (Kagan, 1992). Philosopher David Velleman (2009) has developed this point in greater detail, arguing that lives of gradual improvement are judged to be better lives than those of gradual degradation even when they contain the same quantity of welfare. Therefore it may be the case that animals living lives judged as morally bad (e.g. animals raised and killed for what are regarded as immoral purposes) can never achieve good welfare regardless of how well they are feeling and physically functioning. This would go some way toward explaining the ambivalence many animal liberationists express towards animal welfare research (Francione, 1995).

Chapter 3 explored the popular idea that there is an inverse relationship between farm size and animal welfare. Based on a review of more than 100 published paper papers, it was concluded that no clear relationship exists. In many cases, larger farms appeared to do a better job of ensuring a high degree of animal welfare than smaller farms. This conclusion is advanced with some hesitancy as it is based on a largely qualitative methodological approach.

Statistical significance and the direction of the association were the primary evaluative considerations. Unfortunately, this approach overlooks crucial differences between studies in terms of sample and effect sizes. Proper meta-analytic techniques that take these factors into account should be investigated (Vesterinen et al., 2014). Publication bias is also likely to have affected the research that was available for this review. It has long been noted that null effects are much less likely to be published (Rosenthal, 1979) and there is no indication that animal welfare science is any exception (van der Schot and Phillips, 2013). Perhaps an even larger source of error resulted from the imprecision of our inclusion/exclusion criteria. While the conglomerate definition of animal welfare has the benefit of capturing a diverse array of 'ethical concerns', it also makes it remarkably difficult to conceive of welfare-irrelevant variables (i.e. effects or associations that are unrelated to either biological functioning, affective states or natural living). Future literature reviews involving animal welfare should be more explicit is describing what the authors consider to be welfare-relevant. Even better, they should state the type of variables that would be classified as welfare-irrelevant. Finally, it is important to recognize that farm size is just one characteristic of agricultural intensification. Future research aimed at understanding public scepticism towards modern agricultural production should attempt

to disaggregate the various features of intensification to identify their relative importance. This research should also consider how attitudes towards these features are likely to vary according to socio-demographic factors such as socio-economics status, political and economic ideology, familiarity with agriculture, rural-urban living environment and business experience.

Chapter 4 examined how perceptions of farm animal welfare, support for regulations governing animal care and trust in farmers are influenced by attempts to restrict operational transparency. Exposure to information about ag-gag was shown to diminish trust in farmers and lead to more negative perceptions of farm animal welfare as well as increased support for animal care regulations. This effect remained significant regardless of political orientation, dietary preference and living environment. It is not possible to comment on the extent to which the observed effects might persist over time or whether they might translate into actual behaviour (e.g. voting and purchasing). A measure of behavioural intention would have gone some way toward addressing this limitation. Moreover, participants in this study were recruited via Mechanical Turk, which has been shown to result in considerably more representative participants than standard in-person convenience samples. However, it should also be noted that Mechanical Turk participants still tend to be underemployed, overeducated and more politically liberal than the general U.S. population (Paolacci and Chandler, 2014). While this research demonstrated the detrimental effects of one particular response strategy to one particular type of crisis, future efforts should endeavour to go beyond identifying counterproductive crisis responses to understanding the constituents of effective crisis response strategies (those

than minimize the loss of public trust) so that industry can respond better to inevitable future information shocks.

Chapter 5 adopted a mixed-method methodological approach to investigate a specific animal welfare issue - dehorning dairy calves. Participants overwhelmingly believed that pain relief should be given and the reasons they gave to support their views were very diverse. Closer attention to the responses provided by those opposed to providing pain relief (mostly dairy producers), identified several obstacles to more widespread adoption of pain mitigation strategies that may be useful in extension efforts. Dehorning appears to be a rare example of an animal welfare issue where public-industry agreement is high.

Several caveats of this research are worth mentioning. First, it is important to resist the temptation to interpret these data as evidence that dehorning is significant or important to the subjects in our sample, let alone the wider population. Although people often hold general attitudes about high-profile subjects, they are much less likely to have attitudes about specific industry practices such as dehorning (Herzog et al., 2001). This study assumed that subjects did not possess pre-existing attitudes about dehorning hence the provision of background information was deemed as necessary for participants to make informed judgements. The inclusion of filter questions measuring familiarity with the practice; whether or not they have an opinion about it; and how strong their opinion is (Bishop et al., 1980; Krosnick and Petty, 1995) could have been included to quantify the accuracy of this assumption. Moreover, the provision of information may have biased participant responses. An alternative way of addressing the issue of limited awareness and therefore concern would have been to incorporate several different information treatments

into the study design (e.g. one biased in favour, one biased against and one non-biased). This would make it possible to discern the extent to which framing may have biased responses.

Even when people do possess attitudes there is no guarantee that they will report them honestly. Social desirability bias is the term used to describe the tendency of participants to respond in a manner that communicates a more socially acceptable self-image, rather than what they actually think. One study found significant differences between indirect and direct measures of concern for animal welfare suggesting social desirability bias is a very serious issue (Lusk and Norwood, 2010). The inclusion of indirect measures and/or validated scales measuring the tendency towards socially desirable responding (Marlow and Crowne, 1960), are two viable means of addressing these concerns in future research.

The research presented in this thesis addresses a diverse range of issues surrounding animal welfare and food animal production. In addition to providing contributions that will hopefully lead to further nuanced discussions about the lives of animals under our care it also demonstrated how social science methodologies could be used to address issues ranging from philosophical questions about the nature of animal welfare to specific policies and practices such as ag-gag legislation and dehorning.

References

Adam, K. C. 2011. Shooting the messenger: A common-sense analysis of state ag-gag legislation under the first amendment. Suffolk U. L. Rev. 45:1129.

Ajzen, I. 2001. Nature and operation of attitudes. Annual Rev. Psychol. 52:27–58.

Al-Rawashdeh, O. F. 1999. Prevalence of ketonemia and associations with herd size, lactation stage, parity and postparturient diseases in Jordanian dairy cattle. Prev. Vet. Med. 40:117–125.

Alban, L. 1995. Lameness in Danish dairy cows: frequency and possible risk factors. Prev. Vet. Med. 22:213–225.

ALCASDE. 2009. Report on dehorning practices across EU member states. Accessed May 20, 2013. http://ec.europa.eu/food/animal/welfare/farm/docs/calves _alcasde_D-2-1-1.pdf.

Alexandrova, A. 2015. Well-being and philosophy of science. Philos. Compass. 10:219–231.

Allore, H. G., P. A. Oltenacu, and H. N. Erb. 1997. Effects of season, herd size, and geographic region on the composition and quality of milk in the Northeast. J. Dairy Sci. 80:3040–3049.

Alvåsen K., A. Roth, M. Jansson Mork, C. Hallen Sandgren, P. T. Thomsen, and U. Emanuelson. 2014. Farm characteristics related to on-farm cow mortality in dairy herds: a questionnaire study. Animal. 8:1735–1742.

Alvåsen, K., M. Jansson Mork, C. Hallen Sandgren, P. T. Thomsen, and U. Emanuelson. 2012. Herd-level risk factors asscoaited with cow mortality in Swedish dairy herds. J. Dairy. Sci. 95:4352–4362.

Amiot C. E., and B. E. Bastian. 2017. Solidarity with animals: Assessing a relevant dimension of social identification with animals. PLoS ONE 12: e0168184.

Amory, J. R., P. Kloosterman, Z. E. Barker, J. L. Wright, R. W. Blowey, and L. E. Green. 2006. Risk factors for reduced locomotion in dairy cattle on nineteen farms in the Netherlands. J. Dairy Sci. 89:1509–1515.

Anand, K. J., and P. R. Hickey. 1987. Pain and its effects in the human neonate and fetus. N. Engl. J. Med. 317:1321–1329.

Andrade, S. B., and I. Anneberg. 2014. Farmers under pressure. Analysis of the social conditions of cases of animal neglect. J. Agr. Environ. Ethic. 27:103–126.

Anil S. S., L. Anil, and J. Deen. 2002 Challenges of pain assessment in domestic animals. J. Am. Vet. Med. Assoc. 220:313–319.

Animal Visuals, 2015. Ag-Gag Laws and Factory Farm Investigations Mapped. Accessed July 14, 2013. http://www.animalvisuals.org/projects/data/investigations.

Anthony, R. 2003. The ethical implications of the human-animal bond on the farm. Anim. Welf. 12:505–512.

Antle, J. M. 1999. Benefits and costs of food safety regulation. Food Policy. 24:605–623.

Appleby, M. C., and P. T. Sandøe. 2002. Philosophical debate on the nature of well-being: implications for animal welfare. Anim. Welf. 11:283–294.

Archer, S. C., F. McCoy, W. Wapenaar, and M. J. Green. 2013. Association of season and herd size with somatic cell count for cows in Irish, English, and Welsh dairy herds. Vet. J. 196:515–521.

Arkins, S. 1981. Lameness in dairy cows. Irish Vet. J. 35:163–170.
Auger, G. A. 2014. Trust me, trust me not: an experimental analysis of the effect of transparency on organizations. J. Publ. Relat. Res. 26:325–343.

ASPCA, 2012. Research shows americans overwhelmingly support investigations to expose animal abuse on industrial farms. Accessed July 14, 2015. https://www.aspca.org/aboutus/press-releases/aspca-research-shows-americans-overwhelmingly-supportinvestigations-expose.

Auger, G. A. 2014. Trust me, trust me not: an experimental analysis of the effect of transparency on organizations. J. Public Relat. Res. 26, 325–343.

AVMA. 2012. Welfare implications of dehorning and disbudding of cattle. Accessed July 14, 2013. https://www.avma.org/KB/Resources/LiteratureReviews/Documents /dehorning_cattle_bgnd.pdf.

Balliet, D., and P. A. Van Lange. 2013. Trust, punishment, and cooperation across 18 societies: a meta-analysis. Perspect. Psychol. Sci., 8:363–379.

Barkema, H. W., Y. H. Schukken, T. J. G. M. Lam, M. L. Beiboer, H. Wilmink, G. Benedictus, and A. Brand. 1998. Incidence of clinical mastitis in dairy herds grouped in three categories by bulk milk somatic cell counts. J. Dairy Sci. 81:411–419.

Barkema, H.W., M. J. Green, A. J. Bradley, and R. N. Zadoks. 2009. Invited review: The role of contagious disease in udder health. J. Dairy Sci. 92:4717–4729.

Barker, Z. E., K. A. Leach, H. R. Whay, N. J. Bell, and D. C. Main. 2010. Assessment of lameness prevalence and associated risk factors in dairy herds in England and Wales. J. Dairy Sci. 93:932–941.

Barrientos, A. K., N. Chapinal, D. M. Weary, E. Galo, and M. A. G. von Keyserlingk. 2013. Herd-level risk factors for hock injuries in freestall-housed dairy cows in the northeastern United States and California. J. Dairy Sci. 96:3758–3765.

Bartlett, P. C., G. Y. Miller, S. E. Lance, and L.E. Heider. 1992. Environmental and managerial determinants of somatic cell counts and clinical mastitis incidence in Ohio dairy herds. Prev. Vet. Med. 14:195–207.

Batt, S. 2009. Human attitudes towards animals in relation to species similarity to humans: A multivariate approach. Biosci. Horizons. 2:180–90.

Bastian, B., S. Loughnan, N. Haslam, and H. R. Radke. 2012. Don't mind meat? The denial of mind to animals used for human consumption. Pers. Soc. Psycho. Bull. 38: 247–256.

Batra, T. E., E. B. Burnside, and M. G. Freeman. 1971. Canadian dairy cow disposals: II. Effects of herd size and production level on dairy cow disposal patterns. Can. J. Anim. Sci. 21:85–87.

Beggs, D. S., A. D. Fisher, E. C. Jongman, and P. E. Hemsworth. 2015. A survey of Australian dairy farmers to investigate animal welfare risks associated with increasing scale of production. J. Dairy Sci. 98:5330–5338.

Bendixen, P.H., D. Vilson, J. Ekesbo, and D. B. Astrand. 1987. Disease frequencies in dairy cows in sweden. IV. Ketosis. Prev. Vet. Med. 5:99–109.

