Effects of Controlling Versus Autonomy-Supportive Language on Learning a Novel Motor Skill and Cortisol Release

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EFFECTS OF CONTROLLING VERSUS AUTONOMY-SUPPORTIVE LANGUAGE ON LEARNING A NOVEL MOTOR SKILL AND CORTISOL RELEASE

By

Andrew McMahon Hooyman

Bachelor of Science
University of Nevada, Las Vegas
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A thesis submitted in partial fulfillment
Of the requirements for the

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Department of Kinesiology and Nutrition Sciences
School of Allied Health Sciences
The Graduate College

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July 2012
THE GRADUATE COLLEGE

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Andrew McMahon Hooyman

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Effects of Controlling Versus Autonomy-Supportive Language on Learning a Novel Motor Skill and Cortisol Release

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August 2012
ABSTRACT

Effects of Controlling versus Autonomy-supportive Language on Learning a Novel Motor Skill and Cortisol Release

By

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The purpose of this study was to compare how different types of instruction effect the learning of a novel motor skill and how salivary cortisol correlates to learning differences. Participants (N = 44), average age 22.3 years (standard deviation 2.37), were randomly assigned to an autonomy-supportive, controlling-language or neutral language group which was manipulated via instructional video. Saliva was collected before and after each session, and questionnaires were given after pitching was completed during each day. Results showed that there was a significant difference among groups in throwing accuracy on performance and retention. Questionnaire results also showed significant group differences in perceived autonomy and self-efficacy. There was no difference in cortisol on either day between groups. Further analysis showed that the autonomy-supportive group was superior in all domains over the controlling-language group. From these results, we concluded autonomy-supportive language is a beneficial form of instruction for learning a novel motor skill versus controlling language due to its ability to increase self-efficacy and perception of autonomy. Further research should be done on the psychological and hormonal aspect of motor learning.
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CHAPTER 1
INTRODUCTION

Autonomy is one of the great attributes human kind possesses to live in a multifaceted world. However, in many regards it is often overlooked. Settings such as rehabilitation, sports practices, and personal training, all places which should require the proper development and execution of exercise and motor skills, often do not take into account the autonomy of the client or athlete. Some researchers would argue that it is our biological imperative to exert control over our environment (Leotti, Iyengar, & Ochsner, 2010). These same researchers would argue that we are born to have choice and is not learned and should be nurtured as a biological motivator. In many instances, instructors, coaches, and trainers inform an individual on how to perform the proper technique and overlook the environment the technique is taught within. An environment which meets individual’s basic psychological needs, which autonomy is a part of, is better for motivation of participants than a controlling environment. Whether it is dealing with patients on the road to recovery or an athlete looking to prep their game for the next level, often times an environment of control is utilized by an instructor to maintain total adherence to their task demands and/or practice agenda.

Early on in development, infants understand the concept of having control within their environment compared to being controlled. Sullivan and Lewis (2003) found when 4 month old infants are met with a disruption instead of their expected reward to their learned behavior they respond with negative emotional reactions even if the reward is given later. This shows that when infants’ choices are neglected then there negative response is not due to the lack of reward, but rather the lack of acknowledgment of their behavior. Kochanska and Aksan (2004), also found when infants master a skill, such as feeding themselves, they refused an adult’s attempt to control that ability. At an early age humans are wired to seek control of their
environment and use this control as a very powerful motivator. This may give us a clue of the origins of autonomy from a biological standpoint that early on in development we learn that to best survive in an environment we must first learn to take control of it.

According to Ryan and Deci’s (2000) Self-Determination Theory (SDT) having the ability to choose within an environment and/or having feelings of control within that environment plays a key role in several versatile aspects of life. Within the proper contexts self-determination has shown to have a positive role in an education setting (Guay, Ratelle, & Chanal, 2008), improved self-esteem (Ryan & Deci, 2000), heightened vitality (Nix, Ryan, Manly, & Deci, 1999) and overall well-being (Ryan, Deci, & Grolnick, 1995). Given the natural constructiveness of SDT, self-regulation, and autonomy, their influence should also be further investigated in the discipline of motor learning, as to what role they play in motor skill acquisition. Having the ability to choose within a practice condition is related to the idea of autonomy. It has been an area of interest in motor learning for several years, and investigating it within different contexts and different modes of measure further explains and verifies how autonomy supports learning over other conditions.

Thus far, many studies have shown choice, perhaps the most basic form of autonomy, has been linked to improved learning of motor skills (e.g., Wulf, McNevin, Fuchs, Ritter, & Toole, 2000; Wulf, Raupach, & Pfeiffer, 2005; Wulf & Toole, 1999). When looking at strategies of why self-controlled practice is beneficial for learning Chiviacowsky and Wulf (2002) found participants chose to receive feedback after good trials compared to poor trials of a sequential timing task. This shows the motivational component of autonomy in how participants choose to acknowledge the improvements of their performance. Receiving feedback after good trials of a motor task has been shown to improve intrinsic motivation (Badami, VaezMousavi, Wulf, & Namazizadeh, 2011) much like self-determination facilitates intrinsic motivation and well-
being. Giving focus to the positive aspects of performance, choice shows how autonomy and giving feedback after good trials are parallel with each other and begets intrinsic motivation.

Reeves and Tseng (2010) have shown that controlling and autonomy-supportive instruction can have the same goal but can create a completely different stress response to a participant. The instructions used in this study were either harsh and offered little option for how to complete the puzzle (i.e., controlling) or more nurturing and open to the participant having a sense of choice (i.e., autonomy-supportive). What is most intriguing of this study is that each set of instructions had the same goal, same number of words, and same content of instruction for completing the puzzle, yet the participants in the controlling group showed significantly higher levels of salivary cortisol compared to the autonomy-supportive group. This is an indicator that controlling-language created a more stressful environment than autonomy-supportive instruction. Most likely, the participants in the controlling-language group were more frustrated with the task due to their elevated stress hormone levels the controlling-language condition (Moons, Eisenberger, & Taylor, 2010). The controlling group also perceived their instruction as being more controlling, which could have possibly lead them to feel less competent and less emotionally engaged compared to the autonomy-supportive group. From these findings there is reason to speculate that controlling language may create a stressful environment which may cause the participant to become frustrated with the task. This control raises cortisol and alters the individual’s experience compared to autonomy-supportive language that actually exhibited a suppression of salivary cortisol. The initial cortisol suppression response of the autonomy-supportive group had a significant correlation between perceived autonomy, perceived competence, and perceived motivating style.
Purpose of the Study

The present study has two purposes: 1) To test the effect of controlling versus autonomy-supportive language on learning a novel motor skill; 2) to measure salivary cortisol levels in order to assess potential role of cortisol in mediating motor learning. Each group of participants watched an instructional video using controlling, autonomy-supportive, or neutral language (control condition). Before and after each day of testing, participants gave a saliva sample to measure cortisol. Cortisol levels as a function of language were analyzed as well as their learning of the motor skill.

We propose two hypotheses in this study:

Hypothesis 1: The autonomy-supportive group will show improved learning of the task compared to the controlling language and control groups.

Hypothesis 2: The controlling language group will have higher salivary cortisol readings compared to the control and autonomy-supportive groups.

Significance of the Study

To my knowledge this was the first study to look at the effect similar yet different types of instruction have on learning a novel motor skill in combination with cortisol response.

Perhaps the most interesting part of the study is that it has nothing to do with altering the method with which an individual learns, as in explicitly guiding their learning process. Many studies directly manipulate instruction through different attentional focus, feedback, or the ability to choose to improve learning while maintaining environment (context instructions are given). This study intends to do the opposite, keeping consistent instructional content between groups but manipulating context to thus change learning environment. The next steps are to show evidence of how either a supportive or controlling environment may be more conducive for learning as well as show how one’s body reacts to this environment (via cortisol fluctuations)
and how that reaction may influence learning processes. This will improve our understanding of the role of an autonomy-supportive environment in learning and exactly what chemical developments may be inhibiting or aiding learning.

