A Thesis Presented to

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The Effects of Classical Music on Dairy Cattle

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ABSTRACT:

The purpose of this experiment is to determine if classical musical input will have an effect on the stress level of cattle, measured by total milk production, production per cow, and number of cows milked. By continuing this experiment with different time intervals, the hope is to fully demonstrate the effects of music on milking. In addition, does speaker location affect stress levels in the cattle? Results from playing the music for an extended period of time produced a steady increase in production. Conversely, when the speaker was moved away from the milking units, there was an overall decline in production. This indicates that playing music to lower stress could have a prolonged effect. Having a steady increase in production could be attributed to a lack of ability to return to baseline prior to the next interval of music. Therefore, there would not be enough time for milk production to decrease when the music was not playing, leading to the constant increase in milk production during the entire experiment. The decrease in milk production when the speaker was moved could indicated that by having the speaker far from the milking system it is not actively lowering stress during milking. Finally, further experimentation should be conducted as a third uncontrollable variable of sickness, particularly pneumonia, broke out during the experimentation that could have altered normal results.

Alfred University Honors Introduction:

The following experiment was conducted to determine if the playing of classical music had an effect at lowering the stress of dairy cattle. This reduction of stress can be seen and an increase in milk production, production per cow, and in the number of cows being milked. It is believed that the introduction of new technologies into the dairy field have been seen to cause a decrease in labor, but may cause and increase in stress for the animal. A particular technological advancement is the automatic milking system (AMS).

An automatic milking system (AMS) is a machine that is designed to recognize each individual cow and determine if milking should take place. If the cow should be milked, a robotic arm does the job of cleaning and attaching collecting ducts to the four teats. Once attachment has occurred successfully, collection of milk can begin. The machine also has the ability to measure the exact milk production for each cow and determine how much milk is produced from each of the four teats.

Although this machine is useful at obtaining detailed and effective records of milk production, it is believed that it could induce additional stress in the cow, especially the new heifers that are not accustomed to the process. Therefore, this experiment was used to determine if the playing of classical music to the cattle during times of milking would have a positive effect on their stress levels and be seen as an increase in milk production. In 2014, Alfred University Graduate, Victoria Logel, began conducting tests to acquire these results. In looking at her data, it was seen that milk production did increase during times of milking, but that this increase in milk production was not significant.

This experiment was conducted at Willow Creek Farm in Belmont, NY where there are two AMS located on the property. The herd consisted of 115-144 cattle, which are mostly Holstein cattle. This breed of cattle is notorious for producing the greatest amount of milk when compared to other dairy cattle. These cattle were played classical music that was on a continuous playlist on shuffle. It was heard throughout the barn using a wireless speaker that connected to an iPod via Bluetooth.

In the experiment conducted by Victoria Logel in 2014, she played the music to the cattle for seven days, and then allowed for seven days of no music to allow the cattle to return to their baseline values. During this experimentation, she positioned the speaker directly above the milkers. Ways in which I altered this experiment included playing music for 14 days with the seven day returning to baseline of no music. This was to determine if the length of time that the cattle were exposed to the music altered results. Additionally, I wanted to determine if the location of the speaker would alter the results. I repeated the experiment of seven days of music followed by seven days of no music with the speaker positioned farther from the milkers in the aisleway of the dairy barn.

For both of these variables I predicted that the playing of music would cause and increase in total milk production, production per cow and that while music was playing more cows would be milked. This is because they would be presented the music that would help to lower their stress levels. This was not discovered in the results. It was determined that the playing of classical music to cattle had a more long-term effect on the cattle.

In the experimentation in which the interval length of music was extended, there was a significant increase in total milk production and production per cow during the entire length of the project. Although it did increase only during times of classical music input, there was a total increase over time, indicating that the playing of classical music has a long lasting effect on lowering stress in dairy cattle causing an increase in milk production.

This was not what was seen when the speaker was positioned in the aisleway of the barn. These results indicated that there was a significant decline in production per cow during the total experimentation. There was also a decline in total milk production, but this decline was not significant. This indicates that location of the speaker is crucial in lowering the stress of the animal. Positioning the speaker directly above the milked proved to be more effective at lowering the stress of the cattle than when it was in the aisleway.

These results did not follow my expected predictions, but did provide me with useful information about how classical music can have an effect on the stress level of dairy cattle. One particular area that was difficult to deal with during experimentation was the uncontrollable variable of sickness. During a portion of my experiment, the dairy cattle at the barn developed pneumonia that altered their milk production levels. This is because sickness adds additional stress to the animal, and alters normal body functioning. It could therefore be said that parts of this experimentation could be flawed in production levels due to this uncontrollable sickness.

This project allowed me to become more knowledgeable at writing and analyzing experimental research. It also gave me the opportunity to conduct an experiment that required field work as opposed to simply working in a laboratory setting. By doing this project I was able to increase my ability to conduct and analyze statistical testing on data. My chair advisor and committee members allowed me to make my own decisions about this project while also providing constructive criticism as to how to make this paper professional.

If I had more time to continue researching at this facility and with this particular dairy herd, I would want to determine if music genera has an effect on the dairy cattle. It would be fascinating to determine if different styles of music such as rock, country or metal would alter the results. I hope that in years to come, others will be granted the same opportunity I was to do undergraduate research as fulfillment of a thesis project, as it provides a strong level of accomplishment. I am grateful for Alfred University for this experience.

INTORDUCTION TO MILK PRODUCTION

The dairy cow, *Bos taurus*, is known for its superior ability to produce large amounts of milk that can be used for human consumption. In order for the milk to be safe for human consumption, a variety of different tests are conducted prior to being sold. One way to prevent contaminations is to ensure that the health of the cow is maintained. If there are complications with the cattle, there is a greater chance that there will be problems with milk production. Additionally, there are a number of nutritional aspects of milk production that must be met in order for proper composition of milk to be allowed. In order to understand the production of milk, it is important to describe some basic anatomy of the cow.

Dairy cattle are a ruminant species that have developed a unique digestive system for obtaining necessary nutrients from low quality forages through the utilization of microbial fermentation. A ruminant species contains a stomach that has four separate compartments, each has their own unique property. These include the rumen, reticulum, omasum and abomasum. The rumen is the largest chamber of the stomach and contains fluids and microorganisms, such as bacteria, protozoa and fungi, which function in breaking down fibrous materials into usable nutrients for the cattle to absorb. Digestion of various molecules occurs in different parts of the stomach for absorption into the blood stream and subsequent transportation throughout the body (McDonald, 2011).

In dairy cattle, the production of milk is quite complex, and is a result of the specialized milk producing organs known as the mammary glands that are located in the female cow's udder. Milk is expelled from the body through the usually four exterior teats at the bottom of the cow's udder (Frandson, 2013). In the mammary glands, there is special selection that occurs in order to prevent trace elements that are found naturally in the bloodstream from entering into the milk. These trace elements include fluorine and sulfur. The major elements required for milk production include: calcium, phosphorus, sodium, magnesium and chlorine, with calcium being the most important element (McDonald, 2011). There are a variety of other requirements for milk production.

Almost 87% of milk is composed of water, making it a necessary dietary requirement that can be derived from drinking water, metabolism, and in feed. Metabolic water is the water produced during the build-up and break down of molecules within the body (Cheeke, 2005) Water is probably the most important molecule for the production of milk, but other molecules aside from water and the minerals discussed above are necessary for milk production. There are additional dietary requirements including: energy, protein, fat and limited vitamin requirements.

The energy demands during lactation are greatly increased compared to normal energy requirements, and even greater than during pregnancy (Jurgens, 1978). There are in fact different phases of the cow lactation cycle that require different nutrient requirements for milk production. Figure 1 indicates the various stages of lactation that occur in a 12 month cycle for the dairy cow. These periods include: fresh cow (just after giving birth), peak milk, peak dry matter intake (DMI), Tail end, far off dry cow and close up dry cow. These periods differ in their dietary requirements, as well as total milk produced. The figure also indicates the body weight (that lowers during peak milk production) and milk production (between 5kg/d – 20kg/d) during these periods, as well as indicates the amount of dry matter required during each period (that increases during peak milk production).

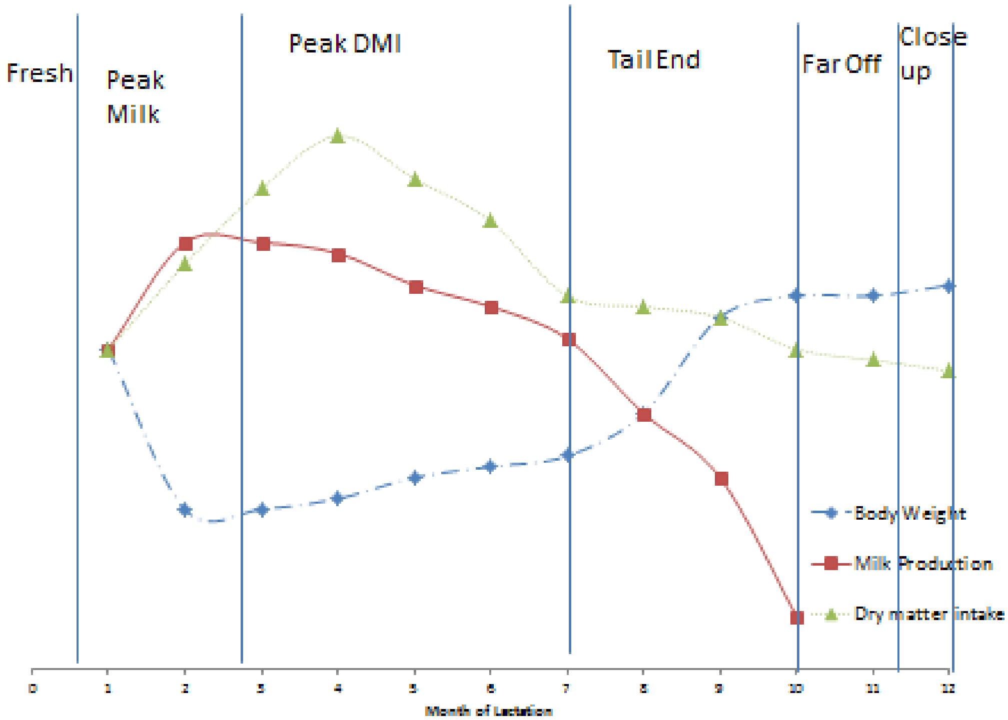

Figure 1: 12 Month Lactation Cycle of a Dairy Cow (Cheeke, 2005)

The close-up dry period is the most difficult time to account for nutritional requirements due to the cow rapidly transitioning from a low energy/high forage diet to an extremely high energy diet to account for the needs of the extra energy for the next pregnancy (Cheeke, 2005). There is a greater need for glucose during lactation, as the main carbohydrate found in milk is lactose, which is composed of one glucose molecule and a galactose molecule. Galactose is similar to glucose in structure, but has a different arrangement of atoms. Therefore, glucose is required in higher quantities in lactating cattle to account for energy requirements for normal functioning and increased demands during lactation (McDonald, 2011). If the glucose requirement has not been met, the body will have to utilize energy from body reserves such as glycogen and fatty acids from adipose tissues that can alter body conditioning. It has been said that it is more efficient to obtain energy from feeding the animal the proper nutrients during lactation than for the animal to use its body stores (Jurgens, 1978).

In addition to extra energy requirements during lactation, there are also requirements for proteins and fats for milk production. Milk fat metabolism is under the control of hormones, while proteins provide 95% of the nitrogen in milk. The protein requirement increases during lactation, as protein must be adequate to supply microorganisms in the rumen as well as be incorporated in the milk (McDonald, 2011). It is unknown as to whether or not vitamins are necessary for milk production, as vitamins are not synthesized directly in the mammary glands, but instead are transported to these glands via the bloodstream. Therefore, although these vitamins can be present in the milk composition, they may not benefit or detract from the final milk compositions and could help the immune system and prevent various dairy cattle diseases (McDonald, 2011).

Milk composition and yield can vary in cattle due to breed, age, milking technique, milking intervals, stage of lactation and disease. Another factor that affects milk yield and composition is traced back to the dietary requirements of the animal, leading to nutritional diseases as being a major factor of milk production (McDonald, 2011). These diseases include milk fever, ketosis, and grass tetany. In addition, there are infectious diseases that affect milk production, the most common being mastitis. A variety of other diseases associated with the digestive tract, reproduction and the respiratory system have been linked to an alteration in milk production. These will be discussed in separate sections in greater detail to determine their individual effect on milk production.

DAIRY CATTLE DISEASES

Mastitis

Mastitis is one of the most common and frequent diseases related to the production of milk in the dairy cattle (Seegers, 2003). It is a disease related to the infection of the mammary glands that occurs due to improper nutrition, increased stress, and lack of cleanliness of the udders, which leads to a compromised immune system (Cheeke, 2005). The infection could be caused by a wide range of pathogens such as *Staphylococcus* spp., *Escherichia coli*, *Klebsiella* spp, *Arcanobacterium pyogenes* and *Enterobacter*. These different pathogens can cause altered severity and length of time that mastitis occurs in the cow (Grohn, 2004). This disorder is more common in higher producing dairy, often leading to an underestimate of the actual effects of mastitis on milk production (Wilson, 1997).

Mastitis is known to cause a significant decline in milk production that can occur 1-2 weeks prior to diagnosis. The greatest loss of milk production occurs shortly after diagnosis and can last up to at least 70 days, but often times can last even longer (Grohn, 2004). Sometimes losses can be permanent, as some cattle that contract mastitis may never achieve their maximum potential milk production in future lactations (Rajala-Schultz, 1999). In addition to causing milk losses, there is also a decline in milk quality, as mastitis depresses fat and protein composition in the milk (Seegers, 2003).

One method of prevention against the onset of mastitis is to administer increased supplementation of vitamin E (McDonald, 2011). Additional supplementation of minerals, such as selenium, copper, and zinc, as well as providing adequate dietary needs can help prevent mastitis (Cheeke, 2005). Also, due to mastitis being caused by uncleanliness, prevention can include proper cleaning of the udders before and after milking.

Treatment for mastitis involves applying antibiotics that will kill the specific bacteria that can be identified by many microbiological tests including the common gram-stain (Wilson, 1997). Gram-negative bacteria are more detrimental than gram positive bacteria, and are known to lead to higher fatality (Seegers, 2003). Therefore, the correct pathogen needs to be known in order to apply appropriate treatments as well as regard the costs associated with each pathogen.

Nutritional Disorders

Ketosis

Ketosis is a metabolic disorder in which the cattle do not have enough glucose to meet the extra energy requirements for lactation. Roughage does not supply enough glucose for this increased energy process; therefore cattle rely on body reserves to supply the energy necessary for lactation (Cheeke, 2005). Use of body reserves leads to the incomplete breakdown of fatty acids in the body, causing the production of ketone bodies. These body reserves that are utilized to make up for the lack of dietary energy include liver glycogen, and adipose tissue lipids (Pond, 1974). Exaggerated levels of ketone bodies can become toxic in the blood (McDonald, 2011). Ketone bodies can also accumulate in the urine and the milk if the disorder is severe (Littledike, 1981).

Ketosis is characterized by a loss in body weight, loss of appetite, decline in milk production, decline in electrolytes, and the possibility of miscarriage, coma, or death. The reduction of electrolytes is due to the ketones binding with free electrolytes prior to exiting the body as waste (Jurgens, 1978). Another symptom is a unique sweet smell that is noticeable in the urine and the animal’s breath (Pond, 1974). This disorder usually occurs in cattle that are the greatest milk producers and during intense milk production, usually occurring around 6-8 weeks postpartum (Littledike, 1981). The effects on milk production can vary, either causing a strong loss of milk production or only having minor consequences. The milk loss is only temporary, as levels go back to normal shortly after treatment (Rajala-Schultz, 1999). In some cases, if the disease is serious, milk loss can be extended, as treatment of the disorder takes a prolonged period of time (Fourichon, 1999). The variation of the symptoms and duration of the disorder can be attributed to the difference in clinical and subclinical ketosis. Clinical ketosis is much more severe and exhibits large losses in milk production and a requirement of treatment in order for normal functioning to return. This is not the case for subclinical ketosis, as some symptoms can go completely unnoticed (Littledike, 1981).

This disease can be prevented by not feeding cattle excess fattening feeds prior to calving or by avoiding altering diets too quickly. Additionally, increasing the amount of concentrates in the feed slowly and continuing to feed proper amounts of roughage and energy rich feeds will help prevent ketosis. This disorder can be monitored by measuring if ketones are present in the milk, as milk ketones can act as an indicator as to whether or not the cow could have ketosis (Littledike, 1981). Additionally, supplementing with niacin prior to lactation can help prevent ketosis (Pond, 1974). If the disease does arise, there are a few different treatments that can be administered in order to return to normal functioning. Treatments can include providing supplemental glucose to the cow through feed, IV injections, or through the use of glucocorticoids. Additionally, providing sufficient nutrition can help treat ketosis if the case is not severe (Littledike, 1981).

Ketosis can lead to many other disorders in the cow, such as displaced abomasum, reproductive complications as well as serious decline in milk production, leading to great losses and even death if not treated (Roboisson, 2014). It is important to know the cause, prevention and treatment of this disorder in order to help minimize these losses.

Milk Fever

Milk fever is another metabolic disorder of dairy cattle that is associated with a declined level of calcium in the body, known as hypocalcemia (Cheeke, 2005). The increased demand for calcium during milk production is increased 2 to 5 times that of the need during pregnancy. If these increased calcium levels are not met, the body will remove calcium from the bone to provide for the milk (Littledike, 1981). This disorder is much more common in older cattle and those cattle that are higher milk producers (Rajala-Schultz, 1999).

Milk fever, also known as parturient paresis, can increase the risk of dystocia, retained placenta, ketosis and mastitis (Curtis, 1985). There is discrepancy as to whether or not milk fever leads to milk losses. This is because in severe cases, cattle were not milked, and were therefore not recorded as having a gain or loss in milk production (Fourchion, 1999). It is also difficult to determine the effect that milk fever has on milk yield, as farmers have particular knowledge of this disorder and try to prevent the disorder by only partially milking their cattle after calving to avoid drops in calcium levels (Littledike, 1981). This disorder occurs in early lactation, when there is an increased demand of calcium for the production of milk (Pond, 1974). It is also known that cows that are lactating and are multiparous are at a higher risk of developing milk fever and mastitis than heifers (Erb, 1985).

Maintenance of acid-base balance in the body can help prevent this disorder. Certain elements can limit the amount of calcium released into the body and include sodium and potassium. Other elements are known to increase the amount of calcium release and include chlorine and sulfur (McDonald, 2011). One method of prevention includes feeding foods that are low in potassium and nitrogen, but remain high in chlorine, sulfur, and calcium during the last three weeks before calving. Successful treatments include IV injections of calcium chloride when blood calcium levels drops to low levels (Pond, 1974). This disorder can also be prevented by supplementing Vitamin D prior to calving, in hopes of retaining calcium homeostasis during lactation. Additional treatments that help the cattle obtain correct calcium levels are by utilizing pressure in the udder that reduces milk formation, allowing increased levels of calcium to be maintained in the blood (Littledike, 1981). Although the risks of milk fever on milk production are unknown, it is important to understand the disorder to allow for proper treatment if the disease does arise.

Grass Tetany

Grass tetany is a type of disease that is common to ruminant species that do not obtain adequate amounts of essential magnesium to support their body systems. Magnesium is a mineral that needs to be supplied to the animals through their diet, as there are limited amounts available in body reserves (McDonald, 2011). Magnesium can be deficient in the diet, and most commonly occurs when magnesium absorption is hindered in the gastrointestinal tract. Magnesium is a high requirement for milk production that is prioritized by the body (Martens, 2011). This disease is known as a metabolic disorder because there are extremely low levels of magnesium found in the circulating blood of the organism. This is why the disease is also known as hypomagnesemia (Cheeke, 2005). Grass tetany is often associated with grazing, due to being fed poor quality grass in the winter or grass that is highly fertilized with nitrogen and potassium in the spring and summer months. It is particularly important to avoid grasses that have been highly fertilized with potassium, as potassium in plants reduces the plants ability to uptake magnesium (Martens, 2011 :Pond, 1974). It is also known that as energy increases, magnesium digestibility increases, therefore a depression of feeding causes a change in magnesium levels (Martens, 2011).

Magnesium is an element that is required in the body for the proper activation and function of key enzymes such as ATPase and kinases as well as functioning in protein synthesis and synaptic transmission. Therefore, if magnesium is in low amounts in the body it can lead to neurological disorders, such as grass tetany. This disease is characterized by a depression of feeding, and uncertain gait, grinding of their teeth, excessive salivation, ataxia, convulsions and muscle spasms. It is also thought to cause a decline in milk yield, but only has minor effects that often go undiscovered (Martens, 2011). Magnesium is one of the required minerals for milk production and it is therefore not surprising that a decline in magnesium in the body could lead to a decline in milk yield and composition. Additionally, magnesium deficiency can lead to a depression in feeding, which is detrimental for milk production, as high energy is needed for production as well as causing slight nervousness, anemia and udder swelling (Littledike, 1981).

Magnesium requirements are increased during late pregnancy and lactation in order to meet the demands for milk production (Martens, 2011). Older lactation cows are more susceptible to this disease, although it has been seen in younger heifers and even in some calves (Littledike, 1981). Magnesium deficiency can be prevented by increasing magnesium and sodium intake in feeding through dietary supplements. If the disease does occur, treatment includes supplementation of magnesium either in the feed, in salt blocks, in drinking water or by direct IV injections (Martens, 2011). It is most successful if treatment occurs early, as it gets increasingly more difficult the longer the disease persists in the cattle, occasionally leading to death (Littledike, 1981).

Grass tetany is a disease that affects the neurological function of the organism, as well as effecting milk production. Therefore, this disease requires attention in order to help prevent in the future. To develop new techniques for prevention and treatment more research has to be done on the causing agents. This indicates that more studies should be conducted on the soil content, plant content, microbial aspects and other animal factors that have not been fully researched (Littledike, 1981).

Reproductive Disorders

Lactation is a process that occurs in mammals after giving birth to offspring as a way to provide nourishment to their young. In dairy cattle, the milk produced during lactation is acquired and sold for human consumption. Therefore, any illnesses that affect reproductive success and prevent calving will inevitably have an effect on the ability to produce milk through lactation. There are a variety of reproductive disorders including: pregnancy toxemia, dystocia, retained placenta, metritis, stillbirths, and cystic ovaries. Each disorder has a varying effect on milk production in the animal.

Dystocia is a disorder in which the cow experiences difficulties during birth and often requires assistance in order for successful delivery of the calf. This disorder increases the risk of developing metritis, which will be defined later in the section. It occurs in some cases due to a lack of energy for calving. There have been sugestions that an increase in energy would decrease the risk of dystocia (Cutis, 1985). Dystocia can lead to a small decline in milk yield shortly after calving. These same symptoms are also observed during still birth in cattle (Fourichon, 1999).

A retained placenta can occur after calving. This is more common in older cattle, cattle with short dry periods, and cattle that experience milk fever and low protein. This disorder also has the effect of leading to a higher risk of developing ketosis and metritis (Curtis, 1985). A retained placenta leads to a slight decline in milk yield that only lasts for a short period of time (Fleischer,2001 : Fourichon, 1999). Ways to prevent a retained placenta is to give cattle a higher than recommended protein amount for the last 2-3 weeks prior to calving (Curtis, 1985).

Metritis is a disorder that is characterized by abnormal discharge from the vagina, cervix and uterus (Fleischer, 2001). Milk losses due to this disorder are rare, but have been recorded in some instances. There is an indirect effect on milk production, as metritis has an effect on impairing reproduction (Fourichon, 1999). It is believed that metritis leads to an increased risk of developing dystocia or a retained placenta (Curtis, 1985).

Cystic ovaries are another reproductive disorder that are caused by the build-up of vesicles on the ovaries (Fleischer, 2001). This disorder does not have a negative impact on milk yield, but instead has been shown to lead to an increase in milk yield (Fleischer, 2001: Fourichon, 1999).

Pregnancy toxemia is a disorder that develops when there is not enough glucose readily available to the mother during pregnancy. This is because the fetus has first priority to the glucose in the body. If there is not enough glucose for the mother, then glucose requirements for milk cannot be met, and an increased risk of developing ketosis can occur. It can be treated by increasing the amount of glucose in the feed, as well as through glucose injections (McDonald, 2011).

As shown, there are a variety of different reproductive disorders that can have an effect on the production and yield of milk in the dairy cattle. The diseases vary depending on the age of the cattle, as heifers have a different fertility cycle, and different dietary requirements due to them still growing, leading to differences in potential diseases (Erb, 1985). Therefore, it is important to understand the potential reproductive risks for the different cattle in the herd.

Lameness

Lameness is a type of disorder in cattle that is associated with an irregular gait, unnatural stance, tender feet, and overgrown hoof and can even cause permanent distorted feet and legs abnormalities (Cheeke, 2005). There are a variety of different causes to lameness including abscesses, sole ulcers, foot rot and can be caused by improper nutrition. This disorder leads to a variety of symptoms including a decline in milk production, weight loss, decline in reproductive performance and in severe cases can even lead to death (Warnick, 2001). One particular cause of lameness is an increased production of lactic acid in the rumen that can cross into the blood stream and infect areas of the body such as the foot (McDonald, 2011). The increase of lactic acid is attributed to being fed a diet high in grains that are easily broken down in the rumen to usable volatile fatty acids, but large amounts can lead to a rapid decrease in the rumen pH to acidic levels (Cheeke, 2005).

In regards to milk production, it is believed that lameness leads to a decline in milk production as a result from a depressions in feeding. A reduction in milk production during lameness is more common in early lactation and in dairy cattle that are older and are higher milk producers. The older the cow is, the higher the milk production will be and therefore there is a higher chance that there will be a more severe decline in milk production (Warnick, 2001).

Lameness is also a unique disease that can occur at any time during the lactation cycle, unlike other diseases that occur shortly after calving (Rajala-Schultz, 1999). Although it is recorded that there is a decline in milk production, often times it has been found that the decline in production is not significant. Therefore it is often overlooked as being a cause for a decline, as differences in statistical testing on the effect of lameness have led to differences in final results. It is therefore debated as to whether or not lameness is an actual cause of milk production decline (Rajala-Schultz, 1999).

Due to their being a large variety of diseases that can lead to lameness, there are multiple methods of treatments to help restore natural gait in the animal. The treatments vary depending on the type of illness. The most effective way to help with the factors associated with lameness is to prevent the symptoms from arising in the first place. This is done by paying close attention to nutrition management as well as treating any injuries prior to an onset of infection (McDonald, 2011).

Displaced Abomasum

Displaced abomasum (DA) is a disorder of the stomach of ruminants in which the abomasum of the stomach fills with either fluid or gas causing it to enlarge and move dorsally and either to the right or left of the abdominal cavity. The abomasum is one of the four major compartments found in the ruminant digestive system. This compartment contains the gastric juices common to single stomach species such as humans. It therefore has an acidic environment that helps break down material for absorption (McDonald, 2011). If it moves to the right of the abdominal cavity it is termed a right displaced abomasum (RDA), which leads to torsion, or blockage of feed passage in the gastrointestinal tract which is a serious problem. When the abomasum moves to the left of the abdominal cavity it known as a left displaced abomasum (LDA) and is due most likely to gas accumulation. There is limited torsion in and LDA, and this type of movement of the abomasum is more common than a RDA (Coppock, 1973). A displaced abomasum is known as a multifactorial disorder that can be caused by or associated with breed, sex, age, season, high body condition score, low rumen levels, atony or hyper tony of the abomasum, accumulation of gas, stress, metritis, mastitis, and metabolic disorders such as ketosis or milk fever (Coppock, 1973: Cameron, 1998).

This displacement can be repaired by a surgical procedure in order to put the abomasum back into its normal position. Nonsurgical procedures that are less costly can be conducted, but they are not as effective and the disorder is more likely to recur (Coppock, 1973). There is an additional cost to having a displaced abomasum as there is a decline in milk production during the time of displacement. The older, larger and greater producing cows are more likely to have a DA (Coppock, 1973). One way to try and prevent a DA is to feed cattle a diet that is high in fiber and lower is grains as grains are known to increase the gas accumulation in the stomach (Cheeke, 2005). It is better to try and prevent the disorder than to have to treat the disorder once symptoms arise.

Tuberculosis

Tuberculosis is a type of respiratory disorder in cattle that is caused by the bacterial pathogens *Mycobacterium bovis* or *M. caprae*. Although tuberculosis can lead to a depression of milk production, tuberculosis can be detrimental to the dairy industry if it is found within a dairy herd. The bacteria that cause tuberculosis can be shed into the milk from an infected animal and can be spread to humans and other wildlife through consumption of contaminated milk, inhalation of the airborne bacteria and by coming into direct contact with the bacteria through mucous membranes or open skin lesions (Foddai, 2015). Milk containing contamination with tuberculosis cannot be consumed.

Although tuberculosis is a rare disorder in the dairy cattle industry, it is easily spread from one cow to another through nasal secretions, milk, feces, airborne particles, urine and even in types of bedding. It can sometimes be spread by the genitals during mating if the pathogenic bacteria are located in the reproductive organs (Foddai, 2015). This type of disease can have serious detrimental effects on the dairy cattle industry and must therefore be diagnosed early in order to prevent transmission and allow for quick treatment.

CONCLUSION

Through looking at a variety of different dairy cattle diseases, it is clear to see that the health and well-being of the animal has a great impact on milk production and milk yield in the dairy cow. The impact on milk production and milk yield are varied depending on the disease, with some disorders having only a slight impact, while others have a great impact on milk production. Ketosis, displaced abomasum, grass tetany and mastitis seem to have a greater effect on milk production than the other diseases listed. Disorders such as metritis, milk fever, retained placenta, dystocia, and lameness only caused slight alterations in the milk production, indicating that these diseases were not as costly as the other disorders. Interesting enough, in the case of cystic ovaries, there was a reported increase in milk production, indicating that this disorder does not have a negative impact, but instead has a positive effect. Tuberculosis is a disease that is caused by a bacterial pathogen, and therefore caused problems not with the production and yield of the milk but instead with the fact that milk would not be useful from cattle containing this disease, as the pathogen would be found in the milk.

It is clear to see that nutrition plays a crucial role in the development of many of these disorders. If improper nutrition is administered to these organisms, they will be at an increased risk of developing one or multiple disorders listed. The development of one disease in many cases led to the increased risk of developing a second disease. Therefore, it is important to notice and understand all dietary requirements for the stages of pregnancy and lactation. By understanding the possible effects improper nutrition can have on diseases, it could allow many disorders to be prevented. If prevention of these diseases does not occur, it is then important to know the different methods of treatment in order to limit the total losses from having a sick cow. Losses can be seen as a decline in milk production, as well as a decline in herd numbers, as some of these diseases can be fatal. Treatments can be simple, such as administering more supplements in feeds, but can also be quite complex and rely on surgical procedures to attain normal function. Through research, it was seen that most disorders were seen in older dairy cattle that were high milk producers, as they were under high levels of stress and more susceptible to disease.

Possible errors in data collection for milk losses could be contributed to varying definitions of the disease, leading to different times of diagnosis, or lack of diagnosis all together if symptoms are minor. Therefore, some diseases that only show a small decline in milk production could be more costly than believed.

The dairy cattle industry is very complex and requires knowledge of the crucial role of lactation, the body requirements for lactation, as well as and understanding of all possible disorders that could affect milk production. It is therefore necessary to comprehend the causes, treatments and ways to prevent diseases to the cow. By doing this, there will be fewer losses of the milk and an increased profit by the producer.

For the following experiment, milk production was analyzed in terms of the amount of stress an animal exhibited. When a dairy cow is more stressed, they will not be able to produce as much milk than if they were not experiencing this stress. Therefore, it is important to try to minimize stress in dairy cattle prior to milking. When the cow is sick and is presented with various different types of disease, it can be a very stressful period for animals and causes their production to be lowered. Therefore, looking at different types of diseases and how they are treated will help combat the additional stresses that are placed on cattle during sickness. In the weeks of the following experiment, pneumonia was present in the herd and could be linked to some of the changes in milk production for the experiment.

EXPERIMENTAL REPORT:

Abstract:

The purpose of this experiment is to determine if classical musical input will have an effect on the stress level of cattle, measured by total milk production, production per cow, and number of cows milked. By continuing this experiment with different time intervals, the hope is to fully demonstrate the effects of music on milking. In addition, does speaker location affect stress levels in the cattle? Results from playing the music for an extended period of time produced a steady increase in production. Conversely, when the speaker was moved away from the milking units, there was an overall decline in production. This indicates that playing music to lower stress could have a prolonged effect. Having a steady increase in production could be attributed to a lack of ability to return to baseline prior to the next interval of music. Therefore, there would not be enough time for milk production to decrease when the music was not playing, leading to the constant increase in milk production during the entire experiment. The decrease in milk production when the speaker was moved could indicated that by having the speaker far from the milking system it is not actively lowering stress during milking. Finally, further experimentation should be conducted as a third uncontrollable variable of sickness, particularly pneumonia, broke out during the experimentation that could have altered normal results.

Introduction:

A major aspect of the dairy industry involves the production of milk in order to supply the demanding market. For production of the maximum amount of milk, the health and welfare of these animals must be considered as stress can have an impact on the amount of milk produced by the cattle. Higher levels of stress lead to decreases in total milk production (Hopster, 2002). For this study, it was believed that playing music to the cows would cause their stress levels to decrease, allowing for an increase in milk production. I have hypothesized that classical music would have an effect on the stress levels of dairy cattle that can be measured in milk production.

Milking practices have been expanding, as technological advances allow for an increased amount of milkings to be conducted in a shorter, more efficient manner. One such advancement is the automated milking system. These systems help reduce the laborious task of milking for the farmer, as a robotic milking arm does the job of washing and attaching to the teats for milk collection. Cattle are given the freedom of choice when they would like to be milked, to a certain extent. This is a beneficial process that allows for alterations in milking to occur during different stages in lactation, as more milk is produced during certain stages than others (Lodvendahl, 2011).

At the experimentation site, Willow Creek Farm, cattle are tagged so that when they enter the milking system the computer recognizes individual cows and determines if milking should be conducted, as well as recording the total amount of milk produced by the cow for each teat. This allows for records to be kept on each individual cow, so that increases and decreases in milk production can be detected. Therefore, if any variation occurs in an individual cow's milk production it can be detected and treated immediately.

It is said that automated milking has the potential to reduce labor up to 18% as well as increasing milk production by 12% (Jacobs and Seigford, 2012). Although there are certain advantages, it may induce additional stress on the animals for milking, as they are not accustomed to entering this particular machine. Therefore, it is important to reduce the stress of the cattle tohelp ensure a normal level of milk production. One possible way of lowering stress of the animal could be through the use of acoustics.

Music has been shown to decrease emotional stress in humans by helping to relieve stress, anxiety and pain as well as improve immune functioning (Gangrade, 2012 and Alsworth, 2013). This could indicate that playing music may have a positive effect on other organisms, such as cattle. In many mammalian species, different vocalized calls are utilized in developing relationships, such as mother and infant bonds or in mating. Cows that are presented clips of calf vocalizations during lactation and milking increase milk production (McCowan, 2001). If calf vocalizations can affect milk production, then maybe musical acoustics could attribute to a decrease in stress that would also result in an increase in milk production. Experiments with rats demonstrated that playing music during maze running increased their efficiency to complete the maze (Rauscher, 1998). Additionally, research was conducted to determine if music would lower body shaking and vocalization of kenneled dogs. The playing of classical music was shown to help lower the vocalization and body shaking and promoted an increase of sleep by the dogs while it was played in the kennel, while other forms of music such as heavy metal increased body shaking and vocalizations (Kogan, 2012). Therefore, this study is trying to determine if playing classical music to cattle can be linked to a reduction of stress in the animals.

Logel (unpublished) investigated the effect of classical music on milk production in cattle. Using an experimental design of seven days of music followed by a seven day rest period, the use of classical music during milking with an Automated Milking System associated withan increase in milk production, and was therefore linked to a reduction of stress. Although there was an increase, it was not statistically significant. By continuing Logel's experiment using a different time interval, the hope was to fully demonstrate the effects of music on milking. The time interval being used was 14 days of continual music, followed by a seven day resting period to return to baseline. I predict that when there is an increase in time of continuous music it will lead to a statistically significant rise in total milk production and production per cow, as well as causing an increase in the number of cows being milked during music indicating that the classical music being played effectively lowers the stress of the cattle.

Logel positioned the speaker directly above the automatic milking systems. I am also testing location by moving the speaker across the barn to the aisleway, 30 yards from the automatic milking system, to determine if the music would still effect the stress level of the cattle. I also predict that movement of the speaker would still cause a general increase in total milk production, production per cow and number of cows being milked, as the cattle will be exposed to the music in the barn in general, rather than just when in the automated milking system. This would be seen as an increase in milk production for the cattle.

Methods:

Study Site and Subjects:

Research for this experiment was conducted on a herd of cattle located at Willow Creek Farm in Belmont, New York. This dairy farm was established in 1974 and is still functioning and expanding. This farm has been run by the Deichmann family for many years and the current owner Chuck Deichmann is responsible for the installment and utilization of two automatic milking systems (AMS). Milk produced on the farm is organic and is sold to Horizon Organic that supplies the product to stores throughout New York State. This is the same farm and herd that experimentation was conducted on in the previous year by Alfred University graduate, Victoria Logel (2014). The current milking herd consists of between 115-144 Holstein cattle that are milked 24 hours by the two AMS. The first AMS was installed in 2007, while the second was installed a year later in 2008. Both AMS are Lely Astronaut A4 units. Data for each cow were collected from the Lely proprietary software and compiled throughout the length of the study.

Data Collection:

Classical music was played to the cattle from a playlist entitled "100 Most Relaxing Classical Songs in the Universe" (ITunes, 2008). It was played on constant shuffle during the music interval period using a speaker (model RF-WSP313 Rocketfish-Indoor/Outdoor Bluetooth Speaker) that was synced wirelessly to an iPhone 2G. This was the same playlist and methods as from Logel (2014).

Logel's (2014) music was played to the cattle in seven day intervals alternating seven days of music/no music. The speaker was located directly above the automatic milking systems. For this experiment the music was played for 14 consecutive days with a seven day rest of no music. The days of rest in between intervals of music being played were to allow the cattle to obtain baseline values.

After seven weeks, the speaker was moved from above the automatic milking systems to the aisle way of the milking parlor, much farther away from the AMS. The time intervals were the same as Logel's (2014) original experiment with seven days of music and seven days of no music for an additional six weeks. Figure 2 demonstrates the two locations of the speaker during experimentation, and are represented by a dot and a star.

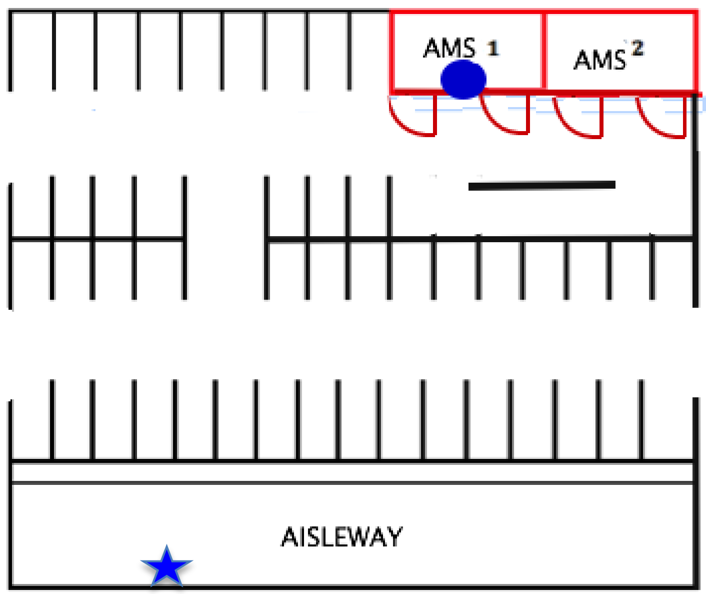

Figure 2: Lay-out representation of the milking parlor at Willow Creek Farm. The dot represents the location of the wireless speaker during the first part of experimentation when it ware directly above the milking systems. The star represents the location where the speaker was moved to the aisleway for further experimentation. This was where the music was played to the cattle.

Data were collected from the Lely systems of the AMS and was uploaded to Minitab 17 (Minitab® Statistical Software, 2010) for data analysis. This was used to determine if there were any differences in values between periods of music and no music, as well as impacts of speaker location. Measurements obtained by the Lely software included: date of collection, number of cows, lactation days, milk production, day production, milkings, refusals, and milk separated.

Comparison to baseline values had to be related to data from 2014, as experimentation had occurred in the previous year and would not represent an adequate baseline value.

Data Analysis:

A two-sampled t-test with a significance level of $\alpha = 0.05$ was used to determine any statistical differences in milk production due to the periods of music and no music. This was conducted for the extended time interval of music as well as when the speaker was moved to the aisleway in the barn.

Line graph were made to visualize the relationship of total milk production as well as production per cow for the dates of experimentation. This was conducted for both variables of extended music period and movement of the speaker. Regression analyses were conducted in order determine if significant relationships occurred over time. This was done in order to compare the data to prior experimentation conducted by Logel.

Results:

The effect that music had on the cattle in regard to number of cows being milked, total milk production and the production per cow is indicted (Table 1). This is opposite of what was recorded for when the speaker was moved, with more cows being milked when music was not playing. Although there were fewer cattle being milked during the music being played than when the speaker was moved in the barn, total milk production and milk production per cow was greater when music was playing. Logel's data also follows this pattern of increased total milk production but showed a decrease in production per cattle during periods of music. For the extended music cycle, although more cattle were milked during the music period, the total milk production and production per cow were decreased significantly when compared to when music was not playing.

Table 1: This table depicts some descriptive statistics for three different areas of milking (number of cows, total milk production and production per cow) and were compared between baseline values from prior experimentation and the two trial periods (extended milking period and movement of speaker)

		Number of Cows	**Total Milk Production (gallons)**	**Production per Cow (gallons)**
Logel's Data	Music	99.9 (+/- 3.9)	5893.6 (+/- 395.8)	58.9 (+/- 2.1)
	No Music	93.3 (+/- 5.1)	5593.6 (+/- 534.0)	59.9 (+/- 3.4)
Extended Music Period	Music	134.9(+/- 3.1)	6844.7 (+/- 422.6)	50.8 (+/- 3.7)
	No music	132.1 (+/- 1.5)	7096 (+/- 652.0)	53.7 (+/- 4.8)
Movement of Speaker	Music	154.9 (+/- 6.5)	8340.9 (+/- 157.6)	53.9 (+/- 2.6)
	No Music	158.9 (+/- 5.5)	8146.4 (+/- 278.3)	51.3 (+/- 1.4)

Extended Music Period

Although milk production was lower with music playing, it was not significant (t= 1.61, df= 28, p= 0.199). The number of cattle milked during the two different period was significantly different (t= -4.69, df= 60, p= 0.001). The production per cow decreased significantly during periods of music when compared to when no music was played (t= 2.42, df= 31, p= 0.021).

Over the course of the experiment, milk production increased linearly (R^2 = 83.3%, p=0.001) with obvious drops during some non-music weeks (Figure 1). The production per cow followed this linear increase during the course of the experiment (R^2 = 89.7%, p=0.001) with the same drops occurring when no music was playing (Figure 2). These increases in milk production over time proved to be statistically significant.

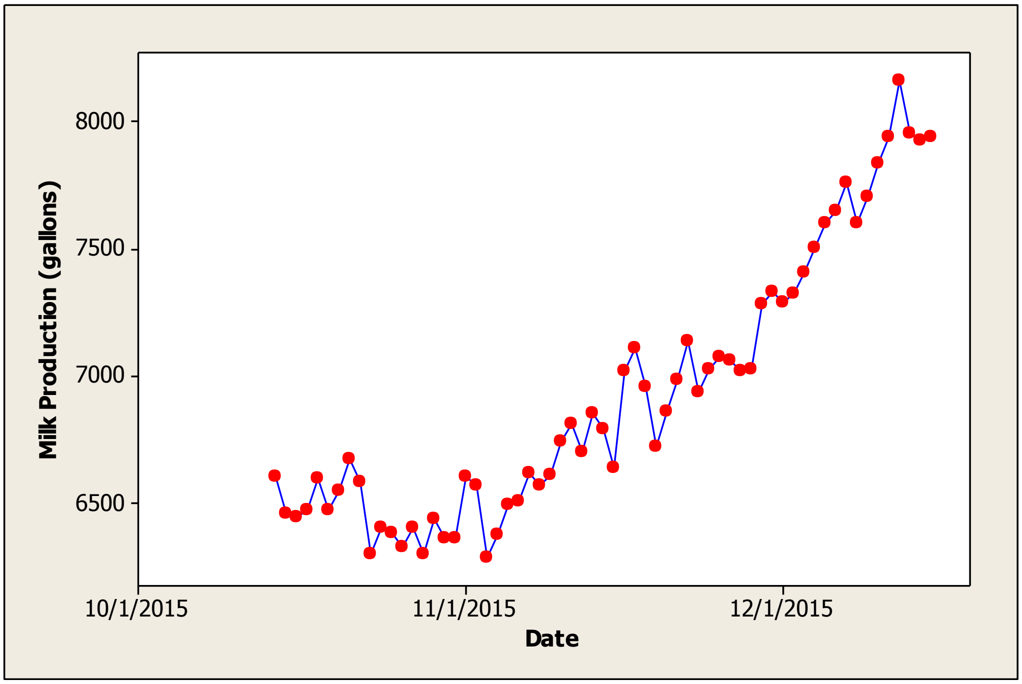

Figure 1: The total milk production recorded during the entire experimentation when the music interval time was extended.

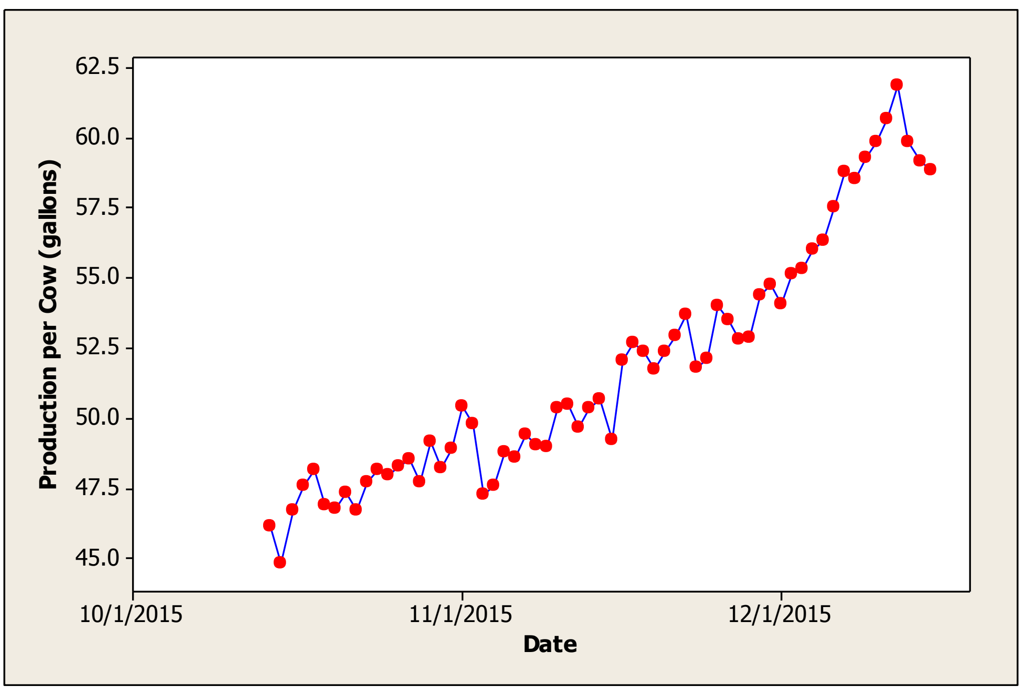

Figure 2: The production per cow during the entire experiment when the music interval time as extended.

Relocation of Speaker

The same tests were conducted when the speaker was moved to a different location in the milking parlor. The playing of music caused a significant increase in total milk production (t= 2.79, df= 31, p= 0.009). There was also significant increase in production per cow during periods of music (t= 4.18, df= 30, p= 0.001). This occurred even when the total number of cows decreased significantly when the speaker was moved (t= -2.20, df= 30, p= 0.034).

Over the course of the experiment when the speaker was moved, there was an overall non-linear decrease in milk production (R^2 = 7.1%, p=0.087) with obvious drops during non-music weeks (Figure 3). The production per cow followed this overall decreasing pattern, with a more linear decrease (R^2 = 46.7%, p=0.001) with the same drops occurring when no music was playing (Figure 4).

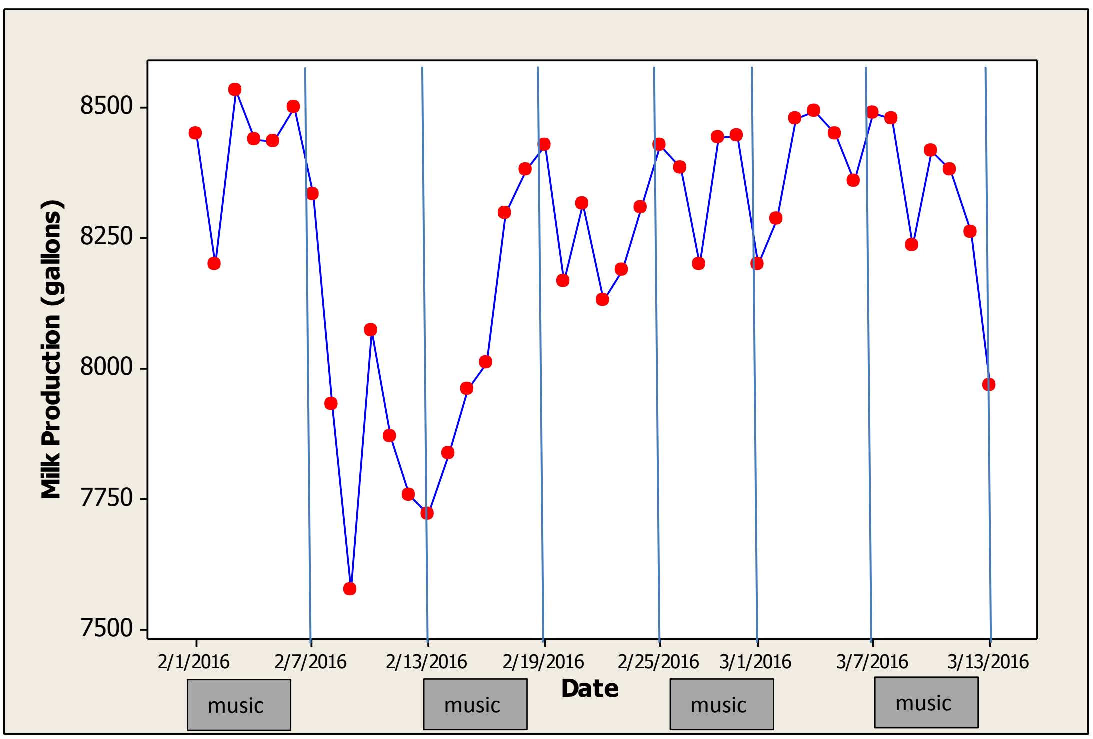

Figure 3: The total milk production for the entire experiment when the speaker was moved to a separate location in the barn.

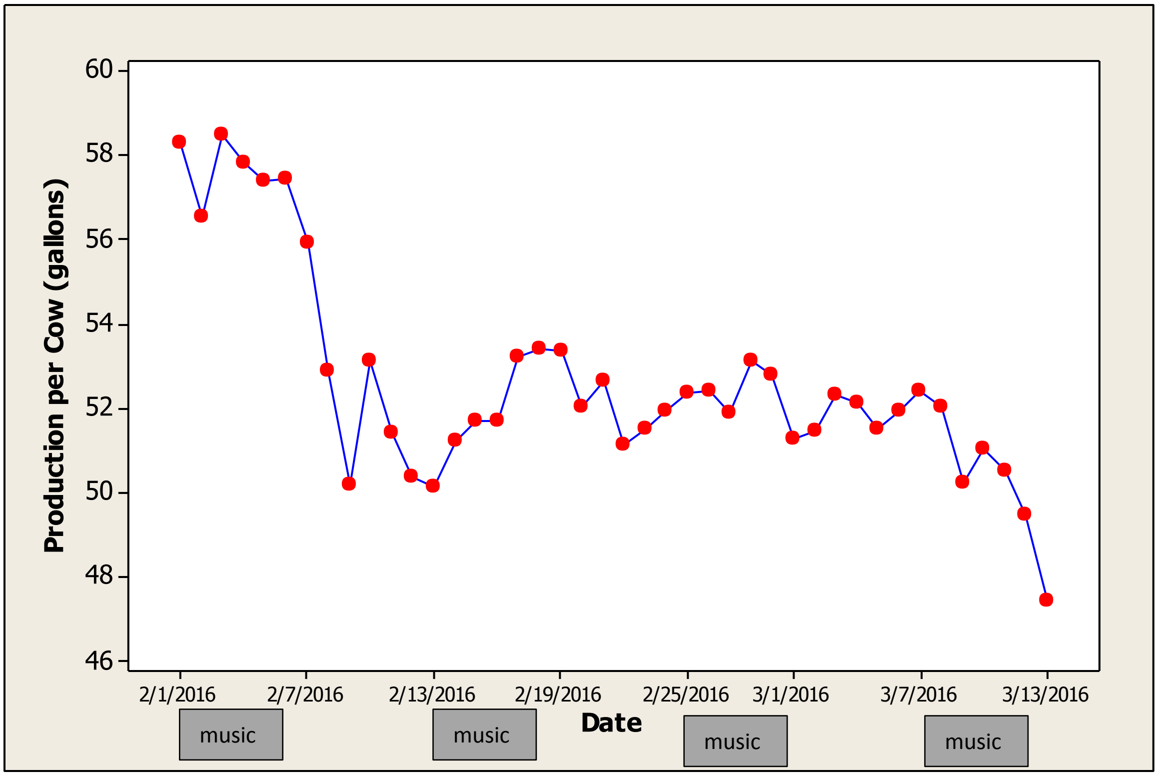

Figure 4: The production per cow during the entire experiment when the speaker was moved to a separate location in the barn.

Discussion:

It is difficult to determine if there is a true relationship between milk production and the playing of music from this study. This is because the data from the experimentation is contradictory. For the first variable change of increasing the music interval, there was an increase in the number of cows being milked, but there was not an increase in milk production during this time. The difference in the number of cows being milked during the time of music vs. no music was statistically significant, as was the production per cow, but the total milk production did not change significantly between the two periods. Additionally, there is an almost constant increase in total milk production and production per cow over the entire length of the study. This corresponds with what was seen in Logel (2014).

The steady increase of total milk production and production per cow during the extended music interval timing could indicate that the effects of playing music are longer lasting than anticipated. The steady increase could be due to the cattle not being able to return to baseline values before the music period started again. It is therefore difficult to definitively say that the playing of classical music caused a decrease in stress as measured by an increase in milk production. It could be said that playing of music could have caused an increase in willingness for cattle to be milked, as more cows were milked during the music period than when no music was present.

Data for the relocation of the speaker to the aisle way of the barn also provided interesting results that were not expected. Although the cattle were being exposed to music continuously, and not only during milking, the number of cows that were milked during this experiment decreased during the playing of music, but total milk production and production per cow increased. Additionally, there is a negative relationship for the entire experiment for milk production and production per cow. This goes against what is seen in results for Logel (2014) and when the music interval was increased during the first part of this experiment. It therefore might shed light on the fact that having the music located directly above the milking system could be advantageous and reduce stress more than when the music was played in the general barn atmosphere. The results were significantly different for number of cows, total milk production and production per cow when the speaker was moved, but it was significant in a negative way. This indicates that this relocation did not adequately lower the stress of the animals.

A third uncontrollable variable that was present during experimentation that could alter results was sickness. During the first part of the study (playing music for an extended period of time), some of the cattle in the herd were contaminated with pneumonia that could have altered the milk production values. Therefore, further experimentation when the herd is healthy would have to be conducted to determine if the steady increase was due to the playing of the music, and not related to the regaining of normal health of the affected individuals in the herd.

Although playing classical music to dogs proved to be an effective manner of reducing stress by limiting the amount of vocalizations and body shaking present in the animal, it was more difficult to see the true effect of classical music on the dairy cattle (Kogan, 2012). This is due to the stress levels being measured as milk production, production per cow and number of cows being milked rather than behavioral aspects such as vocalizations and body movement. Milk production is a variable that is affected by a variety of different aspects including sickness, diet and herd management and could therefore be providing inaccuracies in stress due to other factors causing an increase/decrease in production.

Through final analysis, it would appear that playing music to cattle when the speaker is located directly above the milking systems adequately lowered stress and had a prolonged effect on the animals. For Logel (2014) and this increased interval music experiment, there was a steady increase in milk production and production per cow for the duration of the experiment, indicating that the playing of music could have a long lasting effect of lowering stress, leading to this increase in production. Conclusion from relocating the speaker proved to be less successful and indicated that this method was not successful at lowering the stress of the animals.

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I would like to thank Chuck Deichman, owner of Willow Creek farm for giving me the opportunity and access to use his farm, equipment and his cattle for this experimentation. I would also like to thank Dr. Heather Zimbler-DeLorenzo for being my research advisor and guiding me through the process of writing this research paper. A final thanks goes to my committee members, Dr. Jolanta Skalska and Dr. Cheryld Emmons, for giving their advice and time to this project.

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APPENDIX:

Musical components for each song on the album title “100 of the Most Relaxing Classical Music in the Universe”.

Track #	Name	Artist	High Frequency	Max Amplitude	Min Amplitude
1	Prelude (Morning)	Peer Gynt	22050	22484	-26117
2	Suite No. 3 In D Major BWV 1068: Air	Camerata Rhenania & Hanspeter Gmür	22050	14680	-14368
3	Piano Concerto No. 1 In B-Flat Minor, Op. 23: II. Andantino Semplice - Prestissimo - Tempo I	Berlin Symphony Orchestra,Eduardo Marturet	22050	23249	-19515
4	Menuetto	Bratislava Chamber Orchestra & Vlastimil Horak	22050	18117	-16632
5	Clarinet Concerto in A, K. 622: II. Adagio	Chamber RSO Ljubljana & Pietro Cavaliere	22050	26795	-21305
6	Ave Maria	Caffee Concerto	22050	31308	-31275
7	The Merry Widow: “Lippen Schweigen”	Caffee Concerto	22050	31794	-31863
8	Canon In D	Orchestre de Chambre & Jean-François Paillard	22050	18354	-15975
9	Serenade No. 13 In G	Slowakisches Kammerorchester & Bohdan Warchal	22050	17758	-18651
10	Piano Sonata No. 14 In C-Sharp Minor Op 27	Dubravka Tomšič	22050	6386	-5534
11	Dance of the Blessed Spirits	Munich Chamber Orchestra & Hanspeter Gmür	22050	26448	-27336
12	Water Music Suite No. 1 In F Major,	Slovak Chamber Orchestra & Bohdan Warchal	22050	15316	-15094
13	Ballade No. 1 In G Minor, Op. 23	Makiko Takeda	22050	16577	-18777
14	Cantata No. 147: Jesu, Joy of Man's Desiring	Ferdinand Klinda	22050	6084	-5825
15	Liebestraum No. 3 In A-Flat Major, Op. 62	Dubravka Tomšič	22050	27302	-27048
16	Piano Concerto No. 21 in C, K. 467: II. Andante	Mozart Festival Orchestra & Alberto Lizzio	22050	23249	-19515
17	Pavane for a Dead Princess	Moscow RTV Symphony Orchestra & Alexander Kopylov	22050	19300	-17871
18	Adagio In e Major for Violin and Orchestra, KV 261	Latvian Philharmonic Chamber Orchestra, Tovijs Lifsics & Oleg Kagan	22050	14053	-13523
19	Adagio in G Minor (Arr. Giazotto)	Latvian Philharmonic Chamber Orchestra & Ilmar Lapinsch	22050	32767	-32256
20	Arabesque I: Andantino Con Moto	Peter Schmalfuss	22050	11272	-14227
21	Bagatelle in A Minor, WoO 59 "Für Elise"	Dieter Goldmann	22050	11131	-11680
22	Ballade No. 2 In F Major, Op. 38	Makiko Takeda	22050	19816	-18212
23	Berceuse in D-Flat, Op. 57	Peter Schmalfuss	22050	7997	-8717
24	Bonbons from Vienna (Wiener	Orchester der Wiener Volksoper & Cesare Cantieri	22050	21424	-21113

	Bonbons)				
25	Carnival of the Animals: The Swan	The Swan Caffee Concerto	22050	7854	-8137
26	Cavalleria Rusticana: Intermezzo	Klassische Philharmonie Bonn & Heribert Beisel	22050	10236	-11253
27	Clarinet Concerto in A, K. 622: II. Adagio	Chamber RSO Ljubljana & Pietro Cavaliere	22050	26795	-21305
28	Clarinet Quintet in A Major, K. 581: II. Larghetto	Gabrieli String Quartet	22050	13537	-12493
29	Concerto for Guitar and String Orchestra In D Major: II. Largo	Boris Björn Bagger & Annette Struck-Vrangos	22050	14323	-13751
30	Concerto for Oboe, Strings & Continuo in D Minor, SF. 935: II. Adagio	Camerata Rhenania & Gerhard Vetter	22050	12552	-11816
31	Concerto Grosso, Op. 6, No. 12 In B Minor: III. Larghetto e Piano	Slovak Philharmonic Orchestra & Oliver Dohnányi	22050	17551	-17884
32	Double Violin Concerto in D Minor, BWV 1043: II. Largo Ma non Tanto	Camerata Antonio Lucio	22050	12201	-16143
33	Etude in E Major, Op. 10, No. 3 "Tristesse"	Peter Schmalfuss	22050	22744	-24536
34	Flute and Harp Concerto In C K. 299 / 297c: II. Andantino	Mozart Festival Orchestra, Alberto Lizzio, Peter Jankovic & Renata Modron	22050	18885	-19308
35	Four Impromptus, Op. 90, D. 899, No. 3 in G-Flat Major	Piano Solo Sylvia Capova	22050	16389	-16844
38	The Gadfly: Romance	Staatliches Sinfonie Orchester Istanbul	22050	9655	-10195
39	The Girl With the Flaxen Hair (La Fille Aux Cheveux de Lin)	Peter Schmalfuss	22050	10695	-9104
40	Holberg Suite for String Orchestra, Op. 40: II. Sarabande	Slovak Philharmonic Orchestra & Libor Pesek	22050	14436	-13969
41	Keyboard Concerto in F Minor, BWV 1056: II.	Camerata Antonio Lucio	22050	12635	-12246
42	Kinderszenen, Op. 15: No. 7. Träumerei	Ernst Gröschel	22050	16034	-13680
43	L'Arlesienne Suite No. 1: Adagietto	Ungarisches Staatsorchester	22050	5272	-4998
44	Masquerade Suite: II. Nocturne	Moscow RTV Large Symphony & Karen Khatchaturian	22050	23338	-23190
46	Midsummer Night's Dream, Op. 61: Nocturne	South German Philharmonic Orchestra & Alexander von Pitamic	22050	18900	-16289
47	Minuet in G, WoO 10, No. 2	Dieter Goldmann	22050	32767	-32768
48	Nocturne No. 2 in E-Flat Major, Op. 9, No. 2	Vitalij Margulis	22050	23799	-23958
49	Piano Concerto in A Minor, Op. 16: II. Adagio	Radio Symphony Orchestra Ljubljana, Anton Nanut & Dubravka Tomšič	22050	10264	-11014

50	Piano Concerto No. 1 In B-Flat Minor, Op. 23: II. Andantino Semplice - Prestissimo - Tempo I	Berlin Symphony Orchestra & Eduardo Marturet	22050	23249	-19515
51	Piano Concerto No. 1 in E Minor, Op. 11: II. Romance: Larghetto	USSR State Symphony Orchestra, Gennady Rozhdestvenski & Viktoria Postnikova	22050	21759	-21302
52	Piano Concerto No. 2 In C Minor, Op. 18: II. Adagio Sostenuto	Moscow RTV Symphony Orchestra, Vladimir Fedoseyev & Yekaterina Sarantseva	22050	32613	-32742
53	Piano Concerto No. 2 in F Major, Op. 102: II. Andante	Staatliches Sinfonie Orchester Istanbul	22050	4293	-4422
54	Piano Concerto No. 2 in F Minor, Op. 21: II. Larghetto	Slovak Philharmonic, Oliver von Dohnanyi & Marian Pivka	22050	4293	-4422
55	Piano Concerto No. 5 in E-Flat Major, Op. 73 "The Emperor": II. Adagio un poco Mosso	Nürnberg Symphony Orchestra & Zsolt Deaky	22050	21374	-21056
56	Piano Concerto No. 20 in D Minor, K. 466: II. Romanze (Excerpt)	Mozart Festival Orchestra, Alberto Lizzio & Svetlana Stanceva	22050	32631	-30339
57	Piano Sonata No. 8 in C Minor, Op. 13 "Pathétique": II. Adagio Cantabile	Daniela Ruso	22050	11364	-10633
58	Piano Trios B-Flat Major, Op. 97 "Archduke": III.	Bamberg Trio	22050	14094	-15310
59	Pictures At an Exhibition: The Old Castle	Slovak Philharmonic Orchestra & Zdenek Kosler	22050	9381	-8167
60	Prelude to the Afternoon of a Faun (Prelude a l'apres-midi D'un Faune)	Süddeutsche Philharmonie & Alfred Scholz	22050	28330	-23985
61	Préludes, Op. 28, No. 13 in F-Sharp Major: Lento	Joanna Brzezinska	22050	7053	-7429
62	Préludes, Op. 28, No. 15 in D-Flat Major "Raindrop" - Sostenuto	Peter Schmalfuss	22050	23070	-26580
63	Quartet for Strings No. 1 in D Major, Op. 11: II. Andante Cantabile	Shostakovich Quartet	22050	15692	-15458
64	Quartet for Strings No. 2 In D Major: III. Andante "Nocturne"	Gunars Larsen, Curdin Coray, Howard Griffiths & Roger Pyne	22050	19655	-12019
65	Sadko: Song of India	Aladar Mozi	22050	16677	-19353
66	Serenade for Strings in E Major, Op. 22: I. Moderato	ORF Symphony & Milan Horvat	22050	13272	-13787
67	Serenade No. 10 In	Moscow Chamber Orchestra	22050	14675	-14242

	B-Flat 'Gran Partita' K. 361 / 370a: III. Adagio	& Lev Markiz			
68	Sleepers, Wake! (Wachet Auf, Ruft Uns Die Stimme)	Klemens Schnorr	22050	5510	-6266
69	Suite Bergamasque: Clair de Lune	Peter Schmalfuss	22050	15985	-15950
70	Suite No. 3 In D Major BWV 1068: Air	Camerata Rhenania & Hanspeter Gmür	22050	14680	-14380
71	Symphony No. 5 in C Minor, Op. 67 "Fate": II. Andante con Moto	Moscow RTV Symphony Orchestra & Vladimir Fedoseyev	22050	15789	-19872
72	Symphony No. 5 In C-Sharp Minor: IV. Adagietto	Moscow RTV Large Symphony Orchestra & Kyril Kondrashin	22050	12989	-18764
73	Symphony No. 9 in E Minor, Op. 95 'From the New World': II. Largo (Opening)	Slovak Philharmonic Orchestra & Libor Pesek	22050	7898	-8678
74	Treasure Waltz, Op. 418	Orchestra of the Viennese Volksoper & Carl Michalski	22050	19087	-16789
75	Tristan Und Isolde: Prelude to Act I	Leningrad Philharmonic Orchestra & Yevgeni Mravinsky	22050	13890	-17364