Bentham, J. 1879. An introduction to the principles of morals and legislation. Clarendon Press.

Bermúdez, J. L. 2003. Thinking without words. Oxford University Press.

Berry, W. 1977. The unsettling of America: Culture and agriculture. Avon. New York, NY.

Bestman, M. W. P., and J. P. Wagenaar. 2003. Farm level factors associated with feather pecking in organic laying hens. Livest. Prod. Sci. 80:133–140.

Bewley, J., R. W. Palmer and D. B. Jackson-Smith. 2001. An overview of experiences of Wisconsin dairy farmers who modernized their operations. J. Dairy Sci. 84:717–729.

Bishop, G. F., R. W. Oldendick, A. J. Tuchfarber, and S. E. Bennett. 1980. Pseudo-opinions on public affairs. Public Opin. Q. 44:198–209.

Blau D. M., B. J. McCluskey, S. R. Ladely, D. A. Dargatz, P. J. Fedorka-Cray, K. E. Ferris, and M. L. Headrick. 2005. *Salmonella* in dairy operations in the United States: Prevalence and antimicrobial drug susceptibility. J. Food Prot. 68:696–702.

Blomberg, O. 2007. Disentangling the thick concept argument. N. European J. Phil. 8:63–78.

Blomqvist, K. 1997. The many faces of trust. Scand. J. of Manag. 13:271–286.

Bock, B. B., and M. M. van Huik. 2007. Animal welfare: the attitudes and behaviour of European pig farmers. Brit. Food. J. 109:931–944.

Boivin, X., J. Lensink, C. Tallet, and I. Veissier. 2003. Stockmanship and farm animal welfare. Anim. Welf. 12:479–492.

Bolhuis, J. E., W. G. Schouten, J. W. Schrama, and V. M. Wiegant. 2005. Behavioural development of pigs with different coping characteristics in barren and substrate-enriched housing conditions. Appl. Anim. Behav. Sci., 93:213–228.

Boogaard B. K., S. J. Oosting, and B. B. Bock. 2008. Defining sustainability as a socio-cultural concept: Citizen panels visiting dairy farms in the Netherlands. Livest. Scie. 117:24–33.

Bovenkerk B., F. W. A. Brom, and B. J. Van den Bergh. 2002. Brave new birds: The use of 'Animal Integrity' in animal ethics. Hastings Cent. Rep. 32:16–22.

Bracke, M. B. M., Metz, J. H. M., Dijkhuizen, A. A., and B. M. Spruijt. 2001. Development of a decision support system for assessing farm animal welfare in relation to husbandry systems: strategy and prototype. J. Agric. Environ. Ethics. 14:321–337.

Bracke, M. B. M., C. C. De Lauwere, S. M. Wind, and J. J. Zonerland. 2013. Attitudes of Dutch pig farmers towards tail biting and tail docking. J. Agr. Environ. Ethic. 26:847–868.

Braddock, M. (2010). Constructivist experimental philosophy on well-being and virtue. Southern. J. Philos., 48:295–323.

Broad, G. M. 2014. Animal Production, 'ag-gag' laws, and the social production of ignorance: Exploring the role of storytelling. Environ. Commun. 10:1–19.

Broom, D. M. 1991. Animal welfare: concepts and measurement. J. Anim. Sci. 69:4167–4175.

Brouwer, F. 2012. The Economics of Regulation In Agriculture: Compliance With Public and Private Standards. CABI. Wallingford, Oxfordshire, UK.

Brown, C. C., and J. L. Medoff. 1989. The employer size-wage effect. J. Polit. Econ. 97:1027–1059.

Bruijnis, M. R. N., F. L. B., Meijboom, and E. N. Stassen. 2013. Longevity as an animal welfare issue applied to the case of foot disorders in dairy cattle. J. Agric. Environ. Ethics. 26:191–205.

Brülde, B. 2007. Happiness theories of the good life. J. Happiness. Stud. 8:15–49.

Bruun J., A. K. Ersbøll, and L. Alban. 2002. Risk factors for metritis in Danish dairy cows.

Prev. Vet. Med. 54*:*179–190*.*

Buhrmester, M., T. Kwang, and S. D. Gosling. 2011. Amazon's Mechanical Turk a new source of inexpensive, yet high-quality, data?. Perspect. Psychol. Sci. 6:3–5.

Burstin, K., E. B. Doughtie, and A. Raphaeli. 1980. Contrastive Vignette Technique: An indirect Methodology Designed to Address Reactive Social Attitude Measurement. J. Appl. Soc. Psychol. 10:147–165.

Busato, A., P. Trachsel, and J. W. Blum. 2000. Frequency of traumatic cow injuries in relation to housing systems in Swiss organic dairy herds. J. Vet. Med. A. 47:221–229.

Callahan, E. S., and T. M. Dworkin. 2000. The state of state whistleblower protection. Am. Bus. Law J. 38:99–175.

Campbell, D. T. 1950. The indirect assessment of social attitudes. Psychol. Bull. 47:15.

Cardoso, C. S., M. J. Hötzel, D. M. Weary, J. A. Robbins, and M. A. G. von Keyserlingk. 2016. Imagining the ideal dairy farm. J. Dairy Sci. 99:1–9.

Carruthers, P. 1992. The animal issue: moral theory in practice. Cambridge University Press.

CFI. 2013. Center for Food Integrity: Consumer trust in the food system. The Center for Food Integrity, Gladstone, MO.

Centner, T. J. 2010. Limitations on the confinement of food animals in the United States. J. Agr. Environ. Ethic. 23:469–486.

CFR. 2012 Synthetic substances allowed for use in organic livestock production. Accessed July 11, 2013. http://bit.ly/livestock-synthetics.

CGSB. 2006 Organic Production Systems General Principles and Management Standards. Accessed August 3, 2013. http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/programme-program/normes-standards/internet/bio-org/principes-principles-eng.html#a077.

Chang L., and J. A. Krosnick. 2009. National surveys via RDD telephone interviewing versus the internet comparing sample representativeness and response quality. Public. Opin. Quart. 73:641–678.

Chapinal, N., A. K. Barrientos, M. A. G. Von Keyserlingk, E. Galo, and D. M. Weary. 2013. Herd-level risk factors for lameness in freestall farms in the northeastern United States and California. J. Dairy Sci. 96:318–328.

Chapinal, N., Y. Liang, D. M. Weary, Y. Wang, and M. A. G. von Keyserlingk. 2014. Risk factors for lameness and hock injuries in Holstein herds in China. J. Dairy Sci. 97:4309–4316.

Chaudhuri, A., and M. B. Holbrook. 2001. The chain of effects from brand trust and brand affect to brand performance: the role of brand loyalty. J. Marketing. 65, 81–93.

Converse, P.E. 1970. Attitudes and non-attitudes: continuation of a dialogue. In The quantitative analysis of social problems. E.R. Tufte, ed. Addison-Wesley, Mass.

Crisp, R. 2006. Hedonism reconsidered. Philos. Phenomen. Res. 73:619–645.

Crisp, R. 2008. Well-being. In The Stanford Encyclopedia of Philosophy. Edward N. Zalta, ed. Accessed Aug. 29, 2016. http://plato.stanford.edu/entries/well-being/

Croney, C. C., and S. T. Millman. 2007. Board-invited review: The ethical and behavioral bases for farm animal welfare legislation. J. Anim. Sci. 85:556–565.

Crowne, D. P., and D. Marlowe. 1960. A new scale of social desirability independent of psychopathology. J. Consult. Psychol. 24:349.

Cummings, K. J., L. D. Warnick, K. A. Alexander, C. J. Cripps, Y. T. Grohn, P. L. McDonough, D. V. Nydam, and K. E. Reed. 2009. The incidence of salmonellosis among dairy herds in the northeastern United States. J. Dairy Sci. 92:3766–3774.

Czekaj, T.G., A. S. Nielsen, A. Henningsen, and B. Forkman. 2013. The relationship between animal welfare and economic outcome at the farm level. IFRO Report 222. Department of Food and Resource Economics, University of Copenhagen.

Dairy Australia, 2015. Cows and farms. Accessed Jan. 11, 2016. http:// www.dairyaustralia.com.au/Markets-and-statistics/Farm-facts/Cows-and-Farms.aspx

Dairy New Zealand. 2014. New Zealand Dairy Statistics 2013-2014. Accessed Jan. 10, 2016. http://www.dairynz.co.nz/media/1327583/nz-dairy-statistics-2013-2014-web.pdf

Danielson P. A. 2010. Designing a machine to learn about the ethics of robotics: The N-Reasons platform. Ethics. Inf. Technol. 12:251–261.

Darby, K., M. T. Batte, S. Ernst, and B. Roe. 2008. Decomposing local: a conjoint analysis of locally produced foods. Am. J. Agr. Econ. 90:476–486.

Davidson, D. 1982. Rational animals. Dialectica. 36:317–327.

Davies G. F., B. J. Greenhough, P. Hobson-West, R. G. W. Kirk, K. Applebee, L. C. Bellingan, et al. 2016. Developing a Collaborative Agenda for Humanities and Social Scientific Research on Laboratory Animal Science and Welfare. PLoS One 11: e0158791.

Davison H. C., A. R. Sayers, R. P. Smith, S. J. Pascoe, R. H. Davies, J. P. Weaver. 2006. Risk factors associated with the Salmonella status of dairy farms in England and Wales. Vet. Rec. 159:871–880.

Dawkins, M. S. 1983. Battery hens name their price: consumer demand theory and the measurement of ethological 'needs'. Anim. Behav. 31:1195–1205.

Dawkins, M. S. 1998. Evolution and animal welfare. Q. Rev. Biol. 73:305–328.

Dawkins, M. S. 1990. From an animal's point of view: motivation, fitness, and animal welfare. Behav. Brain. Sci. 13:1–9.

Dawkins, M. S. 2012. Why animals matter: animal consciousness, animal welfare, and human well-being. Oxford University Press.

De Bakker, E., C. De Lauwere, and M. Bokma-Bakker. 2012. 'All that is solid melts into air': the Dutch debate about factory farming. pp. 181–186 in: Climate change and sustainable development, eds. T. Potthast and S. Meisch. Wageningen: Academic Publishers.

De Vries, M., E. A. M. Bokkers, G. Van Schaik, B. Engel, T. Dijkstra, and I. J. M. de Boer. 2014. Exploring the value of routinely collected herd data for estimating dairy cattle welfare. J. Dairy Sci. 97:715–730.

Dechow, C.D., and R. C. Goodling. 2008. Mortality, culling by sixty days in milk, and production profiles in high- and low-survival Pennsylvania herds. J. Dairy Sci. 91: 4630–4639.

DeGrazia, D. 1996. Taking animals seriously: mental life and moral status. Cambridge University Press. Cambridge, MA, USA.

DeGrazia, D. 2016. Sentient nonpersons and the disvalue of death. Bioethics. Accessed Spet. 26, 2016. https://philosophy.columbian.gwu.edu/sites/philosophy.columbian.gwu.edu/files/downloads/degrazia_sentientnonpersons%26death.pdf

Dennett D. 1995. Do animals have beliefs? In H. L. Roitblat and J. A. Meyer (eds.) Comparative Approaches to Cognitive Science. MIT Press, Cambridge, MA.

Désiré, L., A. Boissy, and I. Veissier. 2002. Emotions in farm animals:: a new approach to animal welfare in applied ethology. Behav. Processes. 60:165–180.

Dewey C.E., B. D. Cox, B. E. Straw, E. J. Bush, and H. S. Hurd. 1997. Associations between off-label feed additives and farm size, veterinary consultant use, and animal age. Prev. Vet. Med. 31:133–146.

Dippel, S., M. Dolezal, C. Brenninkmeyer, J. Brinkmann, S. March, U. Knierim, and C. Winckler. 2009. Risk factors for lameness in cubicle housed Austrian Simmental dairy cows. Prev. Vet. Med. 90:102–112.

Dockès, A. C., and F. Kling-Eveillard. 2006. Farmers' and advisers' representations of animals and animal welfare. Livest. Sci. 103:243–249.