Outside of the world of academia this study has the potential of giving insight into instruction usage and its effects to any practitioner who teaches motor skills. This study may seem to have very obvious application for coaches and trainers when it comes to providing instruction on the acquisition of a new sport skill and exercise, but we will contest it is equally important for individuals in a rehabilitation setting, medical skill acquisition, such as performing surgeries, or even learning how to use different machinery, like that of construction equipment. These are positions which already include high stress situations. Anyone who is trying to “re-teach” an individual on how to reach, grasp, or walk may be overlooking in what way they are presenting the instruction to do so. In this oversight, individuals may be wasting their time and money as learning and rehabilitation is delayed. The point is not how easy the instruction is to follow but how it is delivered.
Definition of Terms

The following definitions are given for the purpose of clarification:

Cortisol – A hormone released by the adrenal glands as a response to stress.

Controlling Language – Instruction which the performer is told to follow exactly and gives no variation in how to perform the technique. Usually in a harsh tone leaving the individual feeling controlled.

Autonomy-supportive Language – Instruction which gives the individual a sense of control over their performance as well as a sense of cooperation with the instructor of the task.

Motor Learning – A relatively permanent change in motor performance as a result of experience with a task over time.

Retention – The performance of a skill subsequent to a period of practice in the absence of instruction, augmented feedback, or any experimental manipulation that was present during practice.

CHAPTER 2

Review of Related Literature

The purpose of this study is to create opposing environments, autonomy-supportive versus controlling, and investigate their effect on learning and stress response. Not to be confused with the self-controlled practice studies which have already shown benefits in learning (Wulf, Raupach, & Pfeiffer, 2005; Chiviacowsky & Wulf, 2005; Wulf & Toole, 1999), this is not an experiment investigating how participants use choice, whether it’s through feedback, observation, or use of an assistive device, and how that choice improves learning. Although having the ability to choose is associated with autonomy, this study aims to find how creating a sense of control in an individual improves their learning compared to being controlled. The
difference in these two perspectives, having control versus being controlled, has been shown by Reeve and Tseng (2011) to create very different experiences and physiological outcomes. The following review looks at how choice influences improved learning of motor skill, how autonomy facilitates positive behaviors, and what roles cortisol may play within these domains.

**Choice and Motor Learning**

As we have seen in previous self-controlled practice studies, having the ability to choose is not limited to just one factor participants have control over. Whether it is through feedback, observation, and the use of a device, choice can be used in a dynamic way. In 1999, Wulf and Toole found when participants have a choice of when to use an assistive device in a novel balance task they better learn the skill than a yoked group. A yoked group is a control group whose practice schedule is determined by when the self-controlled group requests to receive feedback or gain assistance over whatever factor they are given control over. For instance, if a participant in the self-control group chose to have feedback on trials 2, 5, and 7, a participant in the yoked group would be given feedback on the same trials. Wulf, Raupach, and Pfeiffer (2005) showed when participants had the choice of when to observe a practice model of the skill they had better retention of the skill compared to a yoked group. Wulf, Clauss, Shea, and Whitacre (2001), found that individuals in a self-controlled practice group, have better learning outcomes than individuals in a yoked condition. What is most intriguing about these studies is not just what role choice plays in learning but how the yoked group receive the same amount of practice on the task, whether through observation, use of a assistive device, or feedback, as the self-controlled group but fail to learn the task as well.

There are many potential reasons why incorporating choice in practice aids in the retention of novel motor skills. From several studies mentioned previously, Chiviacowsky and Wulf (2002) postulated having control over the feedback delivery allows a person to receive
feedback when they need it. Individuals may only utilize choice when they need that extra information, whether it is feedback or otherwise, to give them more information on their performance and how to improve it. Perhaps there is only so much a performer can delineate from their performance until they reach a point where they need an outside perspective to fine tune their motor program. Choice may also have a motivational context to it as well. When learners perform poorly they are less likely to ask for feedback compared to completion of a good trial (Chiviacowsky & Wulf, 2007).

That feedback given after good trials is more effective for learning than after poor trials seems to be counter intuitive. One may think a learner would choose to have feedback after a poor trial so they may have a better understanding of correcting the most amount of error. In reality, participants may not ask for feedback after poor trials because they do not want the confirmation of their poor performance and would rather focus on their better trials. Putting emphasis on the good trials by being given validation that a participant actually performed well improves their motivation to continue to perform well and may increase their arousal levels to be better focused on the task. From here we start to see how involving choice evolved from being a tool for efficient feedback to perhaps holding more of a motivational role.

In another study by Bund and Weimer (2004), self-controlled practice was better for learning, like many of the studies which preceded it, but also found participants in the self-control group had increased self-efficacy compared with the yoked group. This is interesting as there were no differences in performance between any of the groups during the practice phase. Something about just having the ability to choose improved their self-efficacy. This could be a sign of how incorporating choice gives a stronger sense of autonomy. Another study by Badami, VaezMousavi, Wulf, and Namazizadeh (2011) found when people are given feedback after good trials they have higher intrinsic motivation than people given feedback after poor trials.
Therefore, the reason choice is so effective is because of the boost it gives to self-motivation and self-efficacy. These are two areas Ryan and Deci (2000) have also found to be improved when the components of SDT, autonomy and competency, are applied in scenarios involving psychology or education. However, choice and autonomy appear to have similar effects on our performance expectancies and self-motivation as well.

**Autonomy and Behavior**

Choice can be considered a component of autonomy. However, autonomy at its foundation is the sense of having control of one’s behavior within an environment. The idea of autonomy playing an essential part of well-being and a source of intrinsic motivation, first originated by Ryan and Deci (2000) and the emergence of SDT. Through their research, they suggest that autonomy is one of three basic psychological needs, along with competency and relatedness, which gave people self-motivation, improved mental health, and improved well-being.

Through the genesis of the theory, Ryan and Deci have been able to show that the possession of autonomy improves motivation to learn (e.g., Zhou, Ma, & Deci, 2009). In an environment of interpersonal control, such as a prison, a place where control is seen as an effective way to prevent dangerous behavior, researchers have found that behavior becomes more antisocial and leans to becoming violent (Moller & Deci, 2010). SDT has shown that within the grand scheme of human well-being, autonomy confirms its universal role as an essential for human psychological needs (Ryan & Deci, 2006).

In a study done by Puente and Anshel (2010), we can see how autonomy and competence can work in a real community format. In this case, the experimenters observed the perception of exercise participants in a group exercise class and their perceptions varied of themselves and their instructor based off the autonomy associated with class environment and
the competency of the instructor. The study found that, when group exercise participants found the class environment autonomy-supportive and the instructor competent in their ability to teach the class, the perceived relationship between exerciser and instructor strengthened as well as the exerciser’s ability to self-regulate. This self-regulation increased enjoyment, positive affect, and exercise frequency. If the relationship between instructor and exerciser is one of autonomy and competence the exercisers would enjoy and participate in the class more. This shows how autonomy-supportive environments give participants a shared sense of competence and therefore motivate these individuals to continue this behavior. This is an important factor when it comes to teaching people new motor skills. To improve their ability to practice is one thing but to enhance their motivation for improvement is another. In order for an individual to truly reach a level of expertise they must have the motivation to practice on a consistent basis.

This displays how autonomy gives a person a more fulfilling experience doing the same activity compared to those that lack such autonomy (e.g., Zhou, Ma, & Deci 2009). Another study by Tarfardi, Milne, and Smith (1999) found that giving people control over what names the characters in a reading comprehension test have increased test comprehension confidence compared to a yoked group. This is interesting as the choice to name the characters has very little to do with their ability to score on a comprehension test. There were no differences of comprehension found between the self-controlled and yoked groups, yet the self-controlled group had more confidence in their ability. Already we are beginning to see a pattern with autonomy and the positive effects it has on behavior towards learning.

Cortisol

What the previous body of work shows is that autonomy-support given in the context of skill acquisition is varies motivation and thereby has an influence on learning (Badami, VaezMousavi, Wulf, & Namazizadeh, 2011). Although this makes sense from a motivational
stand point exactly what physiological components are at play in this enhanced learning process has been an area untouched by motor learning research. Reeve and Tseng (2011) examined different motivating styles, autonomy-supportive versus controlling, in the building of a complex puzzle. The instructions for each style had the same content but were presented in a different context. The controlling style focused on creating an environment of intrusion, pressure and neglect for the learner’s perspective. In contrast to the controlling style, the autonomy-supportive style gave priority to the learner’s perspective, gave them support, and was open to their initiative. Under this style Reeve and Tseng found that individuals did not have an increased release in cortisol. The controlling-language group did show an increase in cortisol in comparison to the control group (neutral instruction) and autonomy-supportive language group up to 25 to 40 minutes after the exercise was completed.

Dickerson and Kemeny (2004) have shown that negative social evaluation (i.e., belittling the individual’s abilities) is an acute enough stressor to illicit a cortisol response. This is a physiological response utilized as a coping mechanism to stress from the limbic-hypothalamic-pituitary-adrenal (LHPA) axis (Stansbury & Gunner, 1994). In short, the negative emotions the individual feels cause a chain reaction throughout the brain which eventually leads to the adrenal glands releasing increased amounts of cortisol. Reacting in a frustrated or negative manner is associated with this stressor response. According to Moons and colleagues (Moons et al, 2010), reaction of anger towards stress yields a higher release of cortisol to stress than feelings of fear, which cause a release of protein cytokines. This shows once stress is invoked and the brain reacts in anger the body is signaled to release increased amounts of cortisol as a coping mechanism.

A study by Quested and colleagues (Quested, Bosch, Burns, Cumming, Ntoumanis, & Duda, 2011) found that in dancers who exhibit high basic psychological need satisfaction (BPNS),
an essential for well-being according to SDT, had lower salivary cortisol compared to individuals with low BPNS which yielded higher salivary cortisol when preparing for a dance performance. High BPNS occurs when an individual feels supported, in control of their task, and competent in performing the task. Low BPNS is present when the performer feels like they have little control and are neither competent nor supported in their performance. The differences between these two dancing groups draw parallels to the participants in the Reeve and Tseng study.

According to Burns (2006), chronically high amounts of cortisol produced and released into the body can affect immune function overtime. Athletes, students, dancers, and anyone else who may participate in an environment of control versus support, may not just be exposing themselves to potential health problems due to chronic stress from their activity but detriments in performance, too. As we saw with the dancers in the Quested et al. (2011) study, when basic psychological needs such as autonomy and competency are not fulfilled there is an increased threat to one’s performance. Elevated levels of cortisol show us that stress has occurred and may be interfering with our performance. However, there is evidence that cortisol may not only impede our performance but may also interfere with learning.

A study done by De Quervain, Roozendaal, and McGaugh (1998) found that rats who experienced high amounts of stress, in form of light electric stimulation, showed a cascade of glucocorticoids released into the body. Having this release of cortisol has been shown to impair cognitive functioning. The rats that underwent the shocks 30 minutes prior to a water maze retention course showed an inability to perform the task compared to being shocked 2 minutes or 4 hours before testing. This time difference was significant due to the increased amount of adrenocortical function. When the scientists blocked this reaction of cortisol from stress in the rats the impairment was gone. When the rats were unstressed but were administered a dose of
cortisol, the impairment was present again. This demonstrates how cortisol, not necessarily stress, may impair the learning of new skills.

Other animal studies looked at how zoo animal behavior and urinary cortisol levels fluctuate depending on the amount of choice given to them in their environment (Owen et al., 2005; Ryan, 2006). In captive polar bear and panda bears, zoologists have found giving the animals more places to roam within their environment changed their behavior and lowered their cortisol. If they had more choice within their enclosure they would engage in more social behavior and would have lower urinary cortisol compared to having limited space to roam. With a restriction put on the number of areas they can roam their cortisol levels where significantly higher. This limited ability to move within an environment has also been shown in a laboratory experiment (Ryan et al., 1994). Ryan and colleagues found that restricting the movement of rats, a non-painful restriction, caused increased heart rate, norepinephrine, cortisol release, and even gastric ulcers.

These findings coupled with the research presented on cortisol reactivity in autonomy-supportive and controlling conditions suggests that stress-induced cortisol from controlling instruction may impair the learning of a motor task compared to a autonomy-supportive instruction or neutral instruction. Therefore, in the present study participants were assigned to either controlling or autonomy-supportive environments or a control condition. We measured their salivary cortisol pre and post practice and retention and assessed their learning of the task.
CHAPTER 3

Method

Participants. Participants in the study were healthy and able students from undergraduate kinesiology courses at the University of Nevada, Las Vegas between the ages of 18 and 45. Each participant was not on any medication at the time of the study, as Granger and colleagues (Granger, Hibel, Fortunato, & Kapelewski, 2009) have found there are a plethora of medications, ranging from birth control to anti-inflammatory drugs, which can alter salivary cortisol. Participants also had no prior experience with any type of pitching activity. To avoid any unintended fluctuations of cortisol, participants refrained from eating 1 hour prior to the study or consuming alcohol 12 hours before participating, and stayed away from caffeine, smoking, or exercise on each testing day. Five males and 5 females were recruited to the neutral group (mean age 22.2), 10 males and 7 females were recruited to the autonomy-supportive group (mean age 23.6), and 10 males and 7 females were recruited to the controlling-language group (mean age 22.3). After participating in the study each participant was given course credit.

Apparatus and Task. The following are the distances and parameters used for the court set-up, including angle and distance of the camera for data collection. The target used for this study was painted on to an unprimed cotton canvas roll measuring 1.3m x 1.8 m (width x height). Orange paint was used to paint the target. The color of the target was chosen because of its neutral qualities. Participants attempted their pitches at a distance of 33 feet or approximately 10 meters. Wilson tennis balls were used for the pitches. Each participant was given 10 tennis balls at the beginning of each trial block within their prepackaged holder. After the balls struck the target they fell into the ball catch of an Atec Catch Net (Sparks, Nevada) measuring 2.1 m x 2.1 m x 1.4 m, where the target was hung. The center of the bull’s eye of the
target was approximately 1 m from the ground. Before every block of pitches commenced a Flip Camera (Flip, Model M3160, Irvine, California) was mounted onto a tripod which had the camera lens 10 meters from the ground. The camera lens was 6 meters from the target and was focused onto the center of the target from a 20 degree angle. This distance and angle was considered the best set up for the camera as it did not distract the thrower from their task and was still able to capture a clear and accurate picture of where the pitches were striking the target. Model of Cricket Court can be seen in Figure 1 below.

Figure 1

Top view of Cricket Court with dimensions.

Procedure

To control the cortisol levels of participants upon entering the study they waited 10 minutes before beginning any of the testing procedures (Reeve & Tseng, 2011). The purpose was to reduce any residual stress participant’s may have had from everyday life before entering the study environment. To take into account for natural fluctuations of cortisol participants were only tested from 2 PM to 6 PM. This was due to the diurnal variation in cortisol among
humans typically individuals have naturally higher cortisol levels in the morning AM hours compared to the evening PM hours.

**Salivary Collection**

Saliva collection was performed using a standard drinking straw and a collection vial. The vials used were 1.5 ml safe-lock micro centrifuge tubes (Brinkmann Instruments, Westbury, NY). Both of the participants samples collected on each test day were seal and stored in a Whirl-Pak Bags (NASCO, Fort Atkinson, WI). All samples were kept in a standard refrigerator freezer for temporary storage for no more than 4 hours and were then placed in a Subzero Freezer (Revco Inc., Model # UTL185-5-AUA, Asheville, N.C.) at -80 degrees centigrade until analysis was performed. The kits used for analysis were Salivary Analysis Kits (Salimetrics, State College, PA).

Participants arrived at the practice court one at a time. After the initial 10 minute waiting period had expired each participant passively drooled, via a straw, into a collection tube (Dabbs, 1991). Chewing gum was not used in this study as Smith (2010) found people given gum during a cognitive test performed better and were less stressed than control participants. Researchers of this study also found that participants in the chewing gum condition were less stressed and had higher heart rate and cortisol levels than the controls. This could have been a potentially confounding variable for the study and was removed as the method for saliva collection. This passive drool of saliva sampling was the standard for all collections. Participants gave saliva before and after the practice day and the retention day.

The kit used to analyze salivary cortisol was an enzyme immunoassay (EIA) kit. This kit does not require samples to be sent to a lab and can be analyzed in-house with the mixing of reagents which accompany each kit. According to Salimetrics literature (Aardal & Holm, 1995) these kits have a strong correlation to blood samples ($r=.91$). Analysis of salivary cortisol
involved a thaw, centrifuge, and reagent mixing process which is outlined in the Procedure section.

**Performance and Retention**

Participants were randomly assigned to one of three groups: Autonomy-supportive, controlling, and neutral language. The content of the voice-over instructions, provided with the video demonstration of the pitch, are shown in Table 1.

<table>
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<tr>
<th>Instruction Played Over Cricket Video</th>
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<tbody>
<tr>
<td><strong>Autonomy-supportive:</strong></td>
</tr>
<tr>
<td>Here is your opportunity to learn the cricket pitch. Please wait to begin your pitches until the instruction has ended. The tennis balls are in their holders now but you may organize them in a way that you prefer. Once you begin pitching feel free to go at a pace you are comfortable with. When starting the approach of the pitch you may want to cradle and deliver the ball in a windmill fashion so the ball travels over the shoulder and not to an angle or to the side. Here is a hint for throwing your best pitch, upon releasing the ball focus on the center of the target or the area where you want the ball to bounce before it strikes the target.</td>
</tr>
<tr>
<td><strong>Controlling:</strong></td>
</tr>
<tr>
<td>Your job today will be to learn the cricket pitch and perform it well. You may not begin pitching until you are told so. Make sure all of the tennis balls are in their respective holders. You may only remove one tennis ball at a time. Once you have been told when to commence pitching you must maintain a consistent pace. When initiating the approach of the cricket pitch you must cradle the ball so it travels in a circular pattern. At the apex of the pitch the ball must be directly over the shoulder. Do not throw it at a side angle. When initiating the release you need to focus on the center of the target or the bounce area below the target.</td>
</tr>
<tr>
<td><strong>Neutral:</strong></td>
</tr>
<tr>
<td>Today you will be practicing the cricket pitch. Begin pitching once instruction has ended and the court is set. The tennis balls are in their respective holders. At the start of practice the tennis balls will be kept in their respective holders. Throw each series of pitches in an efficient and consistent manner. At the beginning of each pitch cradle and swing the ball so it travels in a circular fashion before it is released. Before the release of the ball, make sure it travels over the shoulder. At the release maintain focus on the center of the target or the bounce area prior to the target.</td>
</tr>
</tbody>
</table>

Participants watched their group-assigned instructional video for the first time without sound (pre-test). The pre-test was important for establishing the baseline performance of each
participant without manipulation from the instruction. This was important for measuring learning within each group. If each group began their first trial with the instruction assigned to their group it would be impossible to measure initial performance without manipulation against learning via instruction.

Video. The video content was of different views of an instructor completing a cricket pitch. The views of the pitch were from each side, the front, and the rear. There was also footage of the tennis ball set up as well as where the ball should bounce before it strikes the target and where the ball should strike the target for optimal amount of points. The instructions and video were played simultaneously. An important distinction to make between the videos played is not just the varied language within the instruction but also the tone used with each instruction. Each set of instructions were spoken in a tone that is congruent with its style. Speaking rate, approx. 3.3 words per second, and volume of the instructions was maintained between each video. However inflection and tone did vary depending on the instruction. The controlling language did adopt a more stern and authoritative tone, imagine the voice of a strict football coach or drill sergeant. Conversely, the autonomy-supportive instruction had a much more nurturing tone, such that it sounded like a friend would be teaching the pitch. The neutral condition actually contained a lack of inflection, change in tone or personality and would remain very flat throughout. Noels, Clément, and Pelletier (1999) found that a teacher’s communication style which included a pressuring tone can have an effect on a student’s intrinsic and extrinsic motivation. Reeve (2009) showed how a combination of this tone and controlling motivation style create the negative effects which this study is looking to simulate. They also found a nurturing tone with an autonomy-supportive motivation style also created the positive effects for the autonomy-supportive instruction we wished to exhumed in the cricket pitch instruction.
Afterwards they began their first set of throws. No feedback on performance or results of throws was given until after all 60 pitches are completed. This is to reduce interaction between participant and researcher so all manipulation can be focused on the instructions. If the interaction between researcher and participant is amiable or stressful then it may interfere with the amount of stress attempting to be created in each condition. After 10 pitches have been completed the participant waited for 1 minute and then watched the instructional video again and then proceeded to throw another 10 pitches. The reason for the additional minute of rest between each set of throws is to allow the buildup of cortisol throughout the experiment. In other studies, it took at least 10 to 25 minutes for peak cortisol release to be reached after a stressor is initiated (DeQuervian et al., 1998; Dickerson & Kemeny, 2004; Reeve & Tseng, 2011). Extending practice duration makes sure that participants are still attempting pitches as peak concentration is reached. This process continued on the practice day until 60 pitches have been completed. Upon completion of all the throws each participant filled out a customized autonomy questionnaire (see Appendix 1) then gave another saliva sample.

On the retention day, each participant began by waiting 10 minutes. Saliva samples were collected again and only 20 pitches were completed in sets of 10, giving the same interval of rest that was had on the practice day between each set. No instructional video or feedback was given on the retention day. Once the final throws are finished, the participant completed the same autonomy questionnaire as on the practice day and gave a final saliva sample.

At the end of both the practice day and the retention day, each participant filled out a questionnaire (Appendix 1) consisting of 18 questions pertaining to autonomy, affect, competency and arousal, as well as, the Positive And Negative Affect Schedule – Expanded Form, PANAS-X, (Watson, Clark, & Tellegen, 1988). This questionnaire served as a qualitative means to compare the experiences between groups. Participants are asked to score a series of emotional
responses to how they feel when given the survey on a scale of 1 (not at all) to 5 (extremely). Each emotion relates to a different affect. This questionnaire focused on the scores given to the positive (words such as: proud, strong, interested, etc.) and negative (words such as: ashamed, distressed, nervous, etc.) affect.

Salivary Biochemical Analysis

The EIA kits used to analyze all saliva samples works on the principle of comparing known values of cortisol, standards and controls which are included with each kit, and comparing them to the collected saliva samples, unknowns. Instead of comparing amount of cortisol within each sample, due to the low levels of cortisol in saliva, a correlation, $r = .91$, is derived via optical density, color of each sample after treatment, when read by a standard plate reader at 450 nm. The plate reader is given the values of the standards which are measured along with the controls, containing high and low levels of cortisol, and the unknowns. With this information the plate reader can plot a curve of standard concentration versus optical density. From this point optical density of the unknowns is placed on curve which then yields the predicted concentration of that unknown.

The saliva samples were analyzed in duplicate in the Genomics lab on the campus of the University of Nevada, Las Vegas. On the day of assay measurement, samples were removed from cold storage of -80° C and the salivary kits were removed from their cold storage of 2-8° C and exposed to one thaw cycle of duration of at least 60 minutes. The samples were analyzed in a lab with temperature of 68-74 F. Samples were centrifuged at 3000 rpm for 15 minutes. Then 25 μL of standards, controls and unknowns were placed into their respective wells of the assay plate via a pipette instrument. The wells of each plate were coated with monoclonal antibodies to cortisol. Only clear samples of unknowns were pipette into the wells to avoid false readings from mucins in the sample, which can increase pH levels of the sample. Each sample and its
duplicate were analyzed in the same plate. Once initial pipetting was completed samples were tested for their pH levels. Any samples that were out the pH range of 9.0 to 3.5 were diluted to bring within range.

Once samples were prepped, a dilute with an enzyme conjugate was added. When samples were clear of any pH imbalances, they were then placed on a plate rotator at room temperature for 5 minutes at 500 rpm. The plate was then incubated for 55 minutes at room temperature and then thoroughly washed with a 1X wash buffer, supplied in the cortisol kit, until no residual fluid was left thus washing away any unbound material from the plate. Two hundred μL of TMB solution were added to each well using an 8 multichannel pipette and then placed on a plate rotator for 5 minutes at 500 rpm. The plate was incubated in the dark for 25 minutes at room temperature. After this final incubation 50 μL of a stop solution were added and mixed on a plate rotator for 3 minutes at room temperature at 500 rpm.

The plate was then analyzed in a spectrometer at a wavelength of 450 nm. To have accurate readings with this ELISA kit the plate was analyzed by the plated reader within 10 minutes after the stop solution was applied. Using the plate reader software, SOFTmax Pro, standards were plotted on a graph and made to fit a sigmoid curve. These readings were then converted from μg/dL to nmol/L which is the standard measurement used within other salivary cortisol literature (Reeve & Tseng, 2009).
Data Analysis

The targeting system for this experiment, shown in Figure 2, uses a typical number system for a target. However, the challenge with this scoring system is its lack of real world quantification of improvement so each pitch was recorded, measured and scaled to give more accurate performance measurements. Every pitch was viewed and measured by the researcher and scaled to give the real distance each ball struck the target (+/- 1.52 centimeters). Using this system we were able to get a fair approximation of how far each pitch hit the target from the bull’s eye in real space. This is a much more sensitive way of measuring error from the center of the target than using the numbering system. The main role of the numbering system of the target is to give participants an idea of where to aim and how well they were doing. It also gives them a means to answer questions 14a, 14b, and 14c of the questionnaire found in Appendix 1. Without an indicator of performance it is difficult for one to gauge their self-efficacy.

Figure 2. Target and Scoring System of Cricket Pitches

Radius of Bull’s Eye: 15.24 cm.
Radius of Target from Bull’s Eye Center: 60.96 cm.
Scoring: Bull’s Eye – 5, 2nd Ring – 4, 3rd ring – 3, Outer Ring – 2, Outside Target: 0
Pre-test data (block 1) was analyzed in 3 (group) x 1 (block) One-way analysis of variance (ANOVA). Practice data were analyzed in a 3 (groups: controlling, autonomy-supportive, and neutral) x 6 (blocks of 10 trials) (ANOVA) with repeated measures on the second factor. Retention data were analyzed in a 3 (groups: controlling, autonomy-supportive, and neutral) x 2 (blocks of 10 trials) analysis of covariance (ANCOVA) with repeated measures on the second factor with initial performance (practice block 1) included as a covariate.

Salivary cortisol for the practice day was analyzed in a 3 (groups: autonomy-supportive, neutral, and controlling) x 2 (cortisol collection: pre and post) mixed model ANOVA with repeated measures. Salivary cortisol for the retention day were also analyzed in a 3 (groups: autonomy-supportive, neutral, and controlling) x 2 (cortisol collection: pre and post) mixed model ANOVA with repeated measures. The questionnaire and PANAS-X data were analyzed through separate one-way ANOVAs. The questionnaire, found in Appendix 2, had five specific areas: Intrinsic Motivation, Perceived Autonomy, Perceived Competence, Perceived Stress, and Self-Efficacy. The respective items were and analyzed in repeated-measures ANOVAs. Cortisol data were also surveyed for relative and absolute cortisol responses and suppressions between groups.

Performance scores were investigated for relationships via a bivariate correlation analysis across PANAS, perceived autonomy, self-efficacy, and pressure. This was to exam the strength of relationship between qualitative scores and performance and retention outcome.

In order to more accurately demonstrate the number of cortisol responses or suppression each sample was submitted to relative and absolute changes from pre and post measurements to better quantify effects of the instruction. There were two criteria that made up the absolute measure of whether a participant experienced a clear-cut cortisol suppression or cortisol response. The first is a relative criterion drafted by Reeve and Tseng (2011). If a
participant experiences a 40% relative change whether it is an increase or decrease in cortisol from baseline then the participant satisfies the relative criteria for a secretory response or suppression. The second is if a participant experiences a 2.8 nmol/L increase or decrease in cortisol then this would satisfy the absolute criteria for a cortisol secretory response or suppression. This absolute criterion signifies a clear-cut cortisol response (Schommer, Hellhammer, & Kirschbaum, 2003). If a sample meets both of these criteria, this would suggest that the cortisol reaction was due to the manipulation and not to other extraneous factors.

CHAPTER 4

Results

Throwing Performance

Pre-test. Block 1 was used as a pre-test condition which was sans instruction and video only of the cricket pitch. This allowed us to account for any initial performances differences between groups which would have had the potential of confounding later results. The main effect of group on block 1 was not significant, \( F(2, 41) < 1 \).

Practice. All groups showed improvement throughout practice (see Figure 2). However, the main effect of block was significant \([F(5, 205) = 10.42, p < .001, \text{partial } \eta^2 = .20]\). The main effect for group was significant \([F(2, 41) = 3.5, p = .04, \text{partial } \eta^2 = .15]\). The interaction of group and block was not significant \([F(10, 205) < 1]\). Post-hoc tests with a Bonferroni correction showed the difference in the group main effect was due to the AS group outperforming the CL group, \( p = .024 \). A Bonferroni correction was used to reduce the risk of attaining a type 1 error. There was no difference between the N group and the AS group, \( p = .43 \). This is understandable as the AS group showed an overall improvement of approx. 21 cm. closer to the target compared to the CL group only improving approx. 12 cm.
Table 2

*Group Means and Standard Deviations for Throwing Performance*

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Test</th>
<th>Performance</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>53.39 (13.94)</td>
<td>41.65 (11.91)</td>
<td>38.59 (14.56)</td>
</tr>
<tr>
<td>Controlling</td>
<td>56.83 (13.53)</td>
<td>52.54 (12.37)</td>
<td>52.13 (16.30)</td>
</tr>
<tr>
<td>Neutral</td>
<td>57.66 (22.45)</td>
<td>49.42 (12.19)</td>
<td>45.06 (12.40)</td>
</tr>
</tbody>
</table>

Standard Deviations in Parentheses

Figure 3

Throwing performance and retention.

Retention. On the retention day without any instruction or video manipulation, the AS group showed the most retention of the task compared to the CL group. The main effect of block was not significant, \( F(1, 40) = 3.27, p = .078 \). The main effect for group was significant, \( F(2, 40) = 3.33, p < .046, \eta^2 = .143 \). The interaction for group and block was not significant, \( F(2, 40) = 1.91, p = .161 \). Post-Hoc tests with a Bonferroni correction showed the AS group
performed significantly better than the CL group, \( p = .042 \). As the post-hoc test displays, the main effect of group was solely due to the difference in performance between the AS and CL groups. The CL group appeared to show little retention of the task with an average score of approx. 52 cm. This average score is similar to their first trial without any instruction which was 56 cm.

**Questionnaire Results**

**Perceived Autonomy Practice.** The questionnaire data revealed no significant difference in response to intrinsic motivation, perceived competence, perceived stress, and self-efficacy on both days. One area that did show a great deal of difference was in perceived autonomy. Analyzing questions 10, 11, and 12 from the questionnaire there was a significant difference between the autonomy supportive group and the neutral and controlling language group. The effect of group was significant, \( F (2, 41) = 5.96, p < .01 \). Tukey’s test revealed that the autonomy-supportive group perceived significantly greater autonomy (average 8.41 out of 10) than the neutral group (6.16 out of 10), \( p = .009 \) and the controlling group (6.4 out of 10), \( p = .036 \).

**Perceived Autonomy Retention.** This perception of autonomy did not persist to the retention day of the study. Effect for autonomy between groups was \( F (2, 41) = 2.12, p > .05 \). The amount of autonomy perceived continued with the AS group as average score was 8.37. The reason for lack of significance was due to increased autonomy in the CL and N group with average scores of 7.01 and 6.83 respectively.
Table 3

Questionnaire Means and Standard Deviations for Perceived Autonomy (Out of 10)

<table>
<thead>
<tr>
<th></th>
<th>Performance</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>8.41 (1.36)</td>
<td>8.37 (1.59)</td>
</tr>
<tr>
<td>Controlling</td>
<td>6.10 (2.35)</td>
<td>7.02 (2.60)</td>
</tr>
<tr>
<td>Neutral</td>
<td>6.17 (2.79)</td>
<td>6.83 (2.53)</td>
</tr>
</tbody>
</table>

Standard Deviations in Parentheses

PANAS-X

Practice Positive Affect. PANAS-X data showed the level of positive and negative affect each participant experienced immediately after completing the task. For positive affect, the effect of group revealed an F (2, 41) = 3.05, p = .059. Post-hoc tests revealed the differences were between the AS and CL groups, p = .048. There was no difference between CL and N groups, p = .389. AS and N group had no difference, p = .717. The AS group was superior to the CL with a positive affect score of 3.61 out 5 compared to 3.07 out of 5. The N group experienced a relatively average score of 3.4 out of 5.

Practice Negative Affect. PANAS-X data for Negative affect showed no significant effect, F (2,41) < 1, p > .05. There was little to no variation between groups in negative affect with each group experiencing an average score of 1.5.

Retention Positive Affect. The difference of positive affect weakened during the retention day as there was not a significant effect, F (2, 41) 1.51, p = .23. Scores of each group remained relatively the same. The AS group experienced a drop in positive affect from the second day with an average score of 3.43. Means for each day can be found in table 4.

Retention Negative Affect. The group effect for negative affect remained the same as the practice day, F (2, 41) < 1, p > .05. Means for each day can be found in table 5.
Figure 4

Average Positive and Negative affect scores for AS, CL, and N groups on Practice and Retention

Table 4

Group Means and Standard Deviations for Positive Affect (Out of 5)

<table>
<thead>
<tr>
<th>Group</th>
<th>Performance</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>3.62 (.58)</td>
<td>3.43 (.78)</td>
</tr>
<tr>
<td>Controlling</td>
<td>3.06 (.68)</td>
<td>2.95 (.86)</td>
</tr>
<tr>
<td>Neutral</td>
<td>3.42 (.62)</td>
<td>3.28 (.80)</td>
</tr>
</tbody>
</table>

Standard Deviations in Parentheses
Table 5

Group Means and Standard Deviation for Negative Affect (Out of 5)

<table>
<thead>
<tr>
<th>Group</th>
<th>Performance</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>1.49 (.32)</td>
<td>1.30 (.48)</td>
</tr>
<tr>
<td>Controlling</td>
<td>1.48 (.44)</td>
<td>1.29 (.30)</td>
</tr>
<tr>
<td>Neutral</td>
<td>1.56 (.42)</td>
<td>1.33 (.26)</td>
</tr>
</tbody>
</table>

Standard Deviations in Parentheses

Self-efficacy

Self-efficacy Practice. Self-efficacy displays a certain level of confidence within a participant’s ability to not only perform the pitch but to perform it at a high level. The effect for self-efficacy on the practice day was $F (2, 41) = 3.73, p = .032$. Post-hoc tests with a Bonferroni correction showed the AS group almost had significantly higher scores compared to the CL group with $p = .051$. There was not a significant between the CL and N groups ($p = .126$). There was no difference between the N and AS group, $p = 1$. The AS group on average had a self-efficacy of 7.4 out of 10, the CL group had 5.7 out 10, the N group had an average score of 7.3 out of 10. These scores indicate how confident a person believes they can attain a certain score. The higher the score the more likely a participant believes they will perform well.

Self-efficacy Retention. Self-efficacy in retention did persist with an effect of $F (2, 41) = 4.08, p = .024$. However, post-hoc tests revealed a weakened effect between the AS and CL group, $p = .15$. However, the difference between the CL and N group was significant, $p = .031$. If the N group had same number of participants of CL and AS we believe their means would not be similar to AS. The CL group self-efficacy mean remained the same from performance to retention day while the AS group had a slight decrease in self-efficacy, 6.9. However, this was not a significant decrease compared to the practice day, $t_{32} = .79, p = .44$. Why self-efficacy fell
among the AS group is because they did not perform their best on block 8 as they had done on block 6, 34 cm compared to 32. The N group did maintain their best performance from block 6 to block 8, means of 40 cm on each day. This may have been why they experienced an increase in self-efficacy, 7.6 out 10. Table 6 displays all means for groups below.

Table 6

Group Means and Standard Deviations for Self-efficacy (Out of 10)

<table>
<thead>
<tr>
<th>Group</th>
<th>Performance</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>7.37 (1.47)</td>
<td>6.90 (1.98)</td>
</tr>
<tr>
<td>Controlling</td>
<td>5.75 (2.10)</td>
<td>5.51 (2.23)</td>
</tr>
<tr>
<td>Neutral</td>
<td>7.33 (2.41)</td>
<td>7.67 (1.62)</td>
</tr>
</tbody>
</table>

Standard Deviations in Parentheses

Cortisol

Cortisol sampling was taken out of a total of 38 participants out of the total 44 due to lack of ELISA kits needed to complete further analysis. The performance samples had to have 2 sample dropped while the retention samples had to have 1 sample dropped. This was due to elevated cortisol values within those samples which tested beyond their range. The majority of readings from the cortisol analysis did fall within the normal range given the age of the participants and the time of day of testing. The variance between the four kits analyzed was ≤ 3%. With males and females participating in the study with a respective age range of 20 to 39 and 20 to 30 the highest acceptable range for the PM for each age gender and age group are listed in Table 7:
Table 7

Cortisol Range for Age and Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
<th>nmol/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>21-30</td>
<td>4.85 – 8.497</td>
</tr>
<tr>
<td>Females</td>
<td>21-30</td>
<td>4.55 – 9.904</td>
</tr>
</tbody>
</table>

These ranges were determined by the Salimetrics recommended ranges literature as well as our own laboratory testing, which Salimetrics recommends for lower range determination. The top ranges in the table were determined by the Salimetrics literature which is based off an experiment done by Aardal and Holm, (1995). The lower range was determined through our own tests as the previous study did not determine them. Any values that tested beyond this range were removed from analysis. Out of the total 38 samples analyzed in duplicate 3 had to be removed due to exceeding the designated range.

Cortisol Practice. Cortisol measured from the practice day gave an indication of what role the manipulation played on the endocrine system of each participant. Cortisol is subject to much variability due to its reactions with stress. The main effect of block was $F(1, 33) = 2.65$, $p > .05$. The main effect of group was not significant, $F(2, 33) = 1.142$, $p > .05$. The interaction of block and group was not significant, $F(2, 33) = 1.686$, $p > .05$. As shown in Table 8, the overall challenge with cortisol is due to the individual variation and perception of stress each individual may experience, not just to stress but other factors as well.

Cortisol Retention. Cortisol was measured on the retention day to see if there was any stress context associated with the pitch and how it was initially taught. If a participant experienced a cortisol reaction or suppression on the practice day perhaps they would have a
similar event on retention day without manipulation. The main effect for block was significant \([F (1, 34) 7.545, p = .01, \eta^2 = .182]\). The main effect for group was not significant \([F (2, 34) < 1]\). The interaction of block and group interaction was not significant \([F (2, 34) < 1]\).

Table 8

Cortisol Sample Means and Standard Deviations for Pre and Post and Day (nmol/L)

<table>
<thead>
<tr>
<th>Group</th>
<th>Day 1 Pre</th>
<th>Day 1 Post</th>
<th>Day 2 Pre</th>
<th>Day 2 Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>3.47 (2.15)</td>
<td>3.90 (1.56)</td>
<td>3.04 (2.19)</td>
<td>3.63 (1.95)</td>
</tr>
<tr>
<td>Controlling</td>
<td>2.27 (1.07)</td>
<td>3.57 (2.41)</td>
<td>3.53 (3.30)</td>
<td>4.13 (3.21)</td>
</tr>
<tr>
<td>Neutral</td>
<td>2.88 (1.91)</td>
<td>2.72 (1.58)</td>
<td>3.39 (2.81)</td>
<td>4.00 (3.25)</td>
</tr>
</tbody>
</table>

Standard Deviations in Parentheses

Cortisol Reactivity. Cortisol Reactivity is the process of examining each participant’s cortisol release or suppression and comparing the total number of significant events found within each group between groups. Other studies (Reeve & Tseng, 2011; Van Cauter & Refetoff, 1985) give parameters for two criteria to follow in order to perform this extra analysis on the cortisol samples. The neutral group did show the lowest amount of relative response although they did have the least number of participants in their group. Tables of the relative, absolute and total criteria met by each group are shown in table 9 and 10:
Table 9

Total Number of Relative and Absolute Cortisol Responses

<table>
<thead>
<tr>
<th>Group</th>
<th>Day 1 Relative</th>
<th>Day 1 Absolute*</th>
<th>Day 2 Relative</th>
<th>Day 2 Absolute*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>6</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Controlling</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Neutral</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

*Sample met both criteria and is found to be a clear cut cortisol response or suppression

Table 10

Total Number of Relative and Absolute Cortisol Suppression

<table>
<thead>
<tr>
<th>Group</th>
<th>Day 1 Relative</th>
<th>Day 1 Absolute*</th>
<th>Day 2 Relative</th>
<th>Day 2 Absolute*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Controlling</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Neutral</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Sample met both criteria and is found to be a clear cut cortisol response or suppression

**Dependent Factor Intercorrelations**

A bivariate correlation was run as to better understand the relationships between the various significant factors involved in the study. This method of analysis helps create what the big picture effect was between learning and qualitative factors. The following factors of day 1 included in the analysis were: average performance, perceived autonomy, positive affect, negative affect, self-efficacy, and perceived pressure. Perceived pressure and negative affect were included in the analysis even though they did not display a group effect so any hidden relationships could be found despite lack of group effects. A 1-tailed analysis was used due to what is known about previous separate group effects and findings of previous research, this
analysis was able to show how the relationships the independent variable, instructional language, had on the different dependent variables.

Practice. From all the variables examined, perceived autonomy had a significant relationship with self-efficacy and near significance with performance. As shown in table 11, we can gather from questionnaire and performance data that if a participant had a high rating of autonomy they were more likely to have a better average performance and higher self-efficacy. The relationship between self-efficacy and performance is very strong and makes sense as having improved scores will yield a stronger confidence in future success. Table 6 and its corresponding analysis show how the controlling language group specifically had low ratings of perceived autonomy and self-efficacy. This gives a glimpse how controlling language in contrast to autonomy-supportive language does not improve confidence of performance while hindering performance increases. From these data we can make a general inference that people who performed well at this task had a higher sense of autonomy and increased self-efficacy. The next question is whether or not the instructional language was able to maintain these relationships from day 1 or not.
Table 11

Intercorrelations of Dependent Factors Day 1

<table>
<thead>
<tr>
<th></th>
<th>Performance</th>
<th>Pearson Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Efficacy</td>
<td></td>
<td>-.400**</td>
<td>0.008</td>
</tr>
<tr>
<td>Positive</td>
<td>-0.188</td>
<td>Sig.</td>
<td>0.137</td>
</tr>
<tr>
<td>Negative</td>
<td>0.23</td>
<td>Sig.</td>
<td>0.089</td>
</tr>
<tr>
<td>Autonomy</td>
<td>-0.273</td>
<td>Sig.</td>
<td>0.053</td>
</tr>
<tr>
<td>Pressure</td>
<td>0.077</td>
<td>Sig.</td>
<td>0.328</td>
</tr>
</tbody>
</table>

N = 36
** p = .01

Retention. For retention another intercorrelation analysis was considered between the same variables that were observed on the performance day. The strengthened relationship between average score and average perceived autonomy shows that once participants are relieved of the controlling motivation style they perform better. Without the instruction present, and as table 3 shows, the lack of control on the retention day allowed people to improve on their performance. Self-efficacy also improved its relationship with performance. This makes sense as the lack of instruction for the controlling and neutral groups allowed participants to focus on the task and thus improve their performance scores.
Table 12

Intercorrelations of Dependent Factors Day 2

<table>
<thead>
<tr>
<th></th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Efficacy</td>
<td>Pearson</td>
</tr>
<tr>
<td></td>
<td>Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td>-.642**</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Positive</td>
<td>Pearson</td>
</tr>
<tr>
<td></td>
<td>Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td>-.173</td>
</tr>
<tr>
<td></td>
<td>.153</td>
</tr>
<tr>
<td>Negative</td>
<td>Pearson</td>
</tr>
<tr>
<td></td>
<td>Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td>.226</td>
</tr>
<tr>
<td></td>
<td>.089</td>
</tr>
<tr>
<td>Autonomy</td>
<td>Pearson</td>
</tr>
<tr>
<td></td>
<td>Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td>-.485**</td>
</tr>
<tr>
<td></td>
<td>.001</td>
</tr>
<tr>
<td>Pressure</td>
<td>Pearson</td>
</tr>
<tr>
<td></td>
<td>Correlation</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td>.223</td>
</tr>
<tr>
<td></td>
<td>.092</td>
</tr>
</tbody>
</table>

N = 37

** p > 0.01

CHAPTER 5

Discussion

The purpose of the present study was to investigate if similar instructions, presented in either an autonomy-supportive, neutral or controlling language, would affect the learning of a novel motor task. The goal of the instructions were to create a sense of being in control of one’s environment (AS), having neutral control (N) or being controlled by their environment (CL). Based on previous research, if each instruction is successful at creating their different level of autonomy, participants were expected to have a corresponding cortisol releases (i.e., AS: reduced release indicating lowered stress, N: maintained release indicating no stress, and CL: increased release indicating increased stress). In addition to cortisol measurements and questionnaires were used to assess how mindset changed depending on which instruction participants were exposed to.
These other areas of measure, cortisol and questionnaire data, give an even deeper insight as to why individuals performed as they did. The questionnaire data gives significant introspection into the mindset of the participants as they are learning the task. With measures of self-efficacy, perceived autonomy, and to some extent affect we can determine what factors had the strongest influence on each group’s relative learning. Although positive affect did not have a significant correlation with performance it is still interesting to witness the change in mood depending on how instruction was given.

To delve even deeper into the influence of mindset, it was the task of this study to examine how such a way of thinking can influence one’s endocrine system via cortisol release. Cortisol testing via salivary analysis was a unique component to this study. It was of interest of researchers to determine how the HPA axis reacts to stress of instruction and thereby causes chemical reactions in the body which may then influence the learning of a novel motor task. Although we did not find any difference between groups with this factor it is still beneficial to understand the challenges of such a variable. Longer time duration between the pre and post sampling may have been the key to discovering the outcome which we hypothesized. Due to the individual variances among individuals when it comes to a stress response it would be prudent for future research to give ample time between collections. We would recommend between 25 minutes at least between sampling. To find a better understanding of how psychology and physiology influence one another, depending on environment, there must be a clear understanding of how the HPA axis works and then apply a protocol around it.

The inferences we can make as to why there was a change in performance and learning between the autonomy-supportive and controlling language groups can be found in the questionnaire data. Looking at the section of the questionnaire data concerning perceived autonomy shows the autonomy-supportive group did in fact experience a significantly higher
amount of perceived choice compared to the other groups. This is a welcome validation that the autonomy-supportive instruction really was creating its intended effect. The controlling language group experienced a mean score of 6.4 out of 10 on perceived autonomy while the autonomy supportive group had a mean score of 8.4. What was an unexpected, although not altogether surprising find, was how the neutral group had a mean score of 6.1 of perceived autonomy. Although the neutral and controlling language group had similar perception of autonomy why they experienced this may be due for different reasons. Having this in mind, it may be beneficial for future research concerning controlling and neutral motivating styles to also include perception of narrator questions, such as the Learning Climate Questionnaire used in Williams et al. (1996), along with overall perception of autonomy. This would allow a deeper look in why they experienced such autonomy or lack thereof. With this knowledge we can better understand how perception of autonomy has an effect on immediate performance changes.

The first indicator we have for how the instruction had an impact on performance is by looking at the first two practice blocks of the practice day. Looking at the initial data of the practice phase it is interesting to see that after the 1st trial block, where everyone watched the video without sound, participants seemed to experience a difference in performance once instruction is introduced. The controlling group showed no improvement relative to their initial trial, from 52 cm from the center to 53 centimeters away from center, while the autonomy-supportive group improved their performance an entire target area better, 55 centimeters to 42 centimeters. Also the neutral group also showed improved performance from blocks one to block two (from 57 to 51 cm). Why the neutral group was able to improve performance and the controlling group was not may have to do with the specific reasons why these two groups felt a lack of perceived autonomy.
Along with a higher sense of autonomy, the autonomy-supportive group also had near improved scores on the PANAS-X for positive affect on the practice day. This makes sense as previous research, (Ryan & Deci, 2000) has shown that autonomy facilitates a sense of well-being in individuals. This significance between the AS and CL group, gives a modest expectation as to which group may wish to continue the practice pitch if given the opportunity. This is important from a practicality standpoint, as the effectiveness of a practice strategy can be weighted by how effectively it gets an individual to continue practicing. PANAS did not reveal that the controlling group experienced more negative affect compared to the other groups.

Another interesting finding was the increased self-efficacy among the AS and N groups and the lack thereof for the CL group. This obviously correlates well with learning and performance. As a participant’s improves performance improves so does their confidence in their ability to perform. What this result may show is not necessarily the ability for just autonomy-support to improve self-efficacy, because the N group showed similar increases, but rather the inability of the controlling instruction to instill such confidence within its participants. Other than poor performance there could be other reasons why the CL group had lower self-efficacy as shown in other research. Normative feedback has shown to alter self-efficacy depending on group (Hutchinson, Sherman, Martinovir, & Tenenbaum, 2008). Perhaps the tone and control the CL group instruction had also had an implication that the CL group’s performance was subordinate to the norm. The instructions goal to control the participant may have left them feeling incompetent to perform the pitch at a high level, although difference in perceived competence was not present among questionnaire responses. The questionnaire could have involved a question asking each participant how they felt their performance related to the norm or satisfied they were with their performance. This perception of ability may also relate to self-efficacy as shown in Bandura and Jourden (1991). The effect still could be more
subliminal, as mentioned previously, and its effect on affect may also be the reason for altered self-efficacy. Although positive affect was not significantly different among groups, the effect was fairly dose and perhaps this altered state of positive affect between groups also influenced one’s self-evaluation and therefore self-efficacy (Stapel & Blanton, 2004).

From the initial findings of the questionnaire data there was hope that the cortisol data would also show similar results. Unfortunately, no significant difference was found between groups. Although the controlling-language group did show a slight increase in cortisol reactivity on the performance day according to Van Cauter and Refetoff (1985) the increase could not be categorized as a cortisol secretory episode. The average increase among the controlling language group was 1.3 nmol/L, an increase of 2.8 nmol/L or greater is the amount needed to classify it as a cortisol secretory episode.

The autonomy-supportive group also did not show the dampening effect on cortisol which was predicted. However, this is not due to the inability of the instruction to leave participants with a lack of autonomy, improved mood, and increased self-efficacy which was already reflected in the questionnaire data. It may be due to the increased amount of effort participants in this group exuded in order to better perform on the task. This was a risk taken when incorporating cortisol measures involved with a task concerning physical activity, as increased levels of activity can also increase cortisol. Cortisol has perhaps the most variability out of any of the other measures in this study as nearly everything can have an effect on it. Although extensive measures were taken in attempts to control each participant’s cortisol, exclusion of medication use, smoking use, alcohol and caffeine consumption, sleeping habits, and exercise and dietary control, these parameters were still at the will of the participant and how strictly they withheld this regimen. Without being able to track all of their activities 24 hours prior to each appointment it is impossible to tell if the variability was due to the study
manipulation or some other confounding variable listed prior. However, investigating the biochemistry of motor learning, especially cortisol with all of its negative side effects when under chronic exposure, is still a valid pursuit and should be continued to be pursued. Doing thus would present a better grasp of what is happening in the domain of the psychological, physiological, and chemical mechanisms of motor learning.

Looking at the intercorrelations of the dependent variables the evidence shows that perception of autonomy and self-efficacy when learning a novel task can be a valuable component to consider since it has significant relationship with performance. Although these relationships do not imply any cause or effect between these various variables, understanding how little overall instruction was given, we can gain insight into what role an environment of control or autonomy plays in learning. In reality the autonomy-supportive video did not give any explicit choice, nor did the controlling video involve other instruction which can increase the level of control. Each video consisted of approx. 120 words and was only 38 seconds long, yet the nuances between each instruction shaped a different experience for each group.

As previous studies have shown (e.g., Reeve & Tseng, 2011; Ross 2006; Wulf, Raupach, & Pfeiffer, 2005) whether it is human or animal data, we find that lack of autonomy or choice manipulates stress levels, learning, and well-being. The human body interprets physiological and psychological stress the same way. The body and brain work together to release cortisol into the system via the hypothalamic, pituitary, adrenal axis (HPA) (Kirschbaum & Hellhammer, 1989; Tsutsumi, Goto, & Kita 1977). We have seen from these studies that a lack of autonomy increases salivary cortisol and autonomy-support actually drops resting levels. However, as this study has shown there may not need to be a significant change in cortisol for there to be a detriment or improvement in learning. This may point to how the sensitivity of motor skill
learning may be more refined than previously understood, especially when viewed from a neurochemical perspective.

Since learning of this skill cannot be linked to a neurochemical one, another factor to consider as to why an autonomy-supportive context is more beneficial than controlling language is because of the number of instructions a participant must attend to when performing the task. Perhaps why an individual has such trouble learning a novel skill is because of the number of superfluous rules he/she must pay attention too. This may flood the working memory causing the participant to have to juggle too many variables and thus causing him/her to neglect giving the optimal amount of focus on learning the task. To draw a comparison between the two groups, the autonomy-supportive group had very little exact instruction to follow. They were given many recommendations with in their instruction and therefore had much more free will to perform the task compared to the controlling-language group which is reflected in the questionnaire data as perceived autonomy was significantly higher. The controlling group was told in their instruction to remember many key rules that really didn’t have anything to do with how they performed the pitch. They were told how to keep the tennis balls in order, when exactly they should begin, and pacing of their pitching. Additionally, they were also told precisely how to throw and what to focus on, shoulder angle and external focus. Having to keep all of these things in mind may have overwhelmed the capacity of their information-processing for the task and therefore increased the difficulty of learning. This may make the participant more self-conscious of their performance and therefore less automatic in their movements and more unlikely to retain the movement pattern of the cricket pitch. This idea falls under previous studies focusing on hindering the self-esteem of participants as well as others making individuals more self-conscious of their performance (Carver & Scheier, 1978; Wulf, Chviacowsky, & Lewthwaite, 2010).
Future Areas of Study

There has been debate between whether these corticosteroids are actually beneficial for learning or not in animal studies (De Kloet, Oitzl, & Joëls, 1999), but many have concluded that the context which the learning task is presented in is what will strengthen the synaptic pathways for better consolidation and retention of a novel task. This experiment aimed at manipulating such a context for learning via autonomy. By invoking a sense of being controlled or having a sense of autonomy we are attempting at disrupting homeostasis of the brain to either drive learning or hinder it. There is much interaction between cortisol and the hippocampus, an area of the brain largely responsible for memory and also has an assodation with other memory related structures. The context a task is taught can trigger different receptors in the hippocampus which act as either a learning boost or blunder. In summary, there still needs to be more work done in human subjects to understand specifically how the chemical receptors in the brain create different learning pathways based on the context of the learning environment. This may explain how the autonomy group showed a trend of improved learning compared to the controlling group even though cortisol was relatively maintained during the practice phase. As shown in mice studies, context changes learning strategies and ultimately alters the consolidation of the skill and thus making it hard to retain and therefore recall (ter Horst, van der Mark, Arp, Berger, de Kloet, & Oitzl, 2012).

In summary, within the realm of motor learning there should be strides taken to better understand why it is we learn the way we do and not just how. As researchers we must evolve and adopt a new perspective to our discipline. With the advances in technology within the realm of neuroscience and neurochemistry there is a whole new realm to motor learning which has large potential of broadening our understanding of learning. This experiment was such an
attempt, although it did not fulfill its intended purpose we hope others can look at these methods and be better prepared with what challenges lay ahead.
APPENDIX 1

Autonomy Survey

Instructions: Please rate the activity you worked on in today’s session.

1. I enjoyