# Antemortem Exploration of the Effect of Human Behavior on Beef Carcass Bruising

Thesis

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By

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Abstract

This non-experimental study sought to examine how the components of the theory of planned behavior influence the human behaviors associated with the result of beef carcass bruising during the pre-harvest handling of beef cattle. The theory of planned behavior served as the conceptual foundation of this study, wherein the components of attitude, subjective norms, and perceived behavioral control were explored through visual observation of pre-harvest handling and researcher administered questionnaires. Observation revealed that the elements of facility design, forceful unloading and cattle slips and falls were most likely to contribute to events associated with carcass bruising, and that attitude, subjective norms, and perceived behavioral control were a factor in the behavioral development of handlers. Future application of this study will enable both researchers and industry members to view the role of handling with a more complex and critical eye, and can lend insight into a more conclusive determination of the behavioral influencers and barriers present in order to accelerate the minimization of beef carcass bruising during antemortem processing.

Dedication

To my husband, family and friends for your unwavering support and love.

Acknowledgments

The gratitude expressed through these words may never truly express the thanks I wish to give those who have supported my graduate education and research, but it is my hope that my appreciation will be shown through application of knowledge and future research endeavors. I would first like to thank Dr. Mary Rodriguez for her tireless support of my education and studies. My guess is that not many of her students in this program start their thesis discussion with an interest in beef carcass bruising, but she embraced my atypical research ideas and encouraged their pursuit, and for that I am extremely thankful. Because of her guidance, I have learned to ask more questions, think more critically, and visualize beyond the here and now. Thanks are also due to Dr. Joy Rumble, as she was instrumental in the development of many parts of our data collection and analysis procedures. Her ability to bring research to its most useable and practical level is a quality I hope to master someday, as is as her capacity for making study development an engaging and stimulating process.

Due to the nature of this study, two faculty members from the department of Animal Science were also an integral piece of the development and completion of our research. Dr. Lyda Garcia has served as an unrelenting source of support, knowledge, and encouragement, and I cannot begin to express the gratitude I hold for the time, travel, and personal resources she has offered. Our time spent walking through harvest floors,

freezers and handling chutes has provided me such valuable insight into an industry that is my passion. Thank you also to Dr. Boyles, a faculty member for whom I harbor much respect, as it was his guidance and direction that refined my research topic to one that has the opportunity to make a difference and positively impact those whose work to feed our nation is unending.

Finally, I would like to extend a heartfelt thank you to my family. My husband has continually served as a calm, unwavering source of support, and is always quick with a "you got this" reminder when the process began to seem overwhelming. To my parents and sister, I thank you for your love and affirmation of my abilities. I am forever grateful, and hope to make you proud in my pursuits of impacting the industry we have all called our own.

## Vita

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Major Field: Agricultural and Extension Education

Concentration: Effect of Human Behavior on Beef Carcass Bruising

Table of Contents

List of Tables

List of Figures

# Chapter 1. Introduction

Carcass bruises in fed cattle have been a topic of concern for producers, packers and everyday consumers alike since the issue was first discovered during the second National Beef Quality Audit in 1995. Upon the inspection of nine beef processing plants, it was determined that nearly half of the cattle surveyed possessed between one to four bruises, which were evident during the hide-off evaluation portion of the audit (Boleman et al., 1998). Subsequent audits illustrated a fluctuation of carcass bruising in accordance with industry segment, i.e. fed cattle or market cow and bull, which reinforced the underlying concern that the problem was not confined to a single sector, but instead fell under the responsibility of all members of the beef industry. Several studies have built on the foundation laid by these audits and have determined that animal handling, when considered as an identifiable precursor to carcass bruising, remains a factor that must be managed effectively (Belk, Scanga, Smith, & Grandin, 2002; Grandin, 1996; Grandin, 2008; Huertas, Eerdenburg, Gil, & Piaggio, 2015; Hoffman, Spire, Schwenke, & Unruh, 1998).

The aspect of human behavior, in the context of animal handling, is largely dependent on the behavioral intentions of the individual (Ajzen, 1985; Ajzen, 1991). Those behaviors that produce negative impacts on animal welfare and the animal product

as a whole are noted with apprehension, as they pose a threat to the economic viability and public perception of beef and animal products (Grandin, 1980; Huertas, Eerdenburg, Gil, & Piaggio, 2015; Lee, 2017). Implications that result from improper handler behavior are generally indicative of poor animal welfare. According to Broom (2000), livestock mortality records can provide an overview of animal treatment, but an accurate assessment of animal handling and welfare occurs when bruises, cuts, and blemishes serve as the deciding factors of an animal's experience.

## 1.1 Significance of the Study

The implications of bruised carcasses are felt throughout the U.S. beef industry in the form of annual losses that climb into the millions (Lee, 2017). Bruising, as defined by Huertas et al. (2015) is the result of tissue damage characterized by vascular rupture and the collection of blood and blood serum. As they negatively affect meat quality and value, bruises must be trimmed from the carcass and ultimately discarded. Depending on bruise severity, the extent to which they impact economic viability varies. These blemishes become most detrimental when found on the loin, ribs, chuck or hindquarters, as these are the most valuable cuts of the carcass (Garcia et al., 2008). In a 2018 study assessing the bruise incidence at five U.S. beef processing plants, it was concluded that 52.1% of beef carcasses were bruised, with trim loss occurring on over 56% (Kline, 2018). These bruises were most commonly found in the loin, rib and round regions, resulting in an average loss of 1.0 kg per carcass (Kline, 2018). Past quality audits have determined that concentrated bruising in these locations are often indicative of improper pre-harvest handling or loading and unloading during transport from the auction to the

harvesting facility. Correlational studies examining the relationship between handling, travel, and unloading procedures reinforce this observation and conclude that there is a strong association between the quality of animal treatment in each of these stages and the end result of carcass bruising and economic loss (Hoffman et al., 1998).

Concern pointing towards the connection linking poor animal handling to carcass bruising and discount was recognized in the producer-focused segment of the 2016 National Beef Quality Audit (Belk et al., 2016). Survey respondents indicated that three of the top six quality challenges facing U.S. beef producers were affiliated with animal welfare and product quality and safety. Those challenges were grouped into the categories of how animals were raised, animal well-being, and food safety/quality assurance. Fed cattle producers further indicated that food safety, which, by definition of surveyed producers includes the implementation of production standards and guidelines established in the Beef Quality Assurance program, was tied for their highest-ranking priority (Belk et al., 2016). The aspects of concern expressed by these producers is consistently shared with U.S. consumers, who have become increasingly interested in the production and handling of the livestock products they consume (Belk et al., 2002). Their feelings regarding animal welfare materialize in meat-counter purchasing decisions, demand for transparency throughout the production and supply chain, and push for regulatory standards, such as the 1958 Humane Slaughter Act and the Humane Methods of Slaughter Act of 1978 (Ahola, 2015). Reasoning behind the development of the Humane Methods of Slaughter Act includes the goal to prevent needless suffering, lessen negative economic impact of improper handling, and to improve slaughter plant

conditions (Hodges, 2010). One of the three critical components, prevention of needless suffering, stems from the basic belief that animals can experience suffering. This belief is often the foundation upon which animal welfare studies are built, as suffering indicates the presence of stress and pain during a handling process (Manteca, 1998).

Based on the economic, quality, and welfare implications associated with beef carcass bruising, this study seeks to explain the impact of human involvement in the process by revealing the behavioral intent and reasoning behind the actions that ultimately lead to carcass injury. Processing plant observations will provide insight into handler behavior and how individual actions encourage or discourage the use of improper animal handling techniques. Data collected through this study will offer an explanation to the question of how human behavior impacts the rate of carcass bruising in beef cattle. The perspectives and knowledge gained through this research have the potential to be applied to similar processing plant environments, settings, and behavioral tendencies. On an industry-wide scale, findings may indicate the need for further employee training opportunities, more focused attention to employee's animal handling throughout processing plants, and the evaluation of plant facilities and their correspondence with safe and efficient animal handling. Application of the information found throughout this study can assist the U.S. beef industry in reducing the incidence of carcass bruising, reducing economic losses, and improving the relationship and understanding of human behavior in relation to an animal's experience during processing.

## 1.2 Research Objectives

The primary objective of this study is to examine how perceived behavioral control, subjective norms, and the attitudes of human handlers influence the behaviors associated with the result of carcass bruising during the pre-harvest handling of beef cattle. The following objectives will guide this research:

1. Describe the observed human handling behaviors and human/animal interaction between plant employees and beef cattle at processing plants.
2. Describe the internal and external factors that influence a handler's behavioral intent.

## 1.3 Assumptions

The findings and knowledge gained from this study are indicative of the population sampled and may vary outside the study parameters. Therefore, the following assumptions are present:

1. Observed handler/animal interactions are representative of regular operations of the processing plant.
2. Answers collected via questionnaires are valid and honest.
3. Principles of the theory of planned behavior, i.e. perceived behavioral control, subjective norms, and attitudes provide insight into one's intent to behave in a certain manner.
4. The goal of human handlers is not to intentionally decrease carcass value, economic viability, and meat quality through their behavior.

5. Human handling that results in animals falling, slipping, or coming into contact with gates, chutes, or equipment in a rough or unnecessary manner is related to bruise incidence.

## 1.4 Limitations

Recognizing limitations of this study will allow for a more thorough assessment of its outcomes. The following limitations are acknowledged:

1. Human/animal interactions are not always predictable and may vary by day, location, and human and animal subjects selected.
2. Data collected at the chosen plants may not be indicative of human behavior patterns present across all United States beef processing facilities. However, the data may provide insight into the human reasoning and intent found in similar handling interactions throughout relative plants.
3. Answers provided by handlers may contain bias or may be influenced by unidentifiable external factors.
4. Researcher presence may cause handlers to act in a manner that does not represent their normal routine.
5. The in-plant observation only provides a look into the handler's behaviors at that moment. There is no way to determine if that behavior is typical of the individual, or if there are external or non-work factors affecting their behavior.

6. The data collected does not include bruise development during carcass fabrication, meaning a chance exists that behaviors commonly associated with bruising do not produce the expected result.
7. This study was conducted during a unique timeframe that involved the onset of the Coronavirus (COVID-19) pandemic. During this time, many plants experienced heightened demands, and were occasionally forced to cease operations due to illness or precaution. Observations recorded during this study may be reflective of the potential stressors created during the pandemic and should be considered while interpreting the results.
8. Perception of positive and negative behaviors observed may differ between researchers and employees based on the premise that some standardly negative or improper practices may be considered acceptable by processing companies.

## 1.5 Definition of Terms

The terms listed are of importance to the understanding and usefulness of this study.

### 1.5a Attitude

Attitude in the context of the theory of planned behavior is noted as the level of favor a person holds towards a specific action or behavior (Ajzen, 1991).

### 1.5b Bruising

As defined by Huertas et al. (2015), bruises are the result of tissue damage and rupture within the vascular system, causing a build-up of blood and blood serum.

1.5c Carcass Quality

The quality of a beef carcass is determined partially by the absence of bruising, dark cutting, and other blemishes. Overall quality is measured through the USDA Yield and Quality grading system, which establishes the yield and eating expectations (Maddock, 2011).

1.5d Handler

A handler is an individual that works and interacts with livestock in various situations and surroundings. This individual is responsible for the care, well-being and effective treatment of livestock, the facilities and equipment used (Animal Handling).

1.5e Perceived Behavioral Control

Perceived behavioral control is the belief one possesses towards their ability to execute an action. Coupled with intent, it produces an end result of an action or behavior (Ajzen, 1991).