Donnelly, M. T. and C. J. Hawkey. 1997. COX-II inhibitors - a new generation of safer NSAIDs? Aliment. Pharmacol. Ther. 11:227–236.

Dorsey, D. 2010. Three arguments for perfectionism. Noûs. 44, 59–79.

Duffy, M. 2009. Economies of size in production agriculture. J. Hunger Environ. Nutr. 4:375–392.

Duncan, I. J., and J. C. Petherick. 1991. The implications of cognitive processes for animal welfare. J. Anim. Sci. 69:5017–5022.

Duncan, I.J.H. and D. Fraser. 1997. Understanding animal welfare. In: Appleby, M.C., Hughes, B.O. (Eds.), Animal Welfare. CAB International, Wallingford, UK.

Duncan, I. J. 2004. A concept of welfare based on feelings. In G. J. Benson and B. E. Rollin (eds.) The Well-being of Farm Animals: Challenges and Solutions. Blackwell, Ames, IA.

Dutta, S., and C. Pullig. 2011. Effectiveness of corporate responses to brand crises: The role of crisis type and response strategies. J. Bus. Res. 64, 1281–1287.

EFSA. 2015. Scientific Opinion on the assessment of dairy cow welfare in small-scale farming systems. EFSA Journal. 13:4137. doi:10.2903/j.efsa.2015.4137.

Ellis-Iversen, J., A. J. Cook, E. Watson, M. Nielen, L. Larkin, M. Wooldridge and H. Hogeveen. 2010. Perceptions, circumstances and motivators that influence implementation of zoonotic control programs on cattle farms. Prev. Vet. Med. 93:276–285.

Espejo, L. A., and M. I. Endres. 2007. Herd-level risk factors for lameness in high-producing holstein cows housed in freestall barns. J. Dairy Sci. 90:306–314.

Evans, S., and R. Davies. 1996. Case control study of multiple-resistant Salmonella typhimurium DT104 infection of cattle in Great Britain. Vet. Rec. 139:557–558.

Fabian, J., R. A. Laven, and H. R. Whay. 2014. The prevalence of lameness on New Zealand dairy farms: A comparison of farmer estimate and locomotion scoring. Vet. J. 201:31–38.

Fajt V. R., S. A. Wagner and B. Norby. 2011. Analgesic drug administration and attitudes about analgesia in cattle among bovine practitioners in the United States. J. Am. Vet. Med. Assoc. 238:755–767.

Faulkner P. M., and D. M. Weary. 2000. Reducing pain after dehorning in dairy calves. J. Dairy Sci. 83:2037–2041.

Faye, B., and F. Lescourret. 1989. Environmental factors associated with lameness in dairy cattle. Prev. Vet. Med. 7:267–287.

Feldman, F. 2002. The good life: A defense of attitudinal hedonism. Philos. Phenomen. Res. 65:604–628.

Feldman, F. 2004. Pleasure and the good life: Concerning the nature, varieties and plausibility of hedonism. Oxford University Press, NY, NY.

Fernandez-Cornejo, J., A. K. Mishra, R. F. Nehring, C. Hendricks, M. Southern and A. Gregory. 2007. Off-farm income, technology adoption, and farm economic performance. No. 7234. Economic Research Service, United States Department of Agriculture.

Fetrow, J., K. V. Nordlund, and H. D. Norman. 2006. Invited review: culling: nomenclature, definitions, and recommendations. J. Dairy Sci. 89:1896–1905.

Fields, G. S. 1975. Rural-urban migration, urban unemployment and underemployment, and job-search activity in LDCs. J. Dev. Econ. 2:165–187.

Fischhoff, B., P. Slovic, and S. Lichtenstein. 1980. Knowing what you want: Measuring labile values. In T. Wallsten (ed.) Cognitive processes in choice and decision behavior. Erlbaum. Hillsdale, NJ.

Fisman, R., & Khanna, T. 1999. Is trust a historical residue? Information flows and trust levels. J. of Econ. Behav. Organ. 38:79–92.

Flaccus, G. 2009. Suit: meatpacker used "downer cows" for four years. Associated Press. Accessed Mar. 16, 2014. http://www.utsandiego.com/news/2009/sep/24 /us-slaughterhouse-abuse-092409/

Foer, J. S. 2010. Eating Animals. Little Brown. New York, NY.

Foot, P. 2003. Natural goodness. Clarendon Press.

Fossler, C. P., S. J. Wells, J. B. Kaneene, P. L. Ruegg, L. D. Warnick, J. B. Bender, L. E. Eberly, S. M. Godden, and L. W. Halbert. 2005. Herd-level factors associated with isolation of Salmonella in a multi-state study of conventional and organic dairy farms. I. *Salmonella* shedding in calves. Prev. Vet. Med. 70:279–291.

Francione, G. L. 1995. Animal rights and animal welfare. Rutgers L. Rev. 48:397.

Frank, N. A., and J. B. Kaneene. 1993. Management risk factors associated with calf diarrhea in Michigan dairy herds. J. Dairy Sci. 76:1313–1323.

Frankena, K., K. A. van Keulen, J. P. Noordhuizen, E. N. Noordhuizen-Straasen, J. Gundelach, D. J. de Jong, and I. Saedt. 1992. A cross-sectional study into prevalence and risk indicators of digital haemorrhages in female dairy calves. Prev. Vet. Med. 14:1–12.

Frankena, K., K. A. van Keulen, J. P. Noordhuizen, E. N. Noordhuizen-Straassen, J. Gundelach, D. J. de Jong, and I. Saedt. 1993. A cross-sectional study of prevalence and risk factors of

dermatitis interdigitalis in female dairy calves in the Netherlands. Prev. Vet. Med. 17:137–144.

Fraser, D. 1995. Science, values and animal welfare: exploring the 'inextricable connection'. Anim. Welf. 4:103–117.

Fraser, D. 1999. Animal ethics and animal welfare science: bridging the two cultures. Appl. Anim. Behav. Sci. 65: 171–189.

Fraser, D. 2003. Assessing animal welfare at the farm and group level: the interplay of science and values. Anim. Welf. 12: 433–443.

Fraser, D. 2005. Animal welfare and the intensification of animal production: an alternative interpretation. Food and Agriculture Organisation of the United Nations, Rome, Italy.

Fraser, D. 2008. Animal welfare and the intensification of animal production. In The Ethics of Intensification. P.B. Thompson (ed.) Springer, Heidelberg, Germany.

Fraser, D., and I. J. Duncan. 1998. 'Pleasures', 'pains' and animal welfare: toward a natural history of affect. Anim. Welf. 7:383–396.

Fraser, D., and C. J. Nicol. 2011. Preference and motivation research. In M. C. Appleby, J.A. Mench, I. A. S. Olsson, B. O. Hughes (eds.) Animal Welfare, CABI, Wallingford, England, UK.

Fraser, D., D. M. Weary, E. A. Pajor, and B. N. Milligan. 1997. A scientific conception of animal welfare that reflects ethical concerns. Anim. Welf. 6:187–205.

Frewer, L. J., A. Kole, S. M. Van De Kroon, and C. De Lauwere. 2005. Consumer attitudes towards the development of animal-friendly husbandry systems. J. Agric. Environ. Ethics. 18:345–367.

Frewer, L. J., Howard, C., Hedderley, D., and R. Shepherd. 1996. What determines trust in information about food-related risks? Underlying psychological constructs. Risk. Anal. 16:473–486.

Fulwider W. K., T. Grandin, B. E. Rollin, T. E. Engle, N. L. Dalsted, and W. D. Lamm. 2008. Survey of dairy management practices on one hundred thirteen north central and northeastern United States dairies. J. Dairy Sci. 91:1686–1692.

Gabler M., P. R. Tozer, and A. J. Heinrichs. 2000. Development of a cost analysis spreadsheet for calculating the costs to raise a replacement dairy heifer. J. Dairy Sci. 83:1104–1109.

Garber L. P., M. D. Salman, H. S. Hurd, T. Keefe, J. L. Schlater. 1994. Potential risk factors for Cryptosporidium infection in dairy calves. J. Am. Vet. Med. Assoc. 205:86–91.

Gardner, I. A., P. Willeberg, and J. Mousing, 2002. Empirical and theoretical evidence for herd size as a risk factor for swine diseases. Anim. Health Res. Rev. 3:43–55.

Gavrell-Ortiz S. E. 2004. Beyond welfare: animal integrity, animal dignity, and genetic engineering. Ethics. Environ. 9:94–120.

Gehani, R. R. 1998. Management of technology and operations. Wiley & Sons, New York, NY.

George, K. A., K. M. Slagle, R. S. Wilson, S. J. Moeller, and J. T. Bruskotter. 2016. Changes in attitudes toward animals in the United States from 1978 to 2014. Biol. Cons. 201:237–242.

Gonyou, H. W. 1993. Animal welfare: definitions and assessment. J. Agric. Environ. Ethics. 6:37–43.

Goodman, J. K., C. E. Cryder, and A. Cheema. 2013. Data collection in a flat world: The strengths and weaknesses of Mechanical Turk samples. J. Behav. Decis. Making. 26:213–224.

Gosling S. D., S. Vazire, S. Srivastava, and O. P. John. 2004. Should we trust web-based studies? A comparative analysis of six preconceptions about internet questionnaires. Am. Psychol. 59:93.

Gottardo F., E. Nalon, B. Contiero, S. Normando, P. Dalvit, and G. Cozzi. 2011. The dehorning of dairy calves: Practices and opinions of 639 farmers. J. Dairy Sci. 94:5724–5734.

Government of the Netherlands. 2013. Dutch Government position on scale of intensive livestock production. Accessed May 20 2015. https://www.government.nl/latest/news/2013/06/14/dutch-government-position-on-scale-of-intensive-livestock-production

Green, L. E., K. Lewis, A. Kimpton, and C. J. Nicol. 2000. Cross-sectional study of the prevalence of feather-pecking in laying hens in alternative systems and its association with management and disease. Vet. Rec. 147:233–238.

Greenwald, A. G., and M. R. Banaji. 1995. Implicit social cognition: attitudes, self-esteem, and stereotypes. Psychol. Rev. 102:4.

Gregoire, A. 2002. The mental health of farmers. Occup. Med. 52:471–476.

Griffin, J. 1986. Well-being: Its meaning, measurement, and moral importance. Clarendon, Oxford, England.

Groehn, J. A., J. B. Kaneene, and D. Foster. 1992. Risk factors associated with lameness in lactating dairy cattle in Michigan. Prev. Vet. Med. 14:77–85.

Gulliksen, S. M., K. I. Lie, T. Loken, and O. Osteras. 2009. Calf mortality in Norwegian dairy herds. J. Dairy Sci. 92:2782–2795.

Hadley G. L., C. A. Wolf, and S. B. Harsh. 2006. Dairy cattle culling patterns, explanations, and implications. J. Dairy Sci. 89:2286–2296.

Hadley, G. L., S. B. Harsh, and C. A. Wolf. 2002. Managerial and financial implications of major dairy farm expansions in Michigan and Wisconsin. J. Dairy Sci. 85:2053–2064.

Haidt, J. 2001. The emotional dog and its rational tail: a social intuitionist approach to moral judgment. Psychol. Rev. 108:814.

Hall, C., and V. Sandilands. 2007. Public attitudes to the welfare of broiler chickens. Anim. Welf. 16:499–512.

Harper, G., and S. Henson. 2001. Consumer concerns about animal welfare and the impact on food choice. EU Fair CT98-3678 Final Report. Accessed Jan. 16, 2013. http://europa.eu.int/comm/food/animal/welfare/eu_fair_project_en.pdf.

Harris, J., C. D. Hibburt, G. A. Anderson, P. J. Younis, D. H. Fitspatrick, A. C. Dunni, I. W. Parsons, and N. R. McBeath. 1988. The incidence, cost and factors associated with foot lameness in dairy cattle in southwestern Victoria. Aust. Vet. J. 65:171–176.

Harrison, R. 1964. Animal Machines. Vincent Stuart, London.

Hartman, D. A., R. W. Everett, S. T. Slack, and R. G. Warner. 1974. Calf mortality. J. Dairy Sci. 57:576–578.

Haybron, D. M. 2008. The pursuit of unhappiness: the elusive psychology of well-being. Oxford University Press, NY, NY.

Haynes, R. P. 2012. The myth of happy meat. The philosophy of food, 39:161.

Heathwood, C. 2005. The problem of defective desires. Australas. J. Philos. 83:487–504.

Heerwegh, D. 2009. Mode differences between face-to-face and web surveys: an experimental investigation of data quality and social desirability effects. Int. J. Public Opin. R. 21:111–121.

Heinrich A., T. F. Duffield, K. D. Lissemore, and S. T. Millman. 2010. The effect of meloxicam on behavior and pain sensitivity of dairy calves following cautery dehorning with a local anesthetic. J. Dairy Sci. 93:2450–2457.

Heleski C. R., A. G. Mertig, and A. J. Zanella. 2004. Assessing attitudes toward farm animal welfare: a national survey of animal science faculty members. J. Anim. Sci. 82:2806–2814.

Hemsworth, P. H., D. J. Mellor, G. M. Cronin, and A. J. Tilbrook. 2015. Scientific assessment of animal welfare. N. Z. Vet. J. 63:24–30.

Hemsworth, P. H., and G. J. Coleman. 2011. Human-Livestock Interactions: The stockperson and the productivity and welfare of intensively-farmed animals. CABI, Oxford, England, UK..

Hemsworth, P. H., and J. L. Barnett. 1992. The effects of early contact with humans on the subsequent level of fear of humans in pigs. Appl. Anim. Behav. Sci. 35:83–90.

Hemsworth, P. H., J. L. Barnett, and G. J. Coleman. 1993. The human-animal relationship in agriculture and its consequences for the animal. Anim. Welf. 2:33–51.

Henrich, J., S. J. Heine and A. Norenzayan. 2010. The weirdest people in the world? Behav. Brain Sci., 33:61–83.

Hersh, M. A. 2002. Whistleblowers—heroes or traitors?: Individual and collective responsibility for ethical behaviour. Annu. Rev. Control. 26:243–262.

Herzog, H. 2010. Some we love, some we hate, some we eat: why it's so hard to think straight about animals. Harper. NY, NY.

Herzog, H., A. Rowan, and D. Kossow. 2001. Social attitudes and animals. In D. J. Salem and A. N. Rowan (eds.), The state of the animals 2001. Humane Socity Press, Washington DC, USA.

Herzog, H. A., N. S. Betchart, and R. B. Pittman. 1991. Gender, sex role orientation, and attitudes toward animals. Anthrozoös. 4:184–191.

Hess, S., L.A. Bolos, R. Hoffmann, R. and Y. Surry. 2014. Is animal welfare better on small farms? Evidence from veterinary inspections on Swedish farms. Proc. International Congress European Association of Agricultural Economists, Ljubljana, Slovenia. Accessed Mar. 20, 2016. http://purl.umn.edu/182781

Heuwieser, W., M. Iwersen, J. Gossellin, and M. Drillich. 2010. Short communication: Survey of fresh cow management practices of dairy cattle on small and large commercial farms. J. Dairy Sci. 93:1065–1068.

Hewson C. J., I. R. Dohoo, K. A. Lemke, and H. W. Barkema. 2007. Canadian veterinarians' use of analgesics in cattle, pigs, and horses in 2004 and 2005. Can. Vet. J. 48:155–164.

Hewson, C. J. 2003. What is animal welfare? Common definitions and their practical consequences. Can. Vet. J. 44:496.

Hill, A. E., A. L. Green, B. A. Wagner, and D.A. Dargatz. 2009. Relationship between herd size and annual prevalence of and primary antimicrobial treatments for common diseases on dairy operations in the United States. Prev. Vet. Med. 88:264–277.

Hoare, R. J. T., and E. A. Roberts. 1972. Investigations in mastitis problem herds. II. Effect of herd size, shed type, hygiene and management practices. Aust. Vet. J. 48:661-663.

Hoe, F. G. H., and P. L. Ruegg. 2006. Opinions and practices of Wisconsin dairy producers about biosecurity and animal well-being. J. Dairy Sci. 89:2297–2308.

Hoeschele, I. 1990. Potential gain from insertion of major genes into dairy cattle. J. Dairy Sci. 73:2601.

Holzhauer, M., C. Hardenberg, C. J. M. Bartels, and K. Frankena. 2006. Herd-and cow-level prevalence of digital dermatitis in the Netherlands and associated risk factors. J. Dairy Sci. 89:580–588.

Huber J., T. Arnholdt, E. Möstl, C. C. Gelfert, and M. Drillich. 2013. Pain management with flunixin meglumine at dehorning of calves. J. Dairy Sci. 96:132–140.

Hurka, T. 2010. The best things in life: A guide to what really matters. Oxford University Press. NY, NY, USA.

Hurka, T. 1993. Perfectionism. Oxford University Press. NY, NY, USA.

Hurley, T. H., P. F. Orazem, and J. Kliebenstein. 1999. Structure of Wages and Benefits in the U.S. Pork Industry. Amer. J. Agr. Econ. 81:144–63.

Hursthouse, R. 1999. On virtue ethics. Oxford Univerity Press. Oxford, UK.

Huston, C. L., T. E. Wittum, B. C. Love, and J. E. Keen. 2002. Prevalence of fecal shedding of Salmonella spp in dairy herds. J. Am. Vet. Med. Assoc. 220:645–649.

Huxley J. N., and H. R. Whay. 2006. Current attitudes of cattle practitioners to pain and the use of analgesics in cattle. Vet. Rec. 159:662–668.

Hyde, J., S. A. Cornelisse, and L. A. Holden. 2011 . Human resource management on dairy farms: Does investing in people matter. Econ. Bull. 31:208–217.

Jacobs, J. 2011. Survey Finds Iowa Voters Oppose Prohibiting Secret Animal-abuse Videos. Des Moines Register. Accessed Jan. 16, 2013. http://blogs.desmoinesregister.com /dmr/index.php/2011/03/22/survey-finds-iowa-voters-oppose-prohibiting -secret-animalabuse-videos/article.

Jago, J. G., and D. P. Berry. 2011. Associations between herd size, rate of expansion and production, breeding policy and reproduction in spring calving dairy herds. Animal. 5:1626–1633.

Jahansoozi, J. 2006. Organization-stakeholder relationships: exploring trust and transparency. J. Manag. Dev. 25:942–955.

James, R. E., M. L. McGilliard, and D. A. Hartman. 1984. Calf mortality in Virginia Dairy Herd Improvement herds. J. Dairy Sci. 67:908.

Jenny, B. F., G. E. Gramling, and T. M. Glaze. 1981. Management factors associated with calf mortality in South Carolina dairy herds. J. Dairy Sci. 64:2284.

Judge, T. A., R. F. Piccolo, N. P. Podsakoff, J. C. Shaw and B. L. Rich. 2010. The relationship between pay and job satisfaction: A meta-analysis of the literature. J. Vocat. Behav. 77:157–167.

Kabagambe, E. K., S. J. Wells, L. P. Garber, M. D. Salman, B. Wagner, and P. J. Fedorka-Cray. 2000. Risk factors for fecal shedding of Salmonella in 91 US dairy herds in 1996. Prev. Vet. Med. 43:177–194.

Kagan, S. 1994. Me and my life. Proceedings of the Aristotelian Society. 94:309–324..

Kagan, S. 1992. The limits of well-being. Soc. Philos. Policy. 9:169–189.

Kahneman, D., and R. Sugden. 2005. Experienced utility as a standard of policy evaluation. Environ. Resour. Econ. 32:161–181.

Kaneene, J. B., and R. Miller. 1994. Epidemiological study of metritis in Michigan dairy cattle. Vet. Res. 25:253–257.

Kang, J., and G. Hustvedt. 2014. Building trust between consumers and corporations: The role of consumer perceptions of transparency and social responsibility. J. Bus. Ethics. 125:253–265.

Katsoulos, P. D., and G. Christodoulopoulos. 2009. Prevalence of lameness and of associated claw disorders in Greek dairy cattle industry. Livest. Sci. 122:354–358.

Keller, S. 2009. Welfarism. Philos. Compass. 4:82–95.

Kendall, H. A., L. M. Lobao, and J. S. Sharp. 2006. Public Concern with animal well-being: place, social structural location, and individual experience. Rural. Sociol. 71:399–428.

Kielland, C., E. Skjerve, O. Østerås, and A. J. Zanella. 2010. Dairy farmer attitudes and empathy toward animals are associated with animal welfare indicators. J. Dairy Sci. 93:2998–3006.

Kielland, C., L. E. Ruud, A. J. Zanella, and O. Østerås. 2009. Prevalence and risk factors for skin lesions on legs of dairy cattle housed in freestalls in Norway. J. Dairy Sci. 92:5487–5496.

Kiliç, İ., and Z. Bozkurt. 2013. The Relationship between farmers' perceptions and animal welfare standards in sheep farms. Australas. J. Anim. Sci. 26:1329.

Kirby, D. 2010. Animal factory: the looming threat of industrial pig, dairy, and poultry farms to humans and the environment. St. Martin's Press. New York, NY.

Kirchin, S. (ed.). 2013. Thick concepts. Oxford University Press. Oxford, UK.

Kirkden, R. D., and E. A. Pajor. 2006. Using preference, motivation and aversion tests to ask scientific questions about animals' feelings. Appl. Anim. Behav. Sci. 100:29-47.

Klein-Jöbstl D., M. Iwersen, and M. Drillich. 2014. Farm characteristics and calf management practices on dairy farms with and without diarrhea: a case-control study to investigate risk factors for calf diarrhea. J. Dairy Sci. 97:5110–5119.

Knight, S. and L. Barnett. 2008. Justifying attitudes towards animal use: A qualitative study of people's views and beliefs. Anthrozoos 21:31–42.

Knobe, J., & Nichols, S. (eds.) 2013. Experimental philosophy. Oxford University Press. NY, NY, USA.

Knowler, D., and B. Bradshaw. 2007. Farmers' adoption of conservation agriculture: A review and synthesis of recent research. Food Policy. 32:25–48.

Kossaibati, M. A., M. Hovi, and R. J. Esslemont. 1998. Incidence of clinical mastitis in dairy herds in England. Vet. Rec. 143:649–653.

Kraut, R. 2009. What is good and why: The ethics of well-being. Harvard University Press. Cambridge, MA, USA.

Kraut, R. 2011. Against absolute goodness. Oxford University Press. NY, NY, USA.

Kreuter, F., S. Presser, and R. Tourangeau. 2008. Social desirability bias in CATI, IVR, and Web surveys the effects of mode and question sensitivity. Public. Opin. Quart. 72:847–865.

Krosnick, J. A., and R. E. Petty. 1995. Attitude strength: An overview. In R. E. Petty and J. A. Krosnick (eds.). Attitude strength: Antecedents and consequences. Hillsdale, NJ: Erlbaum.

Krystallis, A., M. D. de Barcellos, J. O. Kügler, W. Verbeke, and K. G. Grunert. 2009. Attitudes of European citizens towards pig production systems. Livest. Sci. 126:46–56.

Kujala, M., I. R. Dohoo, M. Laakso, C. Schnier, and T. Soveri. 2009. Sole ulcers in Finnish dairy cattle. Prev. Vet. Med. 89:227–236.

Lance, S. E., G. Y. Miller, D. D. Hancock, P. C. Bartlett, L. E. Heider, and M. L. Moeschberger. 1992. Effects of environment and management on mortality in preweaned dairy calves. J. Am. Vet. Med. Assoc. 201:1197–1202.

Landfried, J., 2012. Bound & gagged: potential first amendment challenges to ag-gag laws. Duke Environ. Law Policy Forum 23:377.

Lassen, J., P. Sandøe, and B. Forkman. 2006. Happy pigs are dirty! conflicting perspectives

on animal welfare. Livest. Sci. 103:221–230.

Laurence, S., and E. Margolis, 1999. Concepts and cognitive science. Concepts: core readings. 3:81.

Laven R. A., J. N. Huxley, H. R. Whay, and K J. Stafford. 2009. Results of a survey of attitudes of dairy veterinarians in New Zealand regarding painful procedures and conditions in cattle. New. Zeal. Vet. J. 57:215–220.

Le Cozler, Y., O. Recourse, E. Ganche, D. Giraud, J. Danel, M. Bertin, and P. Brunschwig. 2012. A survey on dairy heifer farm management practices in a Western-European plainland, the French Pays de la Loire region. J. Agr. Sci. 150:518–533.

Leach, K. A., H. R. Whay, C. M. Maggs, Z. E. Barker, E. S. Paul, A. K. Bell, and D. C. Main. 2010. Working towards a reduction in cattle lameness: 1. Understanding barriers to lameness control on dairy farms. Res. Vet. Sci. 89:311–317.

Leggett, C. G., N. S. Kleckner, K. J. Boyle, J. W. Dufield, and R. C. Mitchell. 2003. Social desirability bias in contingent valuation surveys administered through in-person interviews. Land. Econ. 79:561–575.

Lensink, J., A. Boissy, and I. Veissier. 2000. The relationship between farmers' attitude and behaviour towards calves, and productivity of veal units. Ann. Zootechnol. 49:313–327.

Leontides L., C. Ewald, P. Willeberg. 1994. Herd risk factors for serological evidence of Aujeszky's disease virus infection of breeding sows in Northern Germany (1990-1991), J. Vet. Med. B 41:554–560.

Leruste, H., E. A. M. Bokkers, L. F. M. Heutinck, M. Wolthuis-Fillerup, J. T. N. van der Werf, M. Brscic, G. Cozzi, B. Engel, C. G. van Reenen, and B. J. Lensink. 2012. Evlauation of on-farm veal calves' responses to unfamiliar humans and potential influencing factors. Animal. 6:2003–2010.

Lichtenstein, S., and P. Slovic. 1971. Reversals of preference between bids and choices in gambling decisions. J. Exp. Psychol. 89:46.

Lindstrom, U. B., M. V. Bonsdorff, and J. Syvajarvi. 1984. Factors affecting bovine ketosis and its association with non-return rate. J. Sci. Agric. Soc. Finland. 55:497–506.

Linzey, A., and P. A. Clarke. 1990. Animal rights: A historical anthology. Columbia University Press. NY, NY, USA.

Littlewood, K. E., and D. J. Mellor. 2016. Changes in the Welfare of an Injured Working Farm Dog Assessed Using the Five Domains Model. Animals. 6:58.

Livengood, J., and E. Machery. 2007. The folk probably don't think what you think they think: experiments on causation by absence. Midwest. Stud. Philos. 31:107–127.

Long C. R., and K. E. Gregory. 1978. Inheritance of the horned, scurred and polled condition in cattle. J. Hered. 69:395–400.

Lora, I., P. Paparella, M. Brscic, and F. Gottardo. 2014. Survey on mortality rate of young stock on dairy farms of the Province of Padova. Acta Agraria Kasposvariensis. 18:69–74.

Losinger, W. C., and A. J. Heinrichs. 1997. Management practices associated with high mortality among preweaned dairy heifers. J. Dairy Res. 64:1–11.

Loughnan, S., N. Haslam, and B. Bastian. 2010. The role of meat consumption in the denial of moral status and mind to meat animals. Appetite. 55:156–159.

Lund, V., G. Coleman, S. Gunnarsson, M. C. Appleby, and K. Karkinen. 2006. Animal welfare science—Working at the interface between the natural and social sciences. Appl. Anim. Behav. Sci. 97:37–49.

Lusk, J. L., and F. B. Norwood. 2010. Direct versus indirect questioning: an application to the well-being of farm animals. Soc. Indic. Res. 96:551–565.

Lusk, J. L., F. B. Norwood, and R. W. Pricket. 2007. Consumer preferences for farm animal welfare: Results of a nationwide telephone survey, Working Paper, Department of Agricultural Economics, Oklahoma State University.

Macaulay, T. B. 1849. The history of England from the accession of James II. Harper. NY, NY, USA>

MacDonald, J. M., E. J. O'Donoghue, W. D. McBride, R. F. Nehring, C. L. Sandretto, and R. Mosheim. 2007. Profits, costs, and the changing structure of dairy farming. Accessed Apr. 10, 2015. http://www.ers.usda.gov/media/188030/err47_1_.pdf

MacDonald, J. M., J. Cessna, and R. Mosheim. 2016. Changing structure, financial risks, and government policy for the U.S. dairy industry. Accessed Apr. 1, 2016. http://www.ers.usda.gov/media/2027311/err205_errata.pdf

Maeda, Y., and M. Miyahara. 2003. Determinants of trust in industry, government, and citizen's groups in Japan. Risk Anal. 23:303-310.

Maher, P., M. Good, and S. More. 2008. Trends in cow numbers and culling rate in the Irish cattle population, 2003 to 2006. Ir. Vet. J. 61:455–463.

Malone, T., and J. Lusk. 2016. Putting the chicken before the egg price: An ex post analysis of California's batter cage ban. J. Agr. Resource. Econ. 41:518–532.

Marceau, J. F. 2015. Ag gag past, present, and future. Seattle U. L. Rev. 38:1317.

Marlow, D., and D. P. Crowne. 1961. Social desirability and response to perceived situational demands. J. Consult. Clin. Psychol. *25:109*.

Martin, S. W., C. W. Schwabe, and C. E. Franti. 1975. Dairy calf mortality rate: influence of management and housing factors on calf mortality rate in Tulare County, California. Am. J. Vet. Res. 36:1111–1114.

Mattiello, S., C. Klotz, D. Baroli, M. Minero, V. Ferrante, E. Canali. 2009. Welfare problems in alpine dairy cattle farms in Alto Adige (Eastern Italian Alps). It. J. Anim. Sci. 8:628–630.

Mattiello, S., M. Battini, E. Andreoli, M. Minero, S. Barbieri, and E. Canali. 2010. Avoidance distance test in goats: a comparison with its application in cows. Small Rumin. Res., 91: 215–218.

Mayer, R. C., J. H. Davis, and F. D. Schoorman. 1995. An integrative model of organizational trust. Acad. Manage. Rev. 20:709–734.

Mays, N., and C. Pope. 2000. Assessing quality in qualitative research. Brit. Med. J. 320:50.

Mazumdar, D. 1976. The rural-urban wage gap, migration and the shadow wage. Oxford Econ. Pap. 28:406–425.

Mazurek M., D. J. Prendiville, M. A. Crowe, I. Veissier, and B. Earley. 2010. An on-farm investigation of beef suckler herds using an animal welfare index (AWI). BMC Vet. Res. 6:55.

McConnel, C. S., J. E. Lombard, B. A. Wagner, and F. B. Garry. 2008. Evaluation of factors associated with increased dairy cow mortality on United States dairy operations. J. Dairy Sci. 91: 1423–1432.

McGrath, P. J. 2011. Science is not enough: The modern history of pediatric pain. Pain. 152:2457–2459.

McKendree, M. G. S., C. C. Croney, and N. O. Widmar. 2014. Effects of demographic factors and information sources on United States consumer perceptions of animal welfare. J. Anim. Sci. 92:3161–3173.

McMeekan C. M., K. J. Stafford, D. J. Mellor, R. A. Bruce, R. N. Ward, and N. G. Gregory. 1999. Effects of a local anaesthetic and a nonsteroidal anti-inflammatory analgesic on the behavioural responses of calves to dehorning. New Zeal. Vet. J. 47:92–96.

McMillan, F. D. 2000. Quality of life in animals. J. Am. Vet. Med. Assoc. 216:1904–1910.

Mee, J.F., D. P. Berry, and A. R. Cromie. 2008. Prevalence of, and risk factors associated with, perinatal calf mortality in pasture-based Holstein-Friesian cows. Animal. 2:613–620.

Mee, J. F., D. P. Berry, and A. R. Cromie. 2011. Risk factors for calving assistance and dystocia in pasture-based Holstein–Friesian heifers and cows in Ireland. Vet. J. 187:189–194.

Mellor, D. J. 2016. Updating animal welfare thinking: Moving beyond the "Five Freedoms" towards "a Life Worth Living". Animals, 6:21.

Mellor D. J., and T. J. Diesch. 2006. Onset of sentience: the potential for suffering in fetal and newborn farm animals. Appl. Anim. Behav. Sci. 100:48–57.

Mench, J. A. 1998. Thirty years after Brambell: whither animal welfare science?. J. Appl. Anim. Welf. Sci. 1:91–102.

Menke C, S. Waiblinger, D. W. Folsch, and P. R. Wiepkema. 1999. Social behaviour and injuries of horned cows in loose housing systems. Anim. Welf. 8:243–258.

Menzies, F. D., D. G. Bryson, T. McCallion, and D. I. Matthews. 1995. A study of mortality among suckler and dairy cows in Northern Ireland in 1992. Vet. Rec. 137:531–536.

Miele, M., I. Veissier, A. Evans, and R. Botreau. 2011. Animal welfare: establishing a dialogue between science and society. Anim. Welf. 20:103–117.

Mill, J. S. 1885. Nature, the utility of religion, and theism. Longmans, Green.

Miller, R. H., M. T. Kuhn, H. D. Norman, and J. R. Wright. 2008. Death losses for lactating cows in herds enrolled in dairy herd improvement test plans. J. Dairy Sci. 91: 3710–3715.

Milligan, B. N., T. Duffield and K. Lissemore. 2004. The utility of ketoprofen for alleviating pain following dehorning in young dairy calves. Can. Vet. J. 45:140–143.

Misch L. J., T. F. Duffield, S. T. Millman, and K. D. Lissemore. 2007. An investigation into the practices of dairy producers and veterinarians in dehorning dairy calves in Ontario. Can. Vet. J. 48:1249–1254.

Mugera, A. W. and V. Bitsch. 2005. Managing labor on dairy farms: a resource-based perspective with evidence from case studies. Int. Food Agribus. Man. 8:79–98.

Mulnix, J. W., and M. J. Mulnix. 2015. Happy Lives, Good Lives: A Philosophical Examination. Broadview Press.

Nadler, A., and I. Liviatan. 2006. Intergroup reconciliation: Effects of adversary's expressions of empathy, responsibility, and recipients' trust. Pers. Soc. Psychol. B. 32:459–470.

NAWAC, 2005 Animal Welfare (Painful Husbandry Procedures) Code of Welfare. Code of Welfare No. 7. National Animal Welfare Advisory Committee, Wellington, NZ.

Neave, H. W., R. R. Daros, J. H. C. Costa, M. A. G. von Keyserlingk, and D. M. Weary. 2013. Pain and pessimism: Dairy calves exhibit negative judgment bias following hot-iron disbudding. PLoS One. 8: e80556. doi:10.1371/journal.pone.0080556

Negowetti, N. E. 2014. Opening the barnyard door: Transparency and the resurgence of ag-gag and veggie libel laws. Seattle U. L. Rev. 38:1345.

NFACC. 2009. Code of Practice for the Care and Handling of Dairy Cattle. Accessed Apr. 10, 2013. http://www.nfacc.ca/pdfs/codes/Dairy%20Code%20of%20Practice.pdf

Ng, Y. K. 2016. How welfare biology and commonsense may help to reduce animal suffering. Animal Sentience. 1:1.

Nielsen, T. D., L. R. Nielsen, N. Toft, and H. Houe. 2010. Association between bulk-tank milk *Salmonella* antibody level and high calf mortality in Danish dairy herds. J. Dairy Sci. 93:304–310.

NMPF. 2013. Animal Care Reference Manual. Accessed July 1, 2013. http:// www.nationaldairyfarm.com/sites/default/files/2013/FARM_manual_2013_WEB.pdf

Nordenfelt, L. 2006. Animal and human health and welfare: a comparative philosophical analysis. CABI. Oxford, UK.

Nørgaard, N. H., K. M. Lind, and J. F. Agger. 1999. Cointegration analysis used in a study of dairy-cow mortality. Prev. Vet. Med. 42:99–119.