1.5f Processing Facility

A processing facility is the location in which cattle are sorted, processed, and held prior to slaughter. The facility is comprised of chutes and holding pens that are connected via gates or fencing.

Quality and maintenance of the handling facility is directly related to the pre-harvest handling experience. Aspects such as non-slip footing, ventilation, noise and overall design are included when evaluating the effectiveness of a facility (Grandin, 1996).

### 1.5g Subjective Norms

The subjective norm serves as a component of the theory of planned behavior. This refers to the social and cultural pressures that cause an individual to act or not to act on a certain behavior (Azjen, 1991).

# Chapter 2. Review of Literature

Chapter 1 discussed the shared concerns among packers, producers, and consumers regarding the negative impact posed by beef carcass bruising, as well as the histological significance of bruising in relation to carcass quality. Prior to establishing the role of the handler in the event of carcass bruising, it is necessary to examine the literature surrounding bruise histology, causes, and the associated implications of human-animal interaction. Chapter two examines the basis of concern regarding carcass quality, economic implications, and the impact of human behavior and intent.

## 2.1 Bruise Definition and Background

Bruising, as defined by Huertas et al. (2015) is the result of tissue damage characterized by vascular rupture and the collection of blood and blood serum. Typically, this damage is the result of ante-mortem blunt force trauma stemming from contact with a dull, stationary object or pressure exerted in a compression-type fashion (Nash & Sheridan, 2009). Similar to bruising in humans, these contusions vary in size and significance, often indicating the level of damage to the animal and the product underneath the hide (Kline, 2018). The presence of a bruise indicates that the animal experienced pain as a result of sub-par animal handling and welfare, either on farm, during unloading, or throughout processing at the slaughterhouse. This has been identified as a primary concern of consumers and those involved in meat production

alike, as poor welfare and lessened product quality are the goals of neither (Strappini et al., 2009). According to Belk et al. (2002), the underlying moral belief that cattle are sentient beings capable of feeling pain as a result of bruising is a major focus and point of consideration throughout the meat industry. The obligation to treat animals in a humane manner was recognized in a 1994 study that proposed several needs surrounding slaughter and handling (Cortesi, 1994). Respect towards animals, firm regulations to maintain security, personnel training, and efforts to incorporate ethological aspects into the lairage and harvest of animals are all components of an efficient and animal-considerate system (Belk et al., 2002).

The events typically associated with bruising take place prior to harvest during the loading, unloading, and handling of animals (Huertas et al., 2015). The majority of beef cattle experience transport at some point in their lives, whether to simply travel to another farm, to the auction, or ultimately to harvest. During these points of transport, research shows there is a steady correlation between pre-harvest handling and carcass bruising (Huertas et al., 2010). A 2006 study focusing on bruise occurrence among Charolais and Limousine bulls similarly concluded that public interest regarding carcass bruising was valid (Nanni Costa et al., 2006). Their findings suggested that the unfavorable welfare conditions associated with bruises did not reflect a positive image of beef production, which resulted in depressed economic value and loss of saleable product (Nanni Costa et al., 2006).

## 2.2 Bruising Found During Quality Audits

Many years of overlooking or simply not realizing the depth and breadth of beef

quality concerns in the U.S. created a need for a national quality audit, of which the first took place in 1991 (Smith et al., 1992). This first audit sought to establish an industry baseline that would provide a reference for both producers and packers to follow in order to build a more competitive nationwide and international market. A series of face to face interviews with consumers, trade organizations, and industry agencies was implemented in the 1991 audit and became a valuable fixture in each following audit (Smith et al., 1992; Belk et al., 2016). Early audits revealed that many facets of the industry and consumer base shared similar concerns, such as excessive external fat, high incidences of injection-site lesions, and frequent carcass bruising. Over time, as more audits were conducted, injection-site lesion prevalence declined rapidly with increased knowledge of proper injection site and procedure. Amount of external fat is no longer a top concern, and the scope of fat present has recently shifted to include degree of leanness (Belk et al., 2016). Carcass bruising however, has remained an underlying issue impacting visual characteristics of the carcass as well as carcass yield and profitability (Smith et al., 1992).

Beginning with the 1995 national audit, researchers began to record bruising by region, such as the loin, round, or chuck. Carcass severity scoring was also implemented in this audit and designated minor bruises as resulting in less than 0.3 kg of trim required for bruise removal, major as less than 0.68 kg of trim, and critical as more than 1.45 kg of trim (Boleman et al., 1998). This allowed auditors to deduct a more accurate economic model as to the negative impact associated with bruising loss. At this time, approximately 48% of carcasses possessed bruises, with nearly 41% of bruises recorded being found on the loin, and over 30% in the chuck area (Boleman et al., 1998). It was also during this

audit that the primary causes of bruising were identified as contact with the trailer during loading and unloading, low-hanging bars, horned cattle, and protruding objects such as nails (Smith et al., 1995). The 2005 audit showed some improvement, with 35.2% of carcasses possessing at least one bruise, 32.6% of those bruises being found on the loin (Garcia et al., 2008). The declining trend was halted in the most recent 2016 national audit, which revealed an increase in bruising present in beef carcasses. Of the carcasses containing bruises, the majority, 77%, were categorized as minimal (<1 pound surface trim loss) or major, 20.6%, (1-10 pound trim loss) (Belk et al., 2016). The uptick in bruise incidence is indicative of an increased need to determine sources of bruising beyond equipment and contact with objects, which were identified as areas to manage in previous audits.

## 2.3 Effect of Handling on Carcass Bruising

To state that all carcass bruising results from a singular source would be inaccurate, as there are numerous variables associated with bruised tissue. Yet while causes may vary, there are two factors that have received more recent scrutiny and attention: pre-harvest handling and loading/unloading processes during transportation. There are several studies devoted to various aspects of these factors that provide insight into the correlation between handling, transport, and bruise prevalence. A 1998 study conducted by Hoffman, Spire et al. sought to determine the relationship between transport distance and bruise severity by first determining the source of the cattle to calculate distance transported. Nearly 4,000 market ready beef cattle were included in the study and variables such as pre-sale brucellosis testing, use of restraint, distance, and

source were thoroughly considered. Handling for brucellosis testing was not a factor affecting each head of cattle, but repeated handling instances and need for restraint were associated with an uptick in bruise prevalence (Hoffman et al., 1998). Restraint and rough handling were also referenced by Grandin (1996), where she noted that on average, cattle handled in a rough manner sustain twice the amount of bruising as cattle that are handled calmly. These rough handling events are oftentimes caused by distracted or inadequately trained employees, which lead to preventable bruising occurrences caused by improper gate use or excessive force coupled with cattle prods (Grandin, 1996).

According to Grandin, the handling methods used on cattle in feedlots and packing plants should align with standard operating procedures in order to reduce carcass injury. Maintaining a calm manner while handling, reducing noise, use of non-electric prods such as paddles or flags, and effectively using animal flight zones are all procedural behaviors that can greatly diminish the occurrence of bruising events. Effective utilization of flight zones involves knowing where the cattle's points of balance lie and how their instinct to move away from a handler will affect how they move throughout a facility. Understanding this concept bodes well for assuring the safety of humans and animals in a working facility (Grandin, 2008). Staying within these parameters encourages cattle to move at a walk or semi-brisk pace that reduces chances of slipping or balking, which often leads to bruising. Human-animal interaction was also a focal point of a 2010 study conducted with the purpose of evaluating the handling of beef cattle in relation to carcass bruising (Huertas et. al., 2010). The use of devices such as electric prods and sticks were associated with increased likelihood of bruising, as was

shouting at the animals to prompt movement. In this particular study, approximately 60% of the 15,168 beef animals researched possessed at least one bruise, which led the researchers to conclude that human handlers had the ability to positively or negatively affect carcass quality and ultimately the overall value of the product (Huertas et. al., 2010).

In addition to pre-harvest handling, transportation, particularly unloading, has been the subject of observational studies regarding bruising. One such study, conducted by Lee (2017) focused on animal health upon arrival at a harvesting facility. Cattle included in the study were selected based on lot according to the facility order sheet. Selected lots were observed while unloading from the trailer, and all events of cattle coming into contact with the frame or accompanying structures were recorded. Once harvested, those lots were observed to determine bruise size, location, and relation to unloading experience. Following observation, it was concluded that approximately 68% of cattle unloaded had obtained some level of bruising, most commonly recorded in the loin area (Lee, 2017). Trailer type is a notable variable that contributes to bruising occurrence and was one of the primary foci of a recent study that derived not only trailer type as an indicator of bruising, but position within the trailer as well. While potbelly-style trailers were more commonly observed than their straight-model counterparts, the data suggested that cattle positioned in the front portion of a straight trailer or the middle-lower portion of a potbelly trailer were most susceptible to bruising (Kline, 2018). Beyond trailer type and the physical effects of unloading, Broom (2000) suggests that negative handling experiences sustained while exiting the trailer and entering the

processing facility may also affect the animal psychologically. Cattle's behavioral response to a negative experience often materializes in the form of resisting movement, aggression, or balking, which often lead to costly human reactions that associate with bruising, poor animal welfare, and poor monetary viability (Broom, 2000).

## 2.4 Economic Impact of Carcass Bruising

Prior to the creation of National Beef Quality Audits, annual losses to the national livestock industry climbed near $46 million, with the beef sector representing approximately $22 million of that total (Grandin, 1980). While bruising was recognized as a concern throughout many years of auditing, Lee (2017) states that annual economic losses have not experienced a notable decline.

Financial loss typically takes one of two forms in relation to bruising. The first, known as 'the carcass discount method', involves the entire side of beef. If bruising requires removal and results in damage or blemishes, the overall value of that side is reduced. The 'trim loss method' is regarded as providing higher accuracy than the carcass discount method but is more labor intensive and more costly in that regard. Trim loss calculations factor the weight of the bruised area and the value given to the area trimmed, resulting in a more definite economic loss. A 1974 comparison between carcass discounting and trim loss showed that of the $22 million total national loss, the discount method accounted for $14 million and the trim loss method accounted for $8 million. Both methods are subjected to certain levels of variability, as is the event of bruising itself (Grandin, 1980). According to Grandin, the variance seen in bruising is often a product of improper handling or faulty equipment (1980). Huertas et al. (2015) observed

thirteen packing plants with the purpose of determining bruise prevalence and its' resulting economic loss. Of the carcasses studied, 60% had visible bruising, most commonly found in the round area. Trim loss varied from 0.5 kg to 6.0 kg, reinforcing the concern that bruising had the potential to cause major devaluation of beef carcasses (Huertas et al., 2015). In a Chilean study regarding bruise impact on carcass quality, Strappini (2012) also concluded that blemishes and bruising caused significant economic losses, climbing into the millions annually.

In addition to the shared concerns of producers and processors regarding carcass discounts and bruising, consumers have also fostered an interest in carcass bruising as it relates to animal welfare and product quality. At the most basic level, a bruised carcass or blemished meat product signals a lack of regard for animal welfare or improper handling on the producers or processors part. Today more than ever, consumers are attracted to transparency and information pertaining to how an animal was raised prior to consumption. Due to this interest in quality production, consumers will ultimately pay higher prices for what is perceived as a higher-quality, well-cared-for product. Consequently, lower quality product is not desired or held to the premium associated with blemish-free meat (Strappini, 2012). This correlation between quality and appearance is demonstrated in additional studies such as Grunert et al's 2004 research, which focused on visual qualities and expected eating experiences. In this case, the relationship between these variables was very strong and served as an indicator of the impact quality products play in influencing consumer perceptions.