Norström, M., E. Skjerve, and J. Jarp. 2000. Risk factors for epidemic respiratory disease in Norwegian cattle herds. Prev. Vet. Med. 44:87–96.

Nosek, B. A., C. B. Hawkins, and R. S. Frazier. 2011. Implicit social cognition: From measures to mechanisms. Trends. Cogn. Sci. 15:152–159.

Nozick, R. 1974. Anarchy, state, and utopia. Basic books.

Nussbaum, M. C. 2004. Beyond compassion and humanity: Justice for nonhuman animals. In C. R. Sunstein and M. C. Nussbaum (eds.), Animal rights. Current debates and new direction. Oxford University Press, Oxford, UK.

Nussbaum, M. 2006. Frontiers of justice: disability, nationality, species membership. Harvard University Press. Cambridge, MA, USA.

Ohbuchi, K. I., M. Kameda, and N. Agarie. 1989. Apology as aggression control: its role in mediating appraisal of and response to harm. J. Pers. Soc. Psychol. 56:219.

Oishi, S., J. Graham, S. Kesebir, and I. C. Galinha. 2013. Concepts of happiness across time and cultures. Pers. Soc. Psychol. B. 39:559-577.

Oleggini, G. H., L. O. Ely, and J. W. Smith. 2001. Effect of region and herd size on dairy herd performance parameters. J. Dairy Sci., 84:1044–1050.

Oppenheimer, D. M., T. Meyvis, and N. Davidenko. 2009. Instructional manipulation checks: detecting satisficing to increase statistical power. J. Exp. Soc. Psychol. 45:867–872.

Otten, N. D., L. R. Nielsen, P. T. Thomsen, and H. Houe. 2014. Register-based predictors of violations of animal welfare legislation in dairy herds. Animal 8:1963–1970.

Oxender, W. D., L. E. Newman, and D. A. Morrow. 1973. Factors influencing dairy calf mortality in Michigan dairy herds. J. Am. Vet. Med. Assoc. 162:458–462.

Pace, K. M., T. A. Fediuk, and I. C. Botero. 2010. The acceptance of responsibility and expressions of regret in organizational apologies after a transgression. Corporate Communications. 15:410–427.

Paolacci, G., and J. Chandler. 2014. Inside the turk: understanding mechanical turk as a participant pool. Curr. Dir. Psychol. Sci. 23:184–188.

Parfit, D. 1984. Reasons and persons. Oxford University Press. Oxford, UK.

Persson, K., and D. Shaw. 2015. Empirical methods in animal ethics. J. Agr. Environ. Ethic. 28:853–866.

Peters, R. G., V. T. Covello, and D. B. McCallum. 1997. The determinants of trust and credibility in environmental risk communication. Risk Anal. 17:43–54.

Petersen, T. S., and J. Ryberg. 2014. Welfare hedonism and authentic happiness. In Encyclopedia of Quality of Life and Well-Being Research. Springer. Netherlands.

Phillips, J., L. Misenheimer, and J. Knobe. 2011. The ordinary concept of happiness (and others like it). Emotion Rev. 3:320–322.

Phillips, J., S. Nyholm and S. Liao. 2014. The good in happiness. Oxford Studies in Experimental Philosophy. Oxford University Press. Oxford, UK.

Phillps, J., J. De Freitas, J., Mott, C., Gruber, J., & Knobe, J. (In press). True happiness; The role of morality in the folk concept of happiness.

PIMC. 2004. Model code of practice for the welfare of animals–cattle. Accessed June, 15, 2013. http://www.publish.csiro.au/Books/download.cfm?ID=4831

Pinedo, P. J., A. De Vries, and D. W. Webb. 2010. Dynamics of culling risk with disposal codes reported by Dairy Herd Improvement dairy herds. J. Dairy Sci. 93:2250–2261.

Pinker, S. 2011. The better angels of our nature: Why violence has declined. Viking. NY, NY, USA.

Pollan, M. 2006. The omnivore's dilemma: a natural history of four meals. Penguin Press. NY, NY, USA.

Popper, K. 2005. The logic of scientific discovery. Routledge.

Potterton, S. L., M. J. Green, K. M. Millar, H. R. Whay, and J. N. Huxley. 2011. Risk factors associated with hair loss, ulceration, and swelling at the hock in freestall-housed UK dairy herds. J. Dairy Sci. 94:2952–2963.

Prickett, R. W., F. B. Norwood, and J. L. Lusk. 2010. Consumer preferences for farm animal welfare: results from a telephone survey of US households. Anim. Welf. 19: 335–347.

R Core Team. 2015. R: A language and environment for statistical computing. R Found. Stat. Comput.

Raboisson D., E. Maigne, P. Sans, G. Allaire, and E. Cahuzac. 2014. Factors influencing dairy calf and replacement heifer mortality in France. J. Dairy Sci. 97:202–211.

Raboisson D., F. Delor, E. Cahuzac, C. Gendre, P. Sans, and G. Allaire. 2013. Perinatal, neonatal, and rearing period mortality of dairy calves and replacement heifers in France. J Dairy Sci. 96:2913–2924.

Raboisson, D., E. Cahuzac, P. Sans, and G. Allaire, G. 2011. Herd-level and contextual factors influencing dairy cow mortality in France in 2005 and 2006. J. Dairy Sci. 94:1790–1803.

Radke, A. 2012. Do you support 'ag-gag' laws? Beef Magazine Blog. Accessed May, 15, 2013. http://beefmagazine.com/blog/do-you-support-'ag-gag'-laws

Rawlins, B.L. 2008. Measuring the relationship between organizational transparency and employee trust. Public Relat. J. 2:1–21.

Raz, J. 1992. Rights and Individual Well-Being. Ratio Juris, 5:127–142.

Reardon, T. and C. B. Barrett. 2000. Agroindustrialization, globalization, and international development: an overview of issues, patterns, and determinants. Agric. Econ. 23:195–205.

Regan, T. 2004. The case for animal rights. University of California Press.

Rice, C. 2015. Well-being and animals. In G. Fletcher (ed.) The Routledge handbook of philosophy of well-being. Routledge. NY, NY, USA.

Richman, W. L., S. Kiesler, S. Weisband, and F. Drasgow. 1999. A meta-analytic study of social desirability distortion in computer-administered questionnaires, traditional questionnaires, and interviews. J. Appl. Psychol. 84:754.

Riemann, H. P. R. B. Larssen, E. Simensen. 1985. Ketosis in Norwegian dairy herds – some epidemiological associations. Acta Vet. Scand. 26:482–492.

Röcklinsberg, H., C. Gamborg, and M. Gjerris. 2014. A case for integrity: gains from including more than animal welfare in animal ethics committee deliberations. Lab. Anim. 48:61–71.

Rodriguez-Lainz, A., P. Melendez-Retamal, D. W. Hird, D. H. Read, and R. L. Walker. 1999. Farm-and host-level risk factors for papillomatous digital dermatitis in Chilean dairy cattle. Prev. Vet. Med. 42:87–97.

Roine, K., and H. Saloniemi. 1978. Incidence of some diseases in connection with parturition in dairy cows. Acta Vet. Scand. 19:341–353.

Rollin, B. E. 1995. Farm animal welfare: social, bioethical, and research issues. Iowa State University Press. Ames, IA, USA.

Rollin, B. E. 2006. The regulation of animal research and the emergence of animal ethics: a conceptual history. Theor. Med. Bioeth. 27:285–304.

Rollin, B.E. 1993. Animal welfare, science and value. J. Agric. Environ. Ethics. 6:44–50.

Rosati, C. S. 2009. Relational good and the multiplicity problem. Philos. Issues. *19*:205–234.

Rosenthal, R. 1979. The file drawer problem and tolerance for null results. Psychol. Bull. 86:638.

Rousseau, D. M., S. B. Sitkin, R. S. Burt and C. Camerer. 1998. Not so different after all: A cross-discipline view of trust. Acad. Manage. Rev. 23:393–404.

Rowlands G. J., A. M. Russell, and L. A. Williams. 1983. Effects of season, herd size, management system and veterinary practice on the lameness incidence in dairy cattle. Vet. Rec. 113:441–445.

Rozin, P., and E. B. Royzman. 2001. Negativity bias, negativity dominance, and contagion. Pers. Soc. Psychol. Rev. 5:296–320.

Rushen, J., A. A. Taylor, and A. M. de Passillé. 1999. Domestic animals' fear of humans and its effect on their welfare. Appl. Anim. Behav. Sci. 65:285–303.

Rushen, J., and A. M. de Passillé. 2010. The importance of good stockmanship and its benefits for the animals. In: T. Grandin (ed.) Improving animal welfare: a practical approach. CABI, London, UK.

Russell, R. A., and J. M. Bewley. 2013. Characterization of Kentucky dairy producer decision-making behavior. J. Dairy Sci. 96:4751–4758.

Rutherford, K. M. D., F. M. Langford, M. C. Jack, L. Sherwood, A .B. Lawrence, and M. J. Haskell. 2008. Hock injury prevalence and associated risk factors on organic and nonorganic dairy farms in the United Kingdom. J. Dairy Sci. 91:2265–2274.

Sahota, A. 2009. Overview of the global market for organic food and drink. In: H. Willer. and M. Yuseffi (eds.)The world of organic agriculture – statistics and emerging trends 2009. Earthscan, London, UK.

Saloniemi, H., and K. Roine, K. 1981. Incidence of some metabolic diseases in dairy cows. Nord. Vet. Med. 33: 289–296.

Sandøe, P., and H. B. Simonsen. 1992. Assessing animal welfare: where does science end and philosophy begin?. Anim. Welf. 1:257–267.

Sawant A. A., L. M. Sordillo, and B. M. Jayarao. 2005. A survey on antibiotic usage in dairy herds in Pennsylvania. J. Dairy Sci. 88:2991–2999.

Schlosser, E. 2001. Fast food nation: The dark side of the all-American meal. Houghton Mifflin. Boston, MA, USA.

Schmidt, K. 2011. Concepts of animal welfare in relation to positions in animal ethics. Acta Biotheor. 59:153–171.

Schuppli C. A., M. A. G. von Keyserlingk, and D. M. Weary. 2014. Access to pasture for dairy cows: Responses from an on-line engagement. J. Anim. Sci. 92:5185–5192.

Schwartz, G., T. Kane, J. Joseph and J. T. Tedeschi. 1978. The effects of remorse on the reactions of a harm-doer. Brit. J. Soc. Psychol. 17:293–297.

Schwartzkopf-Genswein K. S., E. E. Fierheller, N. A. Caulkett, E. D. Janzen, E. A. Pajor, L. A. González and D. Moya. 2012. Achieving pain control for routine management procedures in North American beef cattle. Anim. Frontiers 2:52–58.

Scudder, J. N., and C. Bishop-Mills. 2009. The credibility of shock advocacy: Animal rights attack messages. Public Relat. Rev., 35:162–164.

Seeborg, M. C., Z. Jin, and Y. Zhu. 2000. The new rural-urban labor mobility in China: Causes and implications. J. Socio. Econ. 29:39–56.

Shahid, M. Q., J. K. Reneau, H. Chester-Jones, R. C. Chebel, and M. I. Endres. 2015. Cow- and herd-level risk factors for on-farm mortality in Midwest US dairy herds. J. Dairy Sci. 98:4401–4413.

Sharma S. and R. Zhang. 2014. China's dairy dilemma: the evolution and future trends of China's dairy industry. Institute for Agriculture and Trade Policy. Accessed Feb. 20, 2016. http://www.iatp.org/files/2014_02_25_DairyReport_f_web.pdf

Shaw F. D., R. I. Baxter and W. R. Ramsay. 1976. The contribution of horned cattle to carcase bruising. Vet. Rec. 98:255–257.

Shimada C, S. Kurumiya, Y. Noguchi, and M. Umemoto. 1990. The effect of neonatal exposure to chronic footshock on pain-responsiveness and sensitivity to morphine after maturation in the rat. Behav. Brain Res. 36:105–111.

Shea, M. 2014. Punishing animal rights activists for animal abuse: rapid reporting and the new wave of ag-gag laws. Columbia J. Law Soc. Prob. 48: 337.

Silva del Río, N., S. Stewart, P. Rapnicki, Y. M. Chang, and P. M. Fricke. 2007. An observational analysis of twin births, calf sex ratio, and calf mortality in Holstein dairy cattle. J. Dairy Sci. 90:1255–1264.

Simensen, E., O. Østerås, K. E. Bøe, C. Kielland, L. E. Ruud, and G. Næss. 2010. Housing system and herd size interactions in Norwegian dairy herds; associations with performance and disease incidence. Acta Vet. Scand. 52:1.

Simonsen, H.B. 1996. Assessment of animal welfare by a holistic approach: behaviour, health and measured opinion. Act Agric. Scand. Sect. A. Anim. Sci. Suppl. 27:91–96.

Simkin, S., K. Hawton, J. Fagg, and A. Malmberg. 1998. Stress in farmers: a survey of farmers in England and Wales. Occup. Environ. Med. 55:729–734.

Simonsen, H.B. 1996. Assessment of animal welfare by a holistic approach: behaviour, health and measured opinion. Acta Agric. Scand. A Anim. Sci. 27:91–96.

Singbo, A.G., and B. Larue. 2014. Scale economies and technical efficiency of Quebec dairy farms. Cahier de recherché working paper 2014-7. Université de Laval, Québec, Canada.

Singer, P. 2011. Practical ethics. Cambridge University Press. Cambridge, MA, USA.

Skarstad, G. A., L. Terragni, and H. Torjusen. 2007. Animal welfare according to Norwegian consumers and producers: definitions and implications. Int. J. Sociol. Food Agric. 15:74–90.

Lichtenstein, S., and P. Slovic, P. 1971. Reversals of preference between bids and choices in gambling decisions. J. Exp. Psychol. 89:46.

Smith, G. 2013. Extralabel use of anesthetic and analgesic compounds in cattle. Vet. Clin. N. Am. Food A. 29:29–45.

Smith G. W., J. L. Davis, L. A. Tell, A. I. Webb, and J. E. Riviere. 2008. Extralabel use of nonsteroidal anti-inflammatory drugs in cattle. J. Am. Vet. Med. Assoc. 232:697–701.

Smith, J. W., L. O. Ely, and A. M. Chapa. 2000. Effect of region, herd size, and milk production on reasons cows leave the herd. J. Dairy Sci. 83:2980–2987.

Sogstad, A. M., T. Fjeldaas, O. Østera, and K. P. Forshell. 2005. Prevalence of claw lesions in Norwegian dairy cattle housed in tie stalls and free stalls. Prev. Vet. Med. 70:191–209.

Solano, L., H. W. Barkema, E. A. Pajor, S. Mason, S. J. LeBlanc, J. C. Zaffino Heyerhoff, C. G. R. Nash, D. B. Haley, E. Vasseur, D. Pellerin, J. Rushen, A. M. de Passillé, and K. Orsel. 2015. Prevalence of lameness and associated risk factors in Canadian Holstein-Friesian cows housed in freestall barns. J. Dairy Sci. 98:6978–6991.

Solbu, H. 1983. Disease recrodings in Norwegian dairy cattle. I. Disease incidence and non-genetic effects on mastitis, ketosis and milk fever. Z. Tierz. Zuechtungsbio. 100:139–157.

Somers, J. G. C. J., K. Frankena, E. N. Noordhuizen-Stassen, and J. H. M. Metz. 2005a. Risk factors for digital dermatitis in dairy cows kept in cubicle houses in The Netherlands. Prev. Vet. Med. 71:11–21.

Somers, J. G. C. J., K. Frankena, E. N. Noordhuizen-Stassen, and J. H. M. Metz. 2005b. Risk factors for interdigital dermatitis and heel erosion in dairy cows kept in cubicle houses in The Netherlands. Prev. Vet. Med. 71:23–34.

Sørensen, B. T., M. D. de Barcellos, N. V. Olsen, W. Verbeke, and J. Scholderer. 2012. Systems of attitudes towards production in the pork industry: a cross-national study. Appetite. 59:885–897.

Sørensen, J. T., and D. Fraser. 2010. On-farm welfare assessment for regulatory purposes: Issues and possible solutions. Livest. Sci. 131:1–7.

Spalding, R.W. R. W. Everett, and R.H. Foote. 1979. Fertility in New York artificially inseminated holstein herds in dairy herd improvement. J. Dairy Sci. 58:718–723.

Speicher, J. A., and R. E. Hepp. 1973. Factors associated with calf mortality in Michigan dairy herds. J. Am. Med. Vet. Assoc. 162:463–466.

Spooner, J. M., C. A. Schuppli, and D. Fraser. 2014a. Attitudes of Canadian citizens toward farm animal welfare: A qualitative study. Livest. Sci. 163:150–158.

Spooner, J. M., C. A. Schuppli, and D. Fraser. 2014b. Attitudes of Canadian pig producers toward animal welfare. J. Agric. Environ. Ethics. 27, 569–589.

Spooner, J., C. A. Schuppli, D. Fraser. 2012. Attitudes of Canadian beef producers toward animal welfare. Anim. Welf. 21, 273–283.

Sripada, C. S., and S. Konrath. 2011. Telling more than we can know about intentional action. Mind Lang. 26:353–380.

Stafford K. J., and D. J. Mellor. 2005. Dehorning and disbudding distress and its alleviation in calves. Vet. J. 169: 337–349.

Stafford K. J. and D. J. Mellor. 2011. Addressing the pain associated with disbudding and dehorning in cattle. Appl. Anim. Behav. Sci. 135:226–231.

Statistics Canada. 2015. The changing face of the Canadian hog industry. Accessed on Feb. 20, 2016. http://www.statcan.gc.ca/pub/96-325x/2014001/article/14027-eng.htm#a4

Statistics Norway. 2015. Statistics of agriculture. Accessed Mar. 30, 2016. https:// www.ssb.no/en/stjord

Stengärde, L., J. Hultgren, M. Tråvén, K. Holtenius, and U. Emanuelson. 2012. Risk factors for displaced abomasum or ketosis in Swedish dairy herds. J. Dairy Sci. 103:280–286.

Sternberg, W. F., L. Scorr, L. D. Smith, C. G. Ridgway, and M. Stout. 2005. Long-term effects of neonatal surgery on adulthood pain behavior. Pain 113:347–353.

Stewart M., J. M. Stookey, K. J. Stafford, C. B. Tucker, A. R. Rogers, S. K. Dowling, G. A. Stilwell, R. C. de Carvalho, M. S. Lima, and D. M. Broom. 2009. Effect of caustic paste disbudding, using local anaesthesia with and without analgesia, on behaviour and cortisol of calves. Appl. Anim. Behav. Sci. 116: 35–44.

Stich, S. P. 1979. Do animals have beliefs? Australas. Journal Philos. 57:15–28.

Stilwell G., M. S. Lima, R. C. Carvalho, and D. M. Broom. 2012. Effects of hot-iron disbudding, using regional anaesthesia with and without carprofen, on cortisol and behaviour of calves. Res. Vet. Sci. 92: 338–341.

Stock, M. L., S. L. Baldridge, D. Griffin, and J. F. Coetzee. 2013. Bovine dehorning: assessing pain and providing analgesic management. Vet. Clin. N. Am. Food A. 29:103–133.

Stott, A. W., B. Vosough-Ahmadi, C. M. Dwyer, B. Kupiec, C. Morgan-Davies, C. E. Milne, S. Ringrose, P. Goddard, K. Phillips, and A. Waterhouse. 2012. Interactions between profit and welfare on extensive sheep farms. Anim. Welf. 21:57–64.

Sturgis, P., and P. Smith. 2010. Fictitious issues revisited: Political interest, knowledge and the generation of nonattitudes. Polit. Stud. 58:66–84.

Sumner, D. A., W. A. Matthews, J. A. Mench, and J. T. Rosen-Molina. 2010. The economics of regulations on hen housing in California. J. Agric. Appl. Econ. 42:429–438.

Sumner, L. W. 1996. Welfare, happiness, and ethics. Clarendon Press.

Sutherland M. A., D. J. Mellor, K. J. Stafford, N. G. Gregory, R. A. Bruce, and R. N. Ward. 2002. Cortisol responses to dehorning of calves given a 5-h local anaesthetic regimen plus phenylbutazone, ketoprofen or adrenocorticotropic hormone prior to dehorning. Res. Vet. Sci. 73:115–123.

Svensson, C., A. Linder, and S. O. Olsson. 2006. Mortality in Swedish dairy calves and

replacement heifers. J. Dairy Sci. 89:4769–4777.

Sviland, S., and S. Waage. 2002. Clinical bovine mastitis in Norway. Prev. Vet. Med. 54:65–78.

Szonyi, B., Y. F. Chang, S. E. Wade, and H. O. Mohammed. 2012. Evaluation of factors associated with the risk of infection with *Cryptosporidium parvum* in dairy calves. Am. J. Vet. Res. 73:76–85.

Tannenbaum, J. 1991. Ethics and animal welfare: the inextricable connection. J. Am. Vet. Med. Assoc. 198:1360.

Tannenbaum, J. 2002. The paradigm shift toward animal happiness. Society. 39:24–36.

Taschke A. C., and D. W. Folsch. 1997. Ethological, physiological and histological aspects of pain and stress in cattle when being dehorned. Tierarztl. Prax. 25:19–27.

Taylor, T. E. 2013. Well-being and prudential value. Philos. Public Policy Q. 31:10.

Te Velde, H., N. Aarts, and C. Van Woerkum. 2002. Dealing with ambivalence: farmers' and consumers' perceptions of animal welfare in livestock breeding. J. Agric. Environ. Ethics. 15:203–219.

Thompson, P. B. 2008. The ethics of intensification: agricultural development and cultural change. Springer, Heidelberg, Germany.

Thomsen, P. T., A. M. Kjeldsen, J. T. Sorensen, H. Houe, and A. K. Ersboll. 2006. Herd-level risk factors for the mortality of cows in Danish dairy herds. Vet. Rec. 158:622–626.

Thomsen, P. T., and J. T. Sorensen. 2009. Factors affecting the risk of euthanasia for cows in Danish dairy herds. Vet. Rec. 165:43–45.

Thornton, P. K. 2010. Livestock production: recent trends, future prospects. Philos. Trans. R. Soc. Lond., B, Biol. Sci., 365:2853–2867.

Tiberius, V. 2013. Well-being, Wisdom and Thick Theorizing: on the Division of Labor between Moral Philosophy and Positive Psychology. In: Kirchin, S. (ed.). Thick concepts. Oxford University Press, Oxford, UK.

Tiberius, V. 2012. Philosophical methods in happiness research. Oxford handbook of happiness. 315-325.

Tiplady, C. M., D. A. B. Walsh, and C. J. Phillips. 2013. Public response to media coverage of animal cruelty. J. Agric. Environ. Ethics 26:869–88

Todaro, M. P. 1969. A model of labor migration and urban unemployment in less developed countries. Am. Econ. Rev. 59:138–148.

Tonsor, G. T., N. Olynk, and C. Wolf. 2009. Consumer preferences for animal welfare attributes: the case of gestation crates. J. Agr. Appl. Econ. 41:713–730.

Tourangeau R and T. Yan. 2007. Sensitive questions in surveys. Psychol. Bull. 133:859.

Tuyttens, F. A. M. 2005. The importance of straw for pig and cattle welfare: a review. Appl. Anim. Behav. Sci. 92:261–282.

Tuyttens, F. A., F. Vanhonacker, E. Van Poucke, and W. Verbeke. 2010. Quantitative verification of the correspondence between the Welfare Quality® operational definition of farm animal welfare and the opinion of Flemish farmers, citizens and vegetarians. Livest. Sci. 131:108–114.

USDA. 1994. Animal Medicinal Drug Use Clarification Act of 1994 (AMDUCA). Title 21 Code of Federal Regulations, part 530. Fed. Regist. 7. FDA, Washington, DC, USA.

USDA. 2008. Beef 2007-08, Part III: Changes in the U.S. Beef Cow-Calf Industry, 1993-2008. Accessed June, 5, 2013. http://www.aphis.usda.gov/animal_health/nahms/beefcowcalf /downloads/beef0708/Beef0708_dr_PartIII.pdf

USDA. 2009. Agriculture Secretary Tom Vilsack Announces Final Rule for Handling of Non-Ambulatory Cattle. Accessed Feb. 15, 2014. http://www.usda.gov/wps/portal/usda/ usdahome?contentidonly=true&contentid=2009/03/0060.xml

USDA/FAS. Peoples Republic of China: Livestock and Products Annual. 2011. Accessed Jan. 15, 2016. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Livestock%20and %20Products%20Annual_Beijing_China%20-%20Peoples%20Republic%20of_9-28-2011.pdf

USDA/NAHMS. 2008. Reference of management practices on small enterprise chicken operations in the United States, 2007. Accessed Aug. 15, 2014. https://www.aphis.usda.gov /animal_health/nahms/poultry/downloads/poultry07/Poultry07_SmallChicken.pdf

USDA/NAHMS. 2009. Dairy 2007, Part IV: Reference of dairy cattle health and management practices in the United States, 2007. Accessed Aug. 1, 2014. https://www.aphis.usda.gov /animal_health/nahms/dairy/downloads/dairy07/Dairy07_dr_PartIV.pdf

USDA/NAHMS. 2015. Swine 2012, Part I: Baseline reference of swine health and management in the United States, 2012. Accessed June 1, 2015. https://www.aphis.usda .gov/animal_health/nahms/swine/downloads/swine2012/Swine2012_dr_PartI.pdf

USDA/NAHMS. 2016. Dairy 2014, Dairy cattle management practices in the United States, 2014. Accessed Apr. 1, 2016. https://www.aphis.usda.gov/animal_health/nahms /dairy/downloads/dairy14/Dairy14_dr_PartI.pdf

USDA/NAHMS. 2013. Sheep 2011, Part III: Health and management practices on U.S. sheep operations, 2011. Accessed July 22, 2015. https://www.aphis.usda.gov/animal_health /nahms/sheep/downloads/sheep11/Sheep11_dr_PartIII.pdf

USDA/NASS. Milk Production. February, 2015. Accessed Mar. 30, 2016. http://www.usda .gov/nass/PUBS/TODAYRPT/mkpr0215.pdf

Vaessen, M. A., J. Veling, K. Frankena, F. A. M. Graat, and T. Klunder. 1998. Risk factors for *Salmonella dublin* infection on dairy farms. Vet. Q. 20:97–99.

van der Schot, A. A. and C. Phillips. 2013. Publication bias in animal welfare scientific literature. J. Agric. Environ. Ethics. 26: 945–958.

Vanhonacker, F., E. Van Poucke, F. Tuyttens, and W. Verbeke. 2010. Citizens' views on farm animal welfare and related information provision: exploratory insights from Flanders, Belgium. J. Agric. Environ. Ethics. 23:551–569.

Vanhonacker, F., W. Verbeke, E. Van Poucke, Z. Pieniak, G. Nijs, and F. Tuyttens. 2012. The concept of farm animal welfare: Citizen perceptions and stakeholder opinion in Flanders, Belgium. J. Agric. Environ. Ethics. 25:79–101.

Vanhonacker, F., W. Verbeke, E. Van Poucke, and F.A. Tuyttens. 2008. Do citizens and farmers interpret the concept of farm animal welfare differently? Livest. Sci. 116:126–136.

Varner, G. E. 2002. *In nature's interests?* Oxford University Press.

Vasseur E, F. Borderas, R. L. Cue, D. Lefebvre, D. Pellerin, J. Rushen, K. M. Wade, and A. M. Passillé. 2010. A survey of dairy calf management practices in Canada that affect animal welfare. J. Dairy Sci. 93:1307–1315.

Velleman, J. D. 2009. The possibility of practical reason. Michigan Publishing, University of Michigan Library.

Ventura B. A., M. A. G. von Keyserlingk and D. M. Weary. 2015. Animal welfare concerns and values of stakeholders within the dairy industry. J Agric. Environ. Ethics. 28:109–126.

Ventura B. A., M. A. G. von Keyserlingk, C. A. Schuppli and D. M. Weary. 2013. Views on contentious practices in dairy farming: The case of early cow-calf separation. J. Dairy Sci. 96:6105–6116.

Verbeke, W., F. J. Pérez-Cueto, M. D. D. Barcellos, A. Krystallis, and K.G. Grunert. 2010. European citizen and consumer attitudes and preferences regarding beef and pork. Meat Sci. 84:284–292.

Verhoog, H. 1992. The concept of intrinsic value and transgenic animals. J. Agric. Environ. Ethics. 5:147–160.

Vesterinen, H. M., E. S. Sena, K. J. Egan, T. C. Hirst, L. Churolov, G. L. Currie, A. Antonic, D. W. Howells, and M. R. Macleod. 2014. Meta-analysis of data from animal studies: a practical guide. J. Neurosci. Meth. 221: 92–102.

Visak, T., and J. Balcombe. 2013. The Applicability of the Self-fulfillment Account of Welfare to Nonhuman Animals, Babies, and Mentally Disabled Humans. Philos. Public Policy Q. 31:27–34.

von Keyserlingk, M. A. G., A. Barrientos, K. Ito, E. Galo, and D.M. Weary. 2012. Benchmarking cow comfort on North American freestall dairies: Lameness, leg injuries, lying time, facility design, and management for high-producing Holstein dairy cows. J. Dairy Sci. 95:7399–7408.

von Keyserlingk, M. A., and M. J. Hötzel. 2015. The ticking clock: Addressing farm animal welfare in emerging countries. J. Agric. Environ. Ethics. 28:179–195.

Waage, S., S. Sviland, and S. A. Ødegaard. 1998. Identification of risk factors for clinical mastitis in dairy heifers. J. Dairy Sci. 81:1275–1284.

Waddock, S. A., and S. B. Graves. 1997. The corporate social performance-financial performance link. Strategic Manage. J. 18:303–319.

Waiblinger, S., and C. Menke. 1999. Influence of herd size on human-cow relationships. Anthrozoos. 12:240–247.

Walker, M., M. Diez-Leon, and G. Mason. 2014. Animal welfare science: Recent publication trends and future research priorities. Int. J. Comp. Psychol. 27.

Walker, W. L., W. B. Epperson, T. E. Wittum, L. K. Lord, P. J. Rajala-Schultz, and J. Lakritz. 2012. Characteristics of dairy calf ranches: morbidity, mortality, antibiotic use practices, and biosecurity and biocontainment practices. J. Dairy Sci. 95:2204–2214.

Wallace J. L. 1997. Nonsteroidal anti-inflammatory drugs and gastroenteropathy: the second hundred years. Gastroenterology. 112:1000–1016.

Waltner-Toews, D., S. W. Martin, and A. H. Meek. 1986. The effect of early calfhood health status on survivorship and age at first calving. Can. J. Vet. Res. 50:314–317.

Warnick, L. D., L. M. Crofton, K. D. Pelzer, and M. J. Hawkins. 2001. Risk factors for clinical salmonellosis in Virginia, USA cattle herds. Prev. Vet. Med. 49**:**259–27*5.*

Warnick, L.D., J. B. Kaneene, P. L. Ruegg, S. J. Wells, C. Fossler, L. Halbert, and A. Campbell. 2003. Evaluation of herd sampling for *Salmonella* isolation on Midwest and Northeast US dairy farms. Prev. Vet. Med. 60:195–206.

Weary D. M., C. A. Schuppli, and M. A. G. von Keyserlingk. 2011. Tail docking dairy cattle: Responses from an online engagement. J. Anim. Sci. 89:3831–3837.

Weary, D. M., B. A. Ventura, and M. A. G. von Keyserlingk. 2016. Societal views and animal welfare science: understanding why the modified cage may fail and other stories. Animal. 10:309–317.

Webster, J. 2016. Animal Welfare: Freedoms, Dominions and “A Life Worth Living”. Animals. 6:35.

Webster, J. 1994. Animal welfare: A cool eye towards Eden. Blackwell.

Weigel, K.A., R. W. Palmer, and D. Z. Caraviello. 2003. Investigation of factors affecting voluntary and involuntary culling in expanding dairy herds in Wisconsin using survival analysis. J. Dairy Sci. 86:1482–1486.

Weijers, D. 2011. “Hedonism”. Internet encyclopedia of philosophy. Accessed Sept, 29 2016. http://www.iep.utm.edu/hedonism/

Wellbrock, W., S. J. Oosting, B. B. Bock, B. Antunović, and G. Kralik. 2010. Harmonization of welfare standards for the protection of pigs with the EU rules: the case of Croatia. Ital. J. Anim. Sci. 8:21–38.

Wells, S. J., L. P. Garber, G. W. Hill. 1996a. Health status of preweaned dairy heifers in the United States. Prev. Vet. Med. 29:185–199.

Wells, S. J., D. A. Dargatz, and S. L. Ott. 1996b. Factors associated with mortality to 21 days of life in dairy heifers in the United States. Prev. Vet. Med. 29:9–19.

Wells, S. J., L. P. Garber, and B. A. Wagner. 1999. Papillomatous digital dermatitis and associated risk factors in US dairy herds. Prev. Vet. Med. 38:11–24.

Wells, S. J., P. J. Fedorka-Cray, D. A. Dargatz, K. Ferris, and A. Green. 2001. Fecal shedding of Salmonella spp. by dairy cows on farm and at cull cow markets. J. Food Prot. 64:3–11.

Whitaker, D. A., A. I. Macrae, and E. Burrough. 2004. Disposal and disease rates in British dairy herds between April 1998 and March 2002. Vet. Rec. 155:43–47.

Whitaker, D. A., J. M. Kelly, and S. Smith. 2000. Disposal and disease rates in 340 British dairy herds. Vet. Rec. 146:363–367.

Wikman, I., A. H. Hokkanen, M. Pastell, T. Kauppinen, A. Valros, and L. Hänninen. 2013. Dairy producer attitudes to pain in cattle in relation to disbudding calves. J. Dairy Sci. 96:6894–6903.

Wilesmith, J. W., P. G. Francis, and C. D. Wilson. 1986. Incidence of clinical mastitis in a cohort of British dairy herds. Vet. Rec. 118:199–204.

Wilson, C. D., and M. S. Richards. 1980. A survey of mastitis in the British dairy herd. Vet. Rec. 106:431–435.

Wythes J. R., J. C. Horder, J. W. Lapworth, and R. C. Cheffins. 1979. Effect of tipped horns on cattle bruising. Vet. Rec. 104:390–392.

Yaylak, E., Y. Akbas, I. Kaya, and C. Uzmay. 2010. The effects of several cow and herd level factors on lameness in holstein cows reared in Izmir province of Turkey. J. Anim. Vet. Adv. 9:2714–2722.

Yeates, J. W., and D. C. Main. 2008. Assessment of positive welfare: a review. Vet. J. 175:293–300.

Yeates, J. W. 2010. Death is a welfare issue. J. Agric. Environ. Ethics. 23:229–241.

Yeates, J. W. 2011. Is 'a life worth living' a concept worth having?. Anim. Welf. 20:397–406.

Yeates, J. W., H. Röcklinsberg, and M. Gjerris. 2011. Is welfare all that matters? A discussion of what should be included in policy-making regarding animals. Anim. Welf. 20:423–432.

You, X., Y. Li, M. Zhang, H. Yan, R. Zhao. 2014. A Survey of Chinese Citizens' Perceptions on Farm Animal Welfare. PLoS One, 9, e109177.

Zhang, K. H., and S. Song. 2003. Rural–urban migration and urbanization in China: Evidence from time-series and cross-section analyses. China Econ. Rev. 14:386–400.

Zucali, M., L. Bava, A. Tamburini, M. Guerci, and A. Sandrucci. 2013. Management risk factors for calf mortality in intensive Italian dairy farms. Ital. J. Anim. Sci. 12:162–166.

Zulkifli, I. 2013. Review of human-animal interactions and their impact on animal productivity and welfare. J. Anim. Sci. Biotechnol. 4:25.