## 2.5 Theory of Planned Behavior

Humans are habitually inclined to follow a plan. Regardless of its intricacy, a plan provides a set of actions required to attain a goal or complete an activity. According to the theory of planned behavior, human actions are directed by three considerations: behavioral beliefs, normative beliefs, and control beliefs (Ajzen, 1985). Originating from the theory of reasoned action, the theory of planned behavior fills the void left by the prior surrounding the volitional control one possesses in regard to their behavior (Ajzen, 1991; Fishbein & Ajzen, 1975). While hinging on the expectation that humans will conduct themselves in a reasonable manner, the theory of reasoned action recognized intent to perform an action as a direct and definitive compulsion to act. However, following these intentional impulses requires consideration of two external factors (Azjen, 1985). Similar to the theory of planned behavior, attitude is recognized, but not in a manner specific to the behavior. Subjective norm, otherwise described as social pressure, acknowledges the influence social norms hold over one's decision to act. This relationship between subjective and attitudinal pressure is grounded in personal beliefs; while not necessarily equal in influence, their collaboration ultimately results in intentional follow-though (Azjen, 1985; Earl, 2016).

The theory of planned behavior improves upon its predecessor through a more targeted approach to predicting expected behavior. Previously, attitude was considered a precursor to action, but at a fairly broad level. In an effort to minimize this gap between the influence of attitude and expected follow-through, Fishbein and Ajzen (1975) called for increased specificity within research, meaning that a connection between a specific

attitude and behavior would more thoroughly explain the behavioral intent (Earl, 2016). The resulting model focuses on the attitude directed toward the specific behavior, subjectivity of peers, and perceived control over the actual performance of said action (Earl, 2016). Behavioral beliefs reflect the expected outcomes of a behavior, while normative beliefs consider the assumed response of those impacted by the behavior. Consideration of external factors that have the potential to impact behavior are categorized as control beliefs. The compilation of these behavioral components ultimately leads to a positive or negative attitude regarding the planned behavior. Typically, heightened perception of control, as well as positive feelings toward an action, lead to increased intent to follow through with said action (Azjen, 2019).

In practical application, the theory of planned behavior has provided a theoretical framework for multiple studies involving agricultural subjects and scenarios. One such study, conducted by Hall et al. (2018), sought to determine the role of intent regarding farmer engagement in extension programming. Upon the conclusion of 30 face-to-face interviews with Tasmanian dairy farmers, the researchers noted that while initial attitudes were positive regarding opportunities to be involved in extension activities, individual beliefs concerning the level of new, pertinent information to be learned was a dictating factor when it came to intent to participate (Hall et al., 2018). According to Gold (2011), these findings are consistent with Ajzen's original posit that intent is the product of one's attitude toward a behavior or action and its subsequent outcome.

When related to intent, subjective norms and cultural pressures can prove very

powerful. In an Indian farming community, this was evident through their hesitance to adopt updated pesticide programs and implement integrated pest management (IPM) (Bond et al., 2009). The underlying belief that pesticide use was vital to vigorous plants oftentimes correlated with the intent to apply spray, whether technically necessary or not. This belief was identified as being shared amongst community members and had created a strong social pressure and 'norm' that discouraged one to forego pesticide application. In this case, the attitudes formed by the farmers regarding pesticide use and alternative methods were a result of the subjective norms and societal expectations of the community (Bond et al., 2009). Their perceived control over the situation was diminished, as they tended to rely on the beliefs of the community and form their opinions, attitudes, and actions based on group efforts. As a result of this study, it was determined that the awareness of the availability of IPM programs would need to be addressed prior to the shift of societal beliefs and norms (Bond et al., 2009).

Understanding an individual's intent to behave in a certain manner requires consideration of attitudes, norms, and perceived behavioral control to fulfill the components of the theory of planned behavior, but for a more encompassing understanding, external factors such as experience and beliefs must also be considered. A 2014 Florida study found that attitude toward a behavior was largely dependent on prior experiences with the behavior, and that subjective norms were also formed partially due to experience (Holt, 2014). In this study, it was found that when the message channel was controlled, a participant's attitude, subjective norms, and behavioral control were in fact predictive of their intent to purchase local blueberries. The implications of this study

suggest that prior experiences, moral beliefs, and self-identity can be used to broaden the theory of planned behavior when seeking to understand the intent of an individual (Holt, 2014).

## 2.6 Conceptual Model

To fully understand the role humans play in carcass bruising in beef cattle, elements of the theory of planned behavior must be considered alongside external components that influence the development of attitude, perceived behavioral control, and subjective norms. This combination builds the foundation for a conceptual framework that will address the physical, psychological, social, and personal beliefs and attitudes underlying the outward act of intent to properly or improperly handle livestock (Figure 2-1). As indicated in the theory of planned behavior, the path between the origination of an action and its' follow-through is multi-faceted and oftentimes diverse. To recognize this complex development of intent, this study aims to explore the attitudes, subjective beliefs, and perceived behavioral control that produces one's intent to act in what they perceive as positive or negative behaviors toward beef cattle in processing plants. Perception of positive and negative behaviors may differ between researchers and employees based on the premise that some standardly negative or improper practices are considered acceptable or normal by processing companies. In this case, perceived behavioral control, attitude, and subjective norms will guide the theoretical aspect of the study, but the influence of external variables such as beliefs, company culture, and labor expectations will also be considered. The relationship between the theoretical, physical, and psychological aspects of a handler's behavior is modeled below (Figure 2-1). The

overarching concept of the model is human behavior, which is then broken down into the subsets of demographics, the three components of the theory of planned behavior, and the external forces of beliefs, company culture, and labor expectations. Demographics, attitudes, subjective norms, and perceived behavioral control function as a group insofar as they are considered internal to the human subject, while organizational beliefs, company culture, and expectations are external pressures. The relationship between inward and outward behavioral influences result in the development of attitude toward a behavior, reaction to subjective norms, and perceived control over one's actions, which combine to produce behavioral intent. Intent is then assumed to employ through physical action, which results in an experience that either causes or prevents the event of carcass bruising.

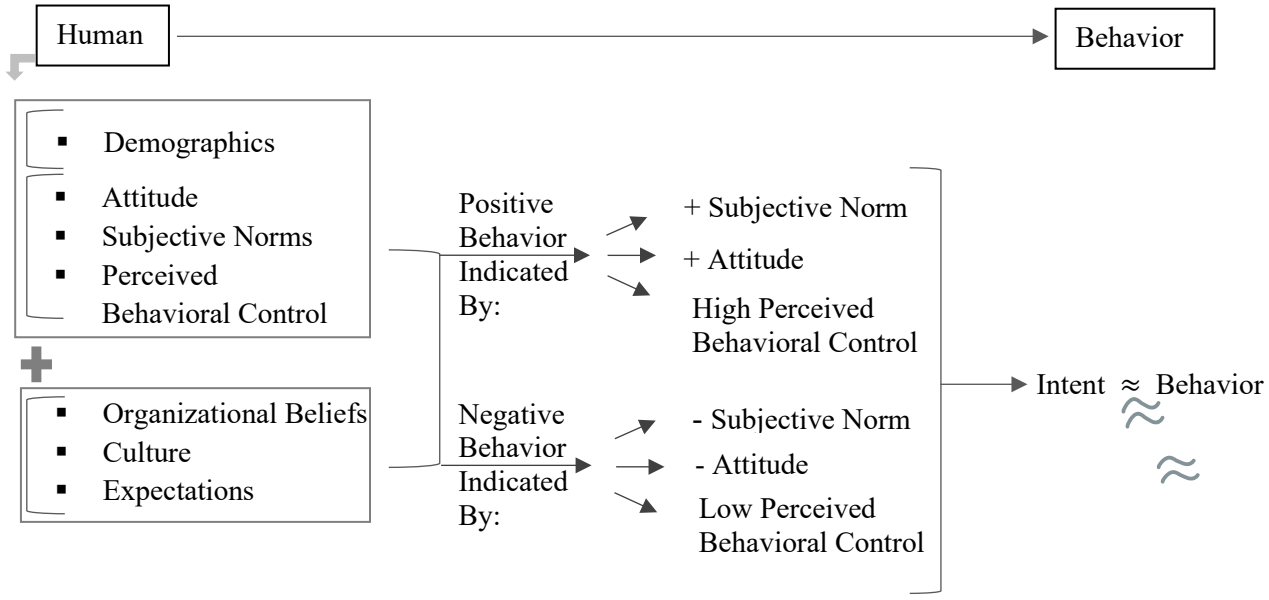



Figure 2-1. Conceptual model illustrating the process in which a handler's intent to act is incorporated into Ajzen's theory of planned behavior and external components such as beliefs, culture and expectations.

## 2.7 Summary

Chapter two provided a review of literature that extended from the basic definition and principles of bruising to the implications and evidence of their involvement in the beef cattle processing industry. Delving into the histological aspects of bruising and their relation to conditions associated with sub-par animal handling and welfare revealed a shared concern for product quality and humane treatment among consumers, producers, and packers. Economic impacts were also recognized, as the presence of a carcass bruise is cause for product discarding and loss of overall value. The proven relationship between animal handling and carcass blemishes were then discussed prior to the inclusion of the theory of planned behavior. This provided the basis for the conceptual model which depicts how the theory of planned behavior couples attitude, perceived control, and subjective norms with external factors to predict positive or negative behavior.

# Chapter 3. Methodology

Through many quality audits, studies, and associated research, it has been determined that carcass bruising in beef cattle is the source of substantial economic losses and quality concerns for the U.S. and international beef industry. The purpose of this study was to examine how a handler's attitude, perceived behavioral control, and subjective norms influence their behavior, which in turn will prevent or make possible the event of carcass bruising. Using the theoretical concepts offered in the theory of planned behavior, this research explored the relationship between a handler's behavior and its consequence on the resulting beef product, which will lay the groundwork for more pointed studies regarding rate of bruising and human/animal interactions. Chapter one explained why the occurrence of bruising presented concern to producers, packers, and consumers as a result of the implied decrease in quality and animal welfare standards. Chapter two provided a thorough background on bruise histology and meaning while also breaking out the concerns listed in chapter one into more detailed and independent parts. Factors such as economic impact, animal handling and the role of human behavior, as seen through the components of the theory of planned behavior, were presented as crucial to the understanding of the human's role in carcass bruising. The conceptual model further represented the handler's role in carcass bruising through incorporating attitude,

behavioral control, subjective norms, and external factors such as organizational expectations and beliefs to create intent, which contribute to the ultimate action of the handler.

This chapter will discuss an exploratory case study utilizing both quantitative and qualitative approaches to describe each case. Each case consisted of researcher observations and researcher-administered questionnaire. It will examine study design, proposed population and sample, data collection tools and methodology.

## 3.1 Research Objectives

The purpose of this study was to apply the components of the theory of planned behavior to the pre-harvest handling of beef cattle through observation and in-person interviews with plant employees in order to explore and gain understanding of their behavioral intent and actions.

The objectives below have provided the foundation and direction of this study.

1. Describe the observed human handling behaviors and human/animal interaction between plant employees and beef cattle at processing plants.
2. Describe the internal and external factors that influence a handler's behavioral intent.

## 3.2 Study Design

Building on the foundation laid by the research objectives, an exploratory case-study design was developed. This study aims to describe the role humans and their subsequent behavior plays in the prevalence of beef carcass bruising during pre-harvest handling at processing plants. As many of the objectives listed above suggest an

exploratory approach, a non-experimental design is best suited to explore this topic (Wilson, 2013). Although case studies are most often associated with qualitative research, their relevance within both qualitative and quantitative research has been referenced while determining that case studies are not explicitly required to include direct qualitative research (Yin, 2009). Data were collected via structured observations and a researcher-administered questionnaire.

### 3.3 Research Population and Sample

The population of this research is meat packing plants. Within each plant, employees regularly involved with handling beef cattle throughout unloading and processing and the plant managers if available were involved in the study. The sample for this study was a purposive, convenient sample of both small and very small facilities and companies to provide an accurate representation of statewide beef processing plants. The designation of small or very small is determined by the Department of Agriculture's Food Safety and Inspection Service (FSIS), wherein a small establishment has between 10 and 500 employees, and a very small establishment has less than 10 employees (Federal Register, 1996). This approach to sample is appropriate because small and very small categorized plants are representative of Ohio's processing plant population. In Ohio, there are approximately 262 state inspected and 192 federally inspected meat packing plants. Of this total population, a sample of four small and very small processing plants were included as cases in this study. Eight handlers were observed throughout four small and very small beef processing plants and five handlers were administered the questionnaire.

## 3.4 Instrumentation

*Structured observations – checklist*

Structured observation served as the first mode of data collection. A checklist, categorized by facility structure and efficiency, unloading processes, human behaviors, cattle activity, and human/animal interaction provided a guide with which to observe antemortem interactions. This checklist was adapted from the 2019 Recommended Animal Handling Guidelines and Audit Guide, which addresses key aspects of facilities, handling, and cattle behavior that expedite the rate of bruising and physical injury (Grandin, 2019). Each category included a subset of questions to document specific behaviors, handling practices, facility environment, and the number of occurrences of each. Facilities and equipment were evaluated for cleanliness, drainage, presence of non-slip flooring, adequate lighting and their overall contribution to the calm and efficient movement of cattle. The unloading areas, holding pens, and chutes were the primary foci of the evaluation, but additional aspects such as back-gates and size of equipment were included as well if applicable. Trailer unloading was also documented through a series of questions centered around the cattle and human interaction during the process. Data pertaining to whether cattle exit the trailer with forceful human assistance or on their own, come into contact with trailer doors or gates, are allowed to walk through the facility at a natural pace or are pushed to move at a fast pace, or obtain any outward injuries as a result of their handling experience were noted.

Evaluation of human handling took place at multiple points throughout processing, including unloading cattle from the trailer, moving cattle to holding pens,

transport from pens to chutes, and finally from the chute to the stunning area. Guiding observational notes prompted researchers to note whether the handlers allowed cattle to maintain a walking pace, behaved aggressively towards animals through physical action or use of hotshots or handling equipment, worked cohesively with fellow handlers, or altered their behavior because of the actions of others. Time of day was recorded upon arrival of the trailer, unloading of all cattle from the trailer, and at the completion of moving all cattle to a holding pen. To establish consistency, the same checklist and guiding questions was utilized at each plant observation.

Observation of cattle movement during unloading and handling was based off criteria listed in the 2019 audit guide that posit calm and welfare-conscious handling are not possible with slips and falls. Prevention of falls is majorly associated with allowing cattle to maintain a walking pace and refraining from becoming aggressive or careless while handling. Cattle that become excited or are moved with unnecessary use of equipment such as electric prods, may result in lower quality or blemished carcasses, which validates the need to account for use of handling equipment in the observatory portion of this study (Grandin, 2019, Warner et al., 2009). Vocalizations are also noted as an indicator of welfare and should be considered when assessing quality of handling and state of the animal's behavior. Throughout the entire handling process, it is recommended that handlers sustain a calm, quiet presence amidst the animal's flight zone, and use handling equipment such as prods only as a last resort (Grandin, 2019).

The checklist data collection tool was based not only on audit criteria, but also on the experiences and applicable findings gathered during a pilot test of the instrument at a

large-scale beef packing plant. While this packing plant was larger than many plants found within Ohio, it was chosen so that the checklist could be applied and revised to account for and represent a broad range of items that would likely occur, albeit on a smaller scale, in small and very small beef processing plants. While at the pilot plant, researchers observed multiple trailer loads of cattle being unloaded, moved to holding pens, and finally moved from the holding pens to the harvest area. With each group of cattle, researchers noted observations regarding the handler, cattle, the unloading procedures, and finally the equipment and facilities used by the handlers. During these observations, suggestions to consider unloading areas, alleys/chutes, and holding pens separately, employee use of handling equipment, and employee attitudes were made and applied to the checklist. Regarding the handlers at this plant, there were multiple observations of an apparent lack of knowledge regarding cattle flight zones and instinctual movement, which merited the addition of an item concerning use of flight zones to the resulting checklist. Overall, while the size of this pilot plant may not have been representative of small Ohio plants, the observations were, and ultimately strengthened the ability of the checklist tool to assist the researcher in thorough observation.

*Researcher administered questionnaire*

Following observation and the completion of the unloading process, face-to-face interviews, guided by the questionnaire, were conducted with participants who were routinely involved in the unloading and pre-harvest handling process. The questionnaire sought to address specific aspects of their role in the processing and handling of cattle,

including their attitude and perceived level of importance regarding their job and its' impact on carcass quality. From both the reference of questionnaire design-based articles and from this study's panel of experts, the questions used in this research were formed.

According to Rowley (2014), the development of effective questions stems from the use of practical terms that are familiar to those in the research population. This recommendation guided the formation of questions, and encouraged the use of terms such as cattle handling, facilities and equipment, carcass bruising, profitability, etc. Members of the expert panel also contributed to the formation of questions, wherein one member drew from their extensive knowledge of beef processing to aid in the development of questions as they related to behavior. Another member then refined the rough outlines of questions posed to minimize any implicit bias present and increase the efficiency of terminology used. Employee respondents were also asked to elaborate on organizational expectations and how they influenced their behavior. Overarching questions referencing cohesivity among employees, facility maintenance, and morale were also addressed. All questions were written to be contextually appropriate.

### 3.5 Validity of Study

The ability to place confidence in the data collected throughout a study serves as a measure of its trustworthiness. In the words of Patino and Ferreira (2018), this concept, known as validity, refers to the applicability of the research and research instruments as they relate to the true and real world scenarios surrounding the study focus and population. This concept is measured in two areas of internal and external validity. According to Andrade (2018), the purpose of determining internal validity is to ensure

that the study instruments and design align with the posed research questions in a non-biased and accurate manner. External validity on the other hand, determines whether the data collected can be used in a general context among related research endeavors or generalizations.

The data collection tools, which include an observational checklist and open-ended interview guide, were addressed for their validity through expert evaluation and pilot testing. Experts constituting the panel came from diverse backgrounds that allowed for a critical, encompassing evaluation of the instruments, and provided thorough insight into the internal, external, and face validity aspects of the study. Similar to internal and external validity, face validity is described as the concept of determining whether an instrument actually assesses the items intended to be evaluated (Hardesty & Bearden, 2004). Through evaluation and feedback provided by the experts involved in this study, the data collection instruments were adjusted and deemed valid to accomplishing the purpose and objectives of this research.

To further establish validity consistent with the manners described above, the observation data collection tool was also tested during observations at multiple beef processing plants. The plants chosen for these pilot observations varied in size and processing capacity to account for a multitude of environments and practices that may arise in the data collection portion of this study. This allowed the research to be applied to multiple settings and environments, which reinforces the data's validity. During these pilot observations, the checklist tool was critically evaluated for clarity, organization, and inclusion of critical observation points. Upon the completion of these pilot evaluations,

the checklist was revised and formatted to accommodate any additions or revisions elicited by the need for more precise and practical observations. Subjecting the checklist to realistic experiences such as these enhances its ability to relate to populations similar to those represented in the study. As the setting of this study is not controlled, consistency was maintained through documented explanations of the reasoning and sources behind identified variabilities. Due to time restrictions, pilot testing of the researcher administered questionnaire was unable to be completed, however all questions were reviewed by the expert panel and subsequent suggestions and revisions were applied.

Researcher Subjectivity statement

Mostly used in qualitative research, subjectivity statements allow the reader to learn more about the researcher's lens through which the study was conducted. In this study, I served as the main instrument of data collection and analysis both in the observations and in the researcher administered questionnaire. As such, providing my lens is essential as it guides the study's findings.

3.6 Data Collection Procedures

All data collection methods, consent authorization processes, and objectives of this study were submitted to The Ohio State University's Institutional Review Board (BuckIRB) for approval, which was received on September 2, 2020. In order to gain access into the packing plants included in this study, prior authorization was requested and granted by the company manager or owner. The checklist data collection tool was used as the primary method to record and guide visual observation during the study. Data

gathered via observations were noted in the checklist. To collect this data, the researcher positioned themselves either on a catwalk above the handling area, or in an area which offered full visibility to the chutes and handling areas. To minimize disturbance of normal operations, researchers did not position themselves inside the handling areas.

To assist in collecting observations throughout this study, three observatory researchers were trained. These additional researchers were selected based off their previous experience and knowledge of cattle handling and were assigned a specific portion of the checklist to guide their observations, such as cattle, handlers, or unloading. Prior to arriving at the plant, the researchers were given time to look over their assigned checklist section, and also received detailed training/explanations regarding the meaning of each item and what they should be recording and watching for during processing. Any questions or clarification needed from these additional researchers was addressed prior to entering the plant and throughout observations if necessary.

Each handler was assigned a numerical label (i.e. Handler 1, Handler 2) that was used for recording. In addition to labeling, participants were asked to complete a very brief demographic survey to provide a more detailed assessment of each handler. The researcher administered questionnaire was conducted following observation of the handling processes and interactions and was administered solely by the researcher, herself. Questionnaire administration was conducted in an interview format because of its ability to capture open and descriptive responses (Merriam, 1998). The questionnaire was administered in a conversational, semi-structured manner that allowed for flexibility, yet maintained consistency with the previously established questions.

## 3.7 Data Analysis

Each case is described by thick, rich description and supported by quantitative descriptive analyses for both objectives 1 & 2. SPSS ® 26.0 software was used to analyze data collected during the observations and questionnaire. For each component of the antemortem observation of animal handling, a scale was designed to gauge the prevalence of behaviors that are conducive to carcass bruising. Behaviors or events that occurred during the observation of facilities, unloading, handlers and cattle were categorized into low, moderate, and high-risk levels.

Based upon guidance from the 2019 audit guide, electric prod use was categorized as low risk being 5% or less, moderate as 25% or less, and high as greater than 25% of cattle prodded. Falls and slips were categorized as low meaning no falls present, moderate as fewer than 1%, and high as greater than 1%. Vocalizations were considered low when less than 1% of animals vocalized, moderate when less than 3% vocalized, and high if greater than 3% of cattle vocalized (Grandin, 2019). Remaining items were categorized in the following manner: up to two occurrences of an item were labeled as "low" risk of producing bruising, three to five occurrences of an item warranted "moderate" risk, and greater than five occurrences of an item was categorized as "high" risk of bruising. These categories serve as a distinguishing factor that signal low, moderate, and high risk of bruising to the carcass due to identified handling behaviors.

Respondents who agreed to participate in the questionnaire were asked a predetermined set of questions and were instructed to describe their accompanying attitudes and perceptions of how the question made them feel and how they viewed their

role as a handler as it related to the question at hand. Since the questionnaire was administered in a conversational format (similar to an interview) as was most appropriate for the study, the researcher coded respondent statements to align with a Likert-type scale for quantitative analysis.

## 3.8 Summary

This exploratory case study sought to describe and further examine the theory of planned behavior as it relates to animal handling in beef processing plants. Preliminary research at both large and small beef processing plants served to strengthen the study's observational instrument and enhance its ability to represent various processing plant scenarios. The study population was comprised of small and very small meat packing plants. During this study, eight handlers were observed and five handlers took part in researcher-administered questionnaires. Data analysis was completed using SPSS ® 26.0 software and descriptive statistics were provided to interpret observations and findings.

# Chapter 4: Results

Chapter one presented a comprehensive background of the concerns shared by packers, producers, and consumers regarding the impact of beef carcass bruising, due both to welfare indicators and the histological significance to the overall quality of the carcass. Chapter two addressed these concerns through peer-reviewed literature and examined the principles of bruising, their implications and evidence of their occurrence in the beef processing industry. Economic and product value implications were also discussed, and a relationship between carcass quality and animal handling was presented. This relationship was described through the lens of the theory of planned behavior, which accounts for attitude, perceived behavioral control, and subjective norms coupled with external factors to more thoroughly understand the reasoning behind human behaviors conducive to carcass bruising. Chapter three then detailed the purpose, study design and data collection methodology while outlining research objectives and basis of the study.

Chapter four provides analysis of observations and data collected as it relates to the objectives of this study. Data will be delivered as it pertains to each individual research objective. Percentages of risk items are reported on a plant basis – if an item presented moderate risk at two of the four plants observed, it would be reported as 50% of observations.

## 4.1 Objective One

Objective one sought to describe the human handling behaviors and human/animal interactions between plant employees and beef cattle at processing plants via visual and written observations using a checklist data collection tool. The checklist

observation tool was divided into four segments, including facilities and equipment, unloading, handlers, and cattle. Each segment of the checklist was assigned to an individual researcher, who was trained to observe and record the handling process from that segment's unique point of view. Presence of items observed were categorized in the following manner, with the exception of electric prod/hotshot use, falls/slips, and vocalizations: up to two occurrences of an item were labeled as "low" risk of producing bruising, three to five occurrences of an item warranted "moderate" risk, and greater than five occurrences of an item was categorized as "high" risk of bruising. Electric prod use was categorized as low risk being 5% or less, moderate as 25% or less, and high as greater than 25% of cattle prodded. Falls and slips were categorized as low if there were no falls present, moderate when fewer than 1%, and high when greater than 1%. Vocalizations were low if less than 1% of animals vocalized, moderate if less than 3%, and high if greater than 3% of cattle vocalized (Grandin, 2019).

### 4.1a Descriptive Analysis of Plant One

The first plant observed in this study was a small, family owned plant. Overall, the plant was not large in size, however the unloading, handling and holding areas appeared to have adequate space to handle cattle safely and efficiently. Prior to the arrival of cattle to be unloaded, the researchers were able to quietly observe the function of the fabrication crew, which seemed to be very unified. When cattle arrived, the researchers moved to their positions within the unloading and handling areas and found that the equipment available to the handler made for a smooth unloading and penning process. The handler did not use any physical handling equipment other than their hands, which

presented a moderate risk, however the reaction from this on the part of the cattle presented a low risk regarding cattle coming into contact with objects or equipment. The most common piece of equipment cattle contacted was the gate latches for the back gates positioned to the side of the animal. In this case, the latches were primarily stationary, and stuck out past the rest of the gate, making contact more likely. During conversation, it was determined that the handler felt very highly of the equipment and facility they worked in, which contributed to a heightened sense of control over their ability to handle cattle safely and efficiently. However, they did mention that the one facet they could not control was how the animal was raised and transported. Throughout observations, this handler was the only employee at the plant working the handling area that day, but appeared to take their job seriously and valued their role and what it ultimately meant to the success of the company and the beef they processed.

### 4.1b Descriptive Analysis of Plant Two

The second plant visited during this study was another small, family owned plant that had a strong family mentality among the employees. Between loads, of which there were six, the researchers had the opportunity to watch the employees interact with each other and go about their daily operations. The employees seemed to be very comfortable with their positions and started the day of observation with positive attitudes. Depending on who was most available at the time, two employees alternated between cutting and unloading cattle, and each were observed and administered the questionnaire. The first handler observed began the process with a positive demeanor, however this changed slightly when one of the haulers (not an employee of the plant) decided to assist in

unloading the cattle from their trailer. This hauler was outwardly aggressive towards the cattle in the trailer, and this visibly frustrated the handler, as the cattle immediately became more challenging to handle calmly. Part of the reason for their excitement was the haulers handling equipment of choice, which was an electric prod. This hauler accounted for most of the electric prod use observed within this study, and they appeared to have a blatant disregard for the location on the animal or manner in which the prod was used. This created a high risk, and also caused a higher incidence of slips and falls from cattle during the unloading process as they clamored around the trailer and onto the unloading ramp. Once this hauler left the plant, the remaining loads were much less eventful, and an electric prod was used twice by the first handler to move a steer that did not respond to other methods of physical encouragement. During observations of the second handler, it was apparent that their handling style was very calm and methodical. While they were not present during the unloading of the trailer that was assisted by the hauler, it was noted that their pace, attitude, and demeanor were consistent and effective. Once cattle exited the trailer, they made an abrupt left turn into the handling facility, which was small, tight, and outdated. Had it not been for the increased demand stemming from COVID-19, the company expressed that they had planned to make modifications and update the handling area during 2020, however the ability to keep the plant moving proved more valuable in the short term. Also of note was that the increased demand had led to the plant nearly doubling the number of beef processed per week from 15 to anywhere between 25 to 30. In the time researchers were present, six trailers hauling a total of 13 cattle recorded. During processing, cattle routinely slipped or fell on the slick

concrete flooring within the chutes, and at one point this caused a backup that required the handler to get down in the chute and assist a heifer in getting back on her feet. This, as well as cattle vocalizations, presented high risks to bruising. When interviewing the handlers, it was evident that they did not feel that the equipment or handling facility itself benefited their ability to handle cattle safely or efficiently. In fact, one of the handlers had very strong negative feelings towards the function of the equipment, which lent to a very low perception of their control over the situation. In the words of one handler, "there is only so much we [the handlers] can actually control." Overall, the two handlers observed and interviewed at this plant appeared to do the best they could with the equipment they had, however this did not contribute to high perceived behavioral control or feelings of responsibility towards the end product.

### 4.1c Descriptive Analysis of Plant Three

The third plant visited was considered small in the sense of USDA categorizations, but was larger than the other plants included in this study. At the time of this study the plant was harvesting approximately 200 head of beef per week, which had been keeping all employees very busy. When researchers entered the handling area, they were able to observe handlers moving a small group of cattle from one holding pen to another, and at first glance there was some disjointedness between the main handler and one of the employees that had stepped in to help. It was later found that the additional employee was not a consistent handler and was typically only asked in if more hands were necessary, which was partially due to their hurried nature. Beyond the handling of that initial small group of cattle, there were two handlers observed. The first was very

methodical in their movement and appeared to be very comfortable around cattle. The second was choppier in their movement, however was still effective and seemed comfortable in their role. Both later expressed their concerns with the facility and equipment at their plant, whose floors contributed to the high risk of cattle slips and falling observed. In one of the handling pens this issue of flooring was enhanced when the watering trough was knocked over. While they did not feel that they had an overwhelming amount of control over the role played by the facilities, the first handler did have a very clear understanding of how bruising would later affect profitability, as they themselves had witnessed the internal quality effect of squeezing a steer between two gates, and believed this could have been prevented. The second handler did seem to believe there was a link between handling and quality, however their overall attitude was more laissez faire, and ultimately viewed their position as "just a job", where accomplishing the task at hand was their main priority. In comparison to the previous two plants, the family atmosphere was perhaps not as pronounced, but the handlers conducted themselves in a proper manner throughout observations. No formal handling equipment was used, and the main drivers of the risk factors observed were related to facilities. At this plant, two trailer loads of three and 11 cattle were observed, and the handling of 15 head was observed within the holding pens and chutes. Two handlers were observed and interviewed.

### 4.1d Descriptive Analysis of Plant Four

The fourth plant was again small and appeared to be run in a very professional

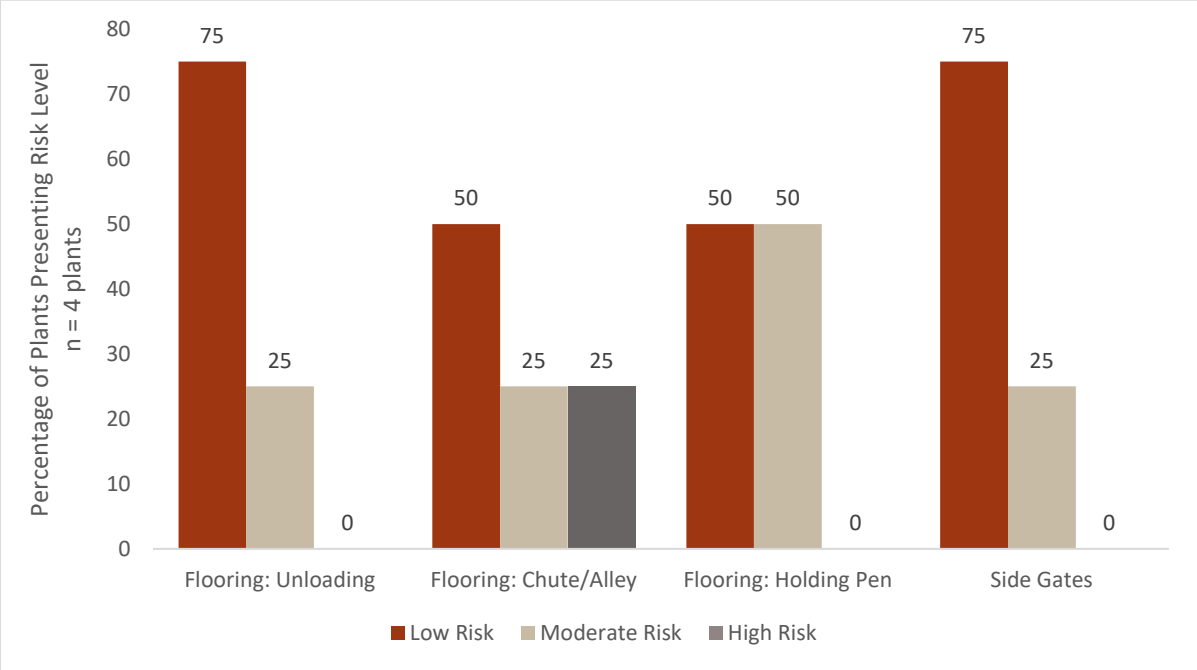
manner. For some employees, their experience at this plant qualified as some of their first direct contact with cattle, and it was obvious that learning and implementing correct handling strategies was important to the crew. Overall, this facility and its equipment posed a low risk to bruising in all areas, and it seemed to work efficiently toward the safe movement of cattle. However, there were two falls recorded while cattle were moving out of the holding pens. The handlers worked cohesively for the majority of the time, while one handler did exhibit a more nervous and negative demeanor during the handling process. In the case of handling, one employee did use their hands to push cattle into the knock box, but there were no cases of improper use of handling equipment observed.

### 4.1e Overview of all Plants: Descriptive Analysis of Facilities and Equipment

Observations of the facilities and equipment included type of flooring, protrusion of objects, presence of foreign material, functionality of back-gates, and adequacy of lighting present in the unloading areas, chutes, and holding pens. Of the processing plants observed, 75% of flooring in unloading areas were deemed low risk, and 25% were moderate risk. Flooring within chute/alley areas were low risk 50% of the time, 25% moderate risk, and 25% high risk. Finally, holding pen floors were 50% low risk, and 50% moderate risk. Presence of protruding objects in unloading areas, chutes and holding pens merited low risk, as only one protruding object was noted throughout all observations. Risk posed from foreign objects and trash or debris was also found to be low risk across all unloading areas, chutes and holding pens. Back gates positioned above cattle presented a low risk to bruising throughout all observations, whereas back gates positioned to the side of the cattle presented a low risk to bruising during 75% of

observations and a moderate risk level during 25% of observations. Lighting in the unloading area was deemed adequate and allowed handlers to see clearly throughout all observations, posing a low risk. Lighting in both the holding pens and chute areas were deemed inadequate to see clearly 50% of the time, while the remainder of observations found lighting to be adequate in the holding pens and chutes. No observations recording a complete lack of lighting, categorized as high risk, were made.

Figure 4.1 Notable Risk Factors Present During Facility and Equipment Observations

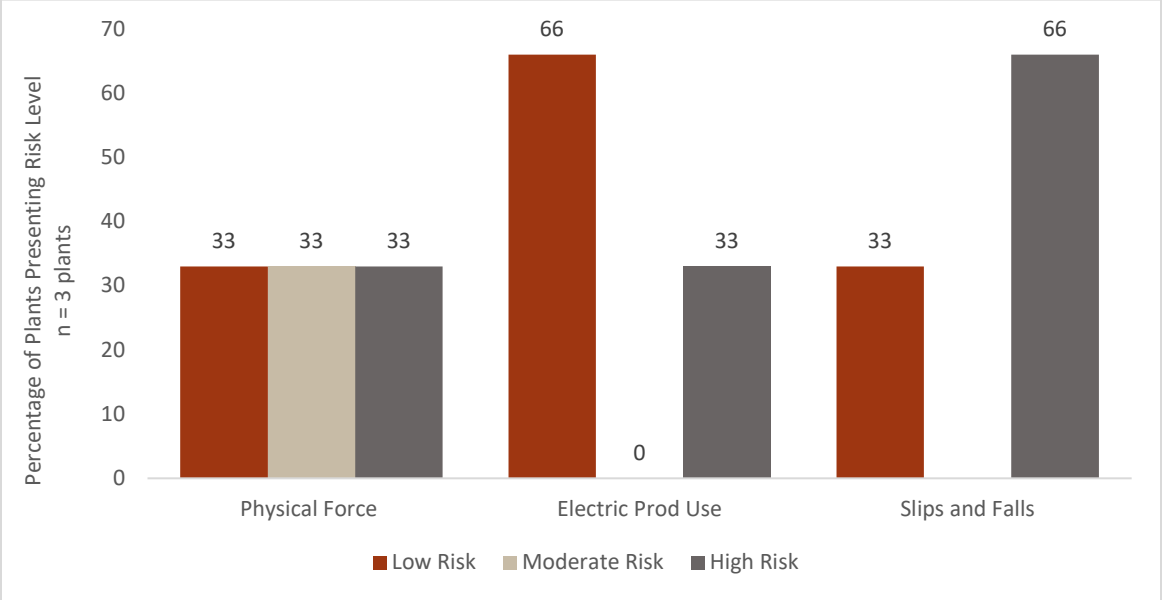



4.1f Overview of all Plants: Descriptive Analysis of Unloading Procedures

Throughout the unloading process, observations were made regarding hauler behavior, equipment use, cattle movement, and employee handler behavior. Low, moderate, and high-risk behaviors demonstrated by haulers physically hitting or striking

cattle was recorded at 33% for low, moderate, and high-risk levels. Electric prod use by haulers was 5% or less during 66% of observations (presenting a low risk) and was greater than 25% during 33% of observations (presenting high risk). Handlers rushed cattle off the trailer during 33% of observations, posing moderate risk, while the remainder of observed unloading was categorized as low risk for this item. Forceful unloading, in which cattle came into forceful contact with the trailer or other unloading equipment, was recorded as moderate risk during 33% of unloads and low risk for the remainder of trailer unloads. In relation, cattle slips and falls from forceful unloading was primarily of high risk to bruising during 66% of observations. The vast majority of cattle maintained a walking pace while exiting the trailer, with all observations falling in the low risk category. Once exited, no cattle re-entered the trailer. Employee handlers were also observed while unloading for use of handling equipment. Electric prods were used sparingly by handlers; however, a single handler utilized their hotshot twice, meriting a moderate risk of less than 25%. Other types of handling equipment used fell into the low risk category, with all instances of use considered proper.

Figure 4.2 Notable Risk Factors Present During Unloading Observations




4.1g Overview of all Plants: Descriptive Analysis of Handlers

Handlers employed by the processing plants assessed were observed for a variety of behaviors, including speed, attitude, use of equipment and calmness while processing cattle. Across all observations, the handler's pace, calmness level, and vocal cues were categorized as low risk. Use of electric prods was categorized as moderate risk (less than 25%), as a single handler used the equipment twice. Additional methods of stimulating cattle movement were simply the use of the handler's hands as visual gestures and physical encouragement, which accounted for a moderate risk level when used to strike the cattle in 25% of observations. Awareness of cattle's flight zones held steady in the low-risk category throughout observations, and the proper use of points of balance and cattle instincts contributed low risk to carcass bruising. Negative attitude was recorded as contributing to a moderate risk level during approximately 50% of observations. While handlers exhibiting negative behavior were not explicitly negative throughout the entire

handling process, there was a notable difference in handling methodology when attitudes became visibly negative.

#### 4.1h Overview of all Plants: Descriptive Analysis of Cattle

Aspects of cattle observed throughout the handling process included vocalization, balking, falling, forceful contact with equipment, and visible injuries obtained throughout processing. Vocalization qualified for the high-risk category throughout 25% of cattle observed, while the remainder of observations noted a low risk with no vocalizations present. Balking was not widespread across all plants observed but did present a moderate risk 25% of the time. Using the measures set forth in the 2019 audit guide, cattle slips and falls were recorded as low risk during 25% of observations and high-risk during 75% of observations. Forceful contact with foreign objects or handling equipment presented a low risk for bruising, however contact with holding pen gates contributed moderate risk. Visible injury in the form of cuts or tears in the hide was observed at two of the selected processing plants and suggested moderate risk for bruising at 25%. Injuries were primarily observed in the pastern and lower-hock region of the back legs.

### 4.2 Objective Two

Objective two sought to describe the internal and external factors that influence a handler's behavioral intent through in-person interviews. Internal factors relating to the theory of planned behavior include attitude, subjective norms, and perceived behavioral control, while external factors take the form of organizational beliefs, expectations and culture. Their relation to each question will be further discussed in the findings portion of this study. Questions related to the environment within small processing plants due to the

COVID-19 pandemic were also added to interviews and are included below to gain clarity in relation to its effects on handler's behavior and attitudes.

4.2a Descriptive Analysis of Attitude

Attitude toward participant's roles as animal handlers was measured through value shown for their personal backgrounds, feelings toward the impact of bruising, and attitudes held regarding COVID-19's impact on plant operations. Responses to questions addressing attitude were categorized on a five-point Likert-type scale where 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, and 5 = *strongly agree*. Regarding participant's backgrounds in agriculture or working with cattle, 40% of respondents strongly agreed and 60% of respondents agreed that their background experience was valuable to their current position. Participants also responded with agreement when asked to describe how they viewed bruising as an impact to profitability, indicating an understanding of the economic impact of bruises. Finally, responses ranged from disagree (20%), to neither agree nor disagree (20%), to agree (60%) when asked to describe the effect of COVID-19 on plant operations, indicating mixed attitudes toward the impact of Coronavirus influences on day-to-day functions. Response frequencies, as well as mean and standard deviation values, can be found for questions relating to attitude in table 4-1.

4.2b Descriptive Analysis of Subjective Norms

Subjective norms were measured through questions relating to the social norms affiliated with the position of animal handler. Responses were categorized on a five-point Likert-type scale where 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor*

*disagree*, 4 = *agree*, and 5 = *strongly agree*. All respondents agreed that their company promoted and valued proper animal handling, and 80% of participants agreed that their coworkers demonstrated responsible animal handling. When asked to describe how the demand for more locally processed beef had impacted their role, responses varied in agreeance on whether the demand had impacted their social norms or not, with 40% responding disagree, 20% neither agreeing or disagreeing, and 40% agreeing. Response frequencies, as well as mean and standard deviation values can be found for questions relating to attitude in table 4-1.

4.2c Descriptive Analysis of Perceived Behavioral Control

Responses were categorized on a five-point Likert-type scale where 1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, and 5 = *strongly agree*. Perceived behavioral control was measured by asking participants to describe the training they received or were required to complete to work in their current roles. Responses implied that handlers disagreed (80%) and were unsure (20%) with the training they received, indicating that the lack of formal or structured training did not contribute to high perceived behavioral control. Responses noting disagreement (60%) with a handler's ability to impact the quality of beef processed at their facility stemmed from perceived notions that other roles such as the producer or hauler held more influence on overall quality. Handlers were also asked how their coworkers' handling methods impacted the way they handled cattle, which resulted in 40% of handlers disagreeing with the methods used by coworkers, indicating a negative impact on perceived behavioral control. 40% of respondents also noted that they were unsure of how their coworkers

influenced their own handling methods, and 20% agreed that their coworkers positively influenced the control they felt over their positions and methods used. Finally, responses to the question of how equipment and facility design benefited their ability to handle cattle in a safe and proper manner showed that 60% of participants disagreed that their physical working conditions were benefitted by existing facilities and equipment. This finding was reinforced through responses noting that the inefficiency of their facilities induced feelings of minimal control regarding their ability to prevent bruising caused by equipment. Response frequencies, as well as mean and standard deviation values can be found for questions relating to attitude in table 4-1.

Table 4-1. Descriptive Analysis of Interview Questions

| Question | Frequency of agreement/disagreement | | | | | M | SD |
|---|---|---|---|---|---|---|---|
| | SD *F*(%) | D *F*(%) | NAND *F*(%) | A *F*(%) | SA *F*(%) | | |
| Attitude | | | | | | | |
| Describe your background in agriculture or working with cattle. | 0(0) | 0(0) | 0(0) | 3(60) | 2(40) | 4.40 | 0.55 |
| Describe how you believe carcass bruising impacts profitability. | 0(0) | 0(0) | 0(0) | 4(80) | 1(20) | 4.20 | 0.45 |
| Describe how operations at your plant have been affected by COVID-19. | 0(0) | 1(20) | 1(20) | 3(60) | 0(0) | 3.40 | 0.89 |
| Subjective Norms | | | | | | | |
| Describe how your company promotes/values animal handling. | 0(0) | 0(0) | 0(0) | 5(100) | 0(0) | 4.00 | 0.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Describe how your coworkers demonstrate animal handling. | 0(0) | 0(0) | 1(20) | 4(80) | 0(0) | 3.80 | 0.45 |
| Describe how the demand for more locally processed beef has impacted your role. | 0(0) | 2(40) | 1(20) | 2(40) | 0(0) | 3.00 | 1.00 |
| How do you feel COVID-19 has affected workplace stress? | 1(20) | 4(80) | 0(0) | 0(0) | 0(0) | 1.80 | 0.44 |
| Perceived Behavioral Control | | | | | | | |
| Describe the type of training that you completed to work here. | 0(0) | 4(80) | 1(20) | 0(0) | 0(0) | 2.20 | 0.45 |
| Describe how you see your role in animal handling affecting the overall quality of the beef processed here. | 0(0) | 3(60) | 0(0) | 2(40) | 0(0) | 2.80 | 1.10 |
| Describe how coworkers handling methods impact the way you handle cattle. | 0(0) | 2(40) | 2(40) | 1(20) | 0(0) | 2.80 | 0.84 |
| Describe how the equipment and the design of this facility benefits or hinders your ability to handle cattle safely and properly. | 1(20) | 3(60) | 0(0) | 0(0) | 1(20) | 2.40 | 1.52 |
| Scale: SD = Strongly Disagree, D = Disagree, NAND = Neither Agree nor Disagree, A = Agree, SA = Strongly Agree | | | | | | | |

4.2d Demographics

To obtain additional information regarding participant's roles, a demographic-related question was also asked in respect to the years of employment within the meat industry. The majority of participants had fewer than five years of experience in the meat industry, however one participant did have five or more years under their belts. Of the handlers observed, there was one female participant and seven male participants.

## 4.3 Summary

Chapter four analyzed data collected during this study. Behaviors recorded during the observations, coupled with descriptive data garnered through in-person interviews, provided a view of the role played by the theory of planned behavior within antemortem cattle handling in beef processing plants. Observation of cattle handling revealed that the elements most likely contributing to the risk of carcass bruising were flooring, specifically within the chute/alley areas, electric prod use, and cattle slips or falls due to rapid movement or slick footing. Other items such as gates and forceful contact with the trailer during unloading posed moderate risks to bruising. Data collected from the questionnaire also provided insight into the risks of bruising, and suggested that workplace stress, inefficient equipment and the absence of structured training contributed to negative attitudes and suppressed perceived behavioral control. Additionally, interviews determined that most respondents held positive attitudes toward their backgrounds in agriculture and with cattle, and understood the financial toll posed by carcass bruising and discounts. Chapter five will provide the conclusions and implications drawn from the above findings and will discuss recommendations for future relevant research.

# Chapter 5: Discussion

The purpose of this study was to apply the components of the theory of planned behavior to the pre-harvest handling of beef cattle in order to explore and gain understanding of a handler's behavioral intent and actions. The structured observations and a researcher-administered questionnaire offered insight into the external pressures and the more silent factors present that resulted in behavior prone to causing carcass bruising. Conclusions derived from data collected, as well as present and future implications are discussed in this chapter. Recommendations for subsequent studies and utilization of this research to guide future applications are also examined.

## 5.1 Conclusions

Results drawn from the observation and questionnaire indicate that handler behavior during the pre-harvest handling of beef cattle is complex and dependent upon multiple internal and external factors. Similarly, the notion that bruising cannot be explained through a ubiquitous cause is supported throughout related literature (Kline, 2018; Strappini, 2009). References to rough handling, contact with objects or equipment, rushed movement, shouting, and improper use of handling equipment as precursors to bruising were upheld in this study, and were indicative of non-preferred behaviors on the part of the handler. As noted by Grandin (1996), cattle that are moved in a rough manner or by an aggressive handler are two times as likely to sustain bruises as cattle that are

handled properly. This concept was demonstrated throughout observations when cattle's reactions to aggressive handling came in the form of slips, falls, or occasional forceful contact with equipment and stationary objects. The most common behaviors observed during this study that resulted in actions linked to bruising were excessive use of electric prods, physically slapping or hitting the cattle, and forcing movement at a faster than natural pace. Prod use was recorded as a high-risk behavior during 33% of observations and was primarily the result of pressure exerted by the hauler to heighten the pace of the unloading process. Occurrence of cattle slips and falls fell largely into the high-risk category, however this event was not singularly tied to aggressive handling. The lack of textured or grooved flooring compounded this issue when cattle unloaded the trailer with wet hooves or tracked water, urine, or manure throughout the chutes and working areas, which produced a slippery surface for both cattle and human handlers alike. In the unloading docks, chutes, and holding pens observed, flooring presented a moderate to high risk of bruising at one or multiple points throughout the study, and lighting in the chute and holding pen areas was recorded as inadequate during 50% of observations.

In addition to the physical data collected regarding facilities, handlers, cattle, and unloading, verbal information collected during researcher administered questionnaires provided insight into the components of behavior related to intent and outward action. Regarding personal backgrounds, experience, and feelings toward bruising's impact on profitability, attitudes were largely positive. On the other end of the spectrum, disagreement and negative attitudes were exhibited when asked about the effect of facilities and design on one's ability to effectively handle cattle, and feelings were

generally positive regarding perception of their role and how coworkers demonstrated handling themselves. This suggests that handlers place value on their personal experience and understand that bruising affects the bottom line, but their opinion of existing working facilities did not bolster a positive attitude all around. These attitudes toward facilities were evident when handlers became briefly and visibly frustrated with a piece of equipment, such as a gate or chute, or flooring when its misfunction or lack of efficiency slowed progress or made proper processing more challenging. In these cases, the inward attitude of the handler was often indicative of their outward behaviors, and negative outward behavior was more common when risk factors were present. When the hauler was present and interactive during the unloading process, this was also found to influence the attitude of the handler. Calm, non-aggressive behavior on the part of the hauler resulted in the continuation of positive body language and behavior on the part of the handler. However, when the hauler demonstrated more high-risk behaviors, such as physical force, rushing cattle, or excessively using an electric prod, the handler was more apt to become frustrated or exhibit negative behavioral cues and attitudes, therefore increasing the instances of moderate to high-risk behaviors observed.

Presence of subjective or social norms found that while many handlers often worked cattle individually, they felt that the social atmosphere between their coworkers and their company was primarily positive. The majority of participants felt as though their company was successful in relaying their value placed on proper and safe handling, and felt their coworkers shared in this belief. Minimal instances of peer pressure or negative subjective norms were observed, however in few cases the hauler appeared to

exert pressure, if only for a moment, toward negative behavior and norms. In these cases, the hauler was not an employee of the processing plant, but their observed "norm" did seem to influence the company norm while present. These findings determined that subjective norms are reflective of a portion of the behaviors observed, however there are cases in which circumstantial pressures can surpass existing norms, even if only for a brief period of time.

As noted in the theory of planned behavior, attitude and subjective norms are accompanied by perceived behavioral control during the development of intent and action. Overall, the perception of control over the outcome of the cattle and ultimate meat products they assisted in producing and processing was consistently low throughout interviews and observations. In reference to their role in animal handling and its affect on beef quality, multiple participants expressed that while they did believe that their role had the ability to make an impact, they felt as though the roles of the primary producer and hauler held more stock in the ultimate end product. Mixed feelings were recorded regarding the influence of coworkers on an individual's ability to control the outcomes of their handling, yet responses were majorly negative regarding the impact of facilities and equipment on their ability to correctly do their jobs. A common sentiment among participants was that there was only so much within their realm of control regarding their physical working conditions. This sentiment was observed in a more physical sense when cattle unloaded the trailer in an excited manner or when cattle slipped or fell during processing. The reaction from the handler in these situations did not appear to be directed inward, as in a sense of disappointment in one's self, but instead took the physical form

of outward resentment toward factors outside the realm of their control, such as smooth (slip-prone) flooring or inefficient handling equipment. Concerns expressed regarding facility design included the overall size and space allotted to work cattle safely, the condition and age of the facility, and occasionally the lack of allowance for instinctual movement for the cattle. The presence of slick flooring also contributed to diminished perceived behavioral control, as the handlers felt they had very little control over attempting to prevent cattle from slipping or falling during processing. These factors also held true for the opposite end of the spectrum, wherein the presence of well-functioning and efficient handling equipment empowered the handler and offered a larger sense of control over how an animal was handled in their care. In this case, the handler viewed the equipment present as a benefit to their role, and felt that it allowed them to more efficiently and safely handle cattle. These findings supported the theoretical basis that human perceptions of their environment and situation are directly associated with the development of perceived behavioral control.

Consideration of external factors such as beliefs, expectations and culture offered further insight into the development of attitudes, perceived behavioral control, and the subjective norms observed. When considering the aspect of training as an outward reflection of organizational beliefs, it could be deduced that the lack of provision or requirement of structured training stemmed from the expectation that handlers were to draw from previous experience and learn through gained experiences while on the job. While further analysis regarding the effect of formalized training would be beneficial, it did appear to instill a belief that structured training and preparation for their role was not

a necessity to complete their role; rather the ability to catch on quickly and perform the needed duties was a priority. Responses to questions regarding training also revealed that participation or training in animal handling and beef quality programs such as Beef Quality Assurance (BQA) was not required by employers. Regarding the value of animal handling, interviews suggested that handlers viewed their company's promotion of the concept as positive. This was consistent with the attitudes observed and suggested that there was an underlying assumption among participants that their company believed in safe and proper handling of the cattle processed there. Evidence of beliefs were also demonstrated through respondents' feelings toward bruising's impact on profitability, where all individuals believed that there was at least a verifiable link between the two. For some respondents, this belief appeared to be solidified upon seeing the impact of bruising in person after cattle had experienced rough handling prior to harvest.

The aspect of training could also contribute to the expectations placed on employees, where minimal formal training or education reflects an assumed expectation that they were responsible for completing the task at hand, but were not expected to exceed industry standards. Expectations could also be measured through a handler's depiction of their coworkers handling practices, where most participants viewed their coworker's methods as positive or somewhat neutral (neither positive nor negative). This would reflect an assumption of high or assumed expectations to be met in their role as handler. The discussion surrounding beliefs and expectations derived from visual observations and responses also encourages the consideration of workplace culture as an influential external factor. Questions related to handler's views of coworkers and

company values suggest a supportive or primarily positive culture, however during the time of this study, workplace stress due to COVID-19 effects could contribute to more pressure or strain on the normative culture.

Due to the unique timing of this study, questions concerning the coronavirus pandemic and its influence on the day-to-day operations of small Ohio packing plants were also included. Handlers tended to view the uptick in demand as a positive outcome, as it nullified any job security concerns, and it signaled a newfound interest from consumers in purchasing locally raised beef. However, this "good" problem to have also created an increase in stress levels stemming from heightened expectations, the need to process cattle faster than normal, and the looming uncertainty regarding each other's health and ability to maintain the current pace. These factors aided in the development of a working environment that was unfamiliar to all participants, and the resulting effects on attitude and the accompanying components of behavior should be considered in future studies.

As suggested in the theoretical foundation of this study, the components of the theory of planned behavior do indeed aid in the explanation of behaviors and actions, however the additional consideration of external factors lend a more accurate description of why handling that causes bruising occurs. This conclusion stems from the realization that attitude, subjective norms, and perceived behavioral control only tell a portion of the story, and though it is a major portion, the explanation and understanding of behavior would not be complete without the underlying factors working to develop such behaviors.

## 5.2 Implications

Data collected throughout this study provide both theoretical and practical implications. This segment will discuss the significance of the interaction between the theory of planned behavior and the practical aspects of resulting handler behavior during pre-harvest handling of beef cattle. As noted in the limitations portion of this report, this study was conducted during a unique timeframe. With the onset of the COVID-19 pandemic, many plants experienced a widespread increase in demand for locally processed beef and were, on occasion, forced to halt operations due to illness. Implications noted in this section should be considered under the premise that plant operations may not be reflective of pre- or post-pandemic norms.

### 5.2a Theoretical Implications

*Theory of Planned Behavior*

Data collected throughout this study offers insight to the explanation of how human behavior is developed and impacts the event of carcass bruising in beef cattle. The theory of planned behavior posits that human behavior can be predicted through a methodical approach to understanding attitudes, subjective norms, and perceived behavioral control (Earl, 2016). Data collected suggests that this theory was upheld in the sense that attitude, subjective norms, and perceived behavioral control each contributed to the resulting behaviors. However, the level of influence held by each component may vary depending on its interaction with the additional variables of beliefs, culture, and expectations. Ultimately the overarching components of attitude, subjective norms, and perceived behavioral control were the most predictive of behavior, as was seen in the

case of the effect of facilities and equipment on perceived control. Further analysis and consideration of these variables may strengthen the theory's explicative capabilities and prove important to the goal of more thoroughly understanding the development of behavior. Regarding the conceptual model, it is implied that positive behavioral components and external factors produce a positive behavior, and that negative produces negative. This was upheld within the findings of this study, however the degree of positivity/negativity contributed by the components of attitude, subjective norms, perceived behavioral control, or external factors requires further research. It is also necessary to acknowledge that in a setting such as this, descriptive data gathered may indicate presence of certain intentions, yet unpredictable factors such as cattle temperament or weather conditions are capable of altering behaviors without notice or theoretical explanation.

### 5.2b Practical Implications

Conclusions drawn from this study suggest that predictive capabilities lie within the interaction of the components of the theory of planned behavior, as well as their external counterparts. It is crucial to understand that these indicators are influenced not only by each other, but also by physical barriers, fellow handlers, and working conditions present. The recurring theme directed toward the hindrance posed by facilities and equipment in regard to safe and proper handling implies that this element has the potential to be a strong influencer of behavior, thus meriting evaluation of the effectiveness of facilities by those who monitor handling or make managerial decisions. The impact of facilities could be minimized if the selection of plants for the study was

based not only on size, but also on the condition and relevance of equipment to current handling needs. Furthermore, it was indicated fairly consistently that handlers understood the impact bruising posed for profitability of the carcass. However, behaviors proven to be associated with bruising still occurred, suggesting that their understanding of bruising was primarily on a financial level. This suggests that a handler's understanding of bruising and its causes needs to be established prior to concluding their true understanding of its effects and the influence their role, behavior, and actions present.

An additional implication within the findings of this study suggests that the addition of stress may influence a handler's behavior. While the stress resulting from a pandemic wasn't a part of "normal" life prior to COVID-19, the reality is that stress is likely present at all times in a handler's life at some level, and therefore should be included as a factor within future behavioral considerations. In some ways the unified stressor of the pandemic may have created more even ground among handlers observed regarding the stressors they felt, which implies the need for more research regarding the role of stress as it relates to handler behavior.

## 5.3 Recommendations

### 5.3a Research Recommendations

Ideally, the data collection component of a study of this nature should be conducted during a time period that is representative of the industry norm. At the time this study took place, many beef processors were experiencing an, at times, overwhelming increase in demand that resulted in two-year harvest reservation waitlists becoming commonplace (Ruff, 2020). Consequently, added stress due to COVID-19

impacts on plant operations was found to play a role in handler attitudes, expectations and cultural norms. To more precisely understand the weight these factors bear to the relevance of the theory of planned behavior, processing norms among small and very small plants should be established and used as a guide for collection of more typical external pressures experienced by handlers. When possible, a larger population could also aid in producing more representative results.

While numerous studies and scholarly articles have provided evidence of actions and events that directly cause carcass bruising in beef cattle, future research could become more conclusive with the addition of post-mortem bruise observation. This would likely involve marking the cattle that are observed during unloading and following the carcass through to harvest and fabrication. Undoubtedly, this would require additional time and resources on the part of the researcher but could provide more definitive links between the events observed and the resulting bruising, or lack thereof. With this data, more insightful correlations could be drawn between the behaviors observed and the factors that influenced them. Tracing the location of the bruise to the event and behaviors which caused it may offer more clear evidence of the elements of human behavior, such as attitude, subjective norms, and perceived behavioral control, that are associated with specific behaviors and external pressures that foster bruising occurrence. The time required to collect carcass data would also open the opportunity to gather more observational data surrounding the handlers and their coworkers. Broadening the researcher's exposure to plant operations and relationships would enhance understanding and may produce more tangible insight as well.

In the future, the aspect of the theory of planned behavior can also be flushed out more in both qualitative and quantitative measures through the expansion of the questionnaire and observations to form constructs representing attitude, subjective norms, perceived behavioral control, beliefs, expectations, and culture. Looking at each of these elements individually and within inter-variable correlations would result in quantitative data that could further the qualitative expression of the interaction between animal handling and the theory of planned behavior.

Invariably, research involving human/animal interaction is at the mercy of the individual cattle and handlers observed during a set amount of time. With that set amount of time come animal temperaments and human behaviors that may not be replicative of what is considered standard for that location. Not only is this reality due to the nature of human/animal interaction, but also from influences similar to what is proposed within the Hawthorne effect. Awareness of being observed has been shown to affect behaviors, from productivity levels to compliance with workplace regulation (McCambridge, Witton, & Elbourne, 2014). While during this study researchers were placed in areas that would not inhibit normal follow through of cattle unloading and processing, their presence was still known, and may have impacted the manner in which handlers behaved. For future research, it may be beneficial to explore options involving recorded observation, however this should be discussed thoroughly with the plant manager prior to enactment.

The aspect of the non-employee hauler was acknowledged in the observations and helped to establish the source of peer or social pressure experienced by the handlers. However, with only visual observations, their role in the development of handler attitudes

and intent could not be fully explained. To complete the analysis of the hauler, questions regarding their involvement and impact on attitude, subjective norms, and perceived behavioral control should be included in the interview portion of future studies. For additional insight, the hauler could also be included in the interview group, with their answers kept separate from employee handlers to compare the behaviors of both.

In future research, the element of training should also receive more scrutiny, as in, how does the presence or absence of structured training impact the outcome of observed behavior and the ability to predict actions through the theory of planned behavior. Comparisons between handlers who had received training and handlers who hadn't could begin some of the questions surrounding the effectiveness of a structured training program, and may provide practical insight into the steps necessary to reduce bruising on the plant level. This aspect could also be studied in a pre and post manner, meaning that observations and interviews would be conducted prior to a handler receiving training, as well as after training was received. Results from a study such as this could more definitively link a handler's behaviors, attitudes, and beliefs to the training they receive.

Finally, as was seen multiple times throughout this study, facility design and equipment can play a large role in determining handler attitudes and behavior. To further study this aspect, a detailed facility evaluation covering flooring, equipment performance, ease of use, and facility efficiency could provide not only insight to the researcher, but also the plant manager or owner, and could help them guide future facility management decisions.

### 5.3b Industry and Extension Recommendations

It is evident through the provided data that a company can be aware and supportive of correct animal handling practices without realizing that their own facility does now allow for their completion in a physical and behavioral sense. To work towards removing those physical barriers and more thoroughly understanding the 'why' behind the behavior of handlers, recommendations stemming from data collected throughout this study should be implemented. The initial phase of this study revealed through observation that facilities can play a substantial role in the success of a handler's efforts to process cattle properly. While many participants felt as though their employer valued and promoted the industry standards surrounding handling, they often expressed the hindrances caused by the design or condition of the facility in which they worked. Observations and questionnaire responses enforced the need to evaluate flooring in the unloading, chute, and holding pen areas for non-slip texture and drainage to prevent wet, slick surfaces, along with chute and pen design in order to allow handlers to move cattle according to their natural flight zones and instinctual behaviors. While adjusting and re-evaluating facility design or equipment placement may require added physical and financial resources, meeting the needs of handlers to process cattle properly could improve attitudes, perceived behavioral control, and minimize behavior that results in carcass bruising.

Results from this study also indicate that the level of training required or provided to handlers holds stake in determining the handler's understanding of the beliefs and expectations placed on their position. The majority of respondents in this study received

no formal training, and instead learned as experience was gained through the fulfillment of their position. While this does provide the opportunity for experiential learning, the addition of a more formal training or continued education opportunity such as BQA may more effectively signal the company's stance on handling and generate a more clear vision of the beliefs and expectations placed on handlers. Among handlers that had completed formal beef quality and animal handling training for prior positions, a more thorough understanding of the goals of their position was present. Offering training and continuing educational opportunities would also present the option for company owners and managers to ensure a handler's understanding of the impact of aggressive or rough handling on carcass bruising, and ultimately company profitability. Continuing with the concept of strengthening the handler's attitude and behavioral understanding of their role, it is important to associate company values with their subsequent carry-out and enforcement. Recurring presence of a manager, owner, or humane handling inspector during ante-mortem processing of cattle can create an inward reminder for handlers to be actively aware of and cognizant of their handling techniques and behavior.

Within university-led departments such as Extension, the findings of this study signal an opportunity for education and outreach to local beef processing plants. For an educator or agent, simply starting with a facility/equipment evaluation would allow for the fostering of a relationship with the plant employees and manager and would aid in the development of recommendations to improve plant efficiency and animal handling practices. In the aspect of training, it is important for Extension professionals to remember that processing plant clientele and haulers should be included in programs,

such as BQA or handling clinics, along with the more typical audience of producers only. This will require more intentional outreach but will likely yield positive results. With the current demand for locally raised beef at a high, this also presents the opportunity to work individually with plant managers and handlers to determine the most efficient manner in which to process cattle, while maintaining handling and safety guidelines and standards.

On a broader industry level, the expansion of existing beef quality and handling programs should be pursued and made more accessible to both company managers and handlers. In addition to in-person and online BQA formats, there are many online and downloadable instructional videos and trainings offered through university and industry professionals nationwide. Nonetheless, without a working knowledge of the locations of these trainings, it may prove challenging to find and offer them to employees. Further research would need to be conducted to definitively speak to the accessibility of these resources, however processors and those involved in the processing industry may benefit from a strategic and unified effort to prioritize handling and understanding how human and animal behaviors interact during processing. The combination of these endeavors, both on the individual processing level and within industry, could alter the attitudes, behaviors, and actions among handlers and may serve as a turning point toward more efficient and behavior-conscious handling techniques that lead to the minimization of carcass bruising in beef cattle.

## 5.4 Summary

By viewing pre-harvest beef cattle processing through the lens of human behavior and its inner components, this study sought to explore and gain understanding of a

handler's behavioral intent and outward actions. Use of the study's findings and concepts for future research will allow those in the meat and processing industry to more thoroughly understand and analyze the weight carried by human behavior in the realm of beef carcass bruising.

Theoretical and practical implications offer further insight into the role of the theory of planned behavior in a beef processing plant and the effect of physical and conditional barriers on the theory's ability to predict behavior. Attitude, subjective norms, and perceived behavioral control are indeed crucial to understanding one's intent and subsequent action, however the additional consideration of external forces on each variable provide a more conclusive and explicative result. Evidence of the influence portrayed by facilities and equipment on perceived behavioral control should maintain a presence in the scope of future research related to handler behavior. Industry focus should also monitor the relevance, accessibility and usage of training materials and resources provided by university and industry professionals, as conclusions drawn from this study indicate that the level of structured training and preparation required to handle animals is somewhat minimal among small and very small Ohio plants.

While there is indeed much yet to learn through further research opportunities, the data and findings presented throughout this study offer reasoning as to how handler behaviors are formed and acted upon. Utilizing this research as the foundation for future studies will enable both researchers and industry members to view the role of handling with a more complex and critical eye, and can lend insight into a more conclusive

determination of the behavioral influencers and barriers present in order to accelerate the minimization of beef carcass bruising during antemortem processing.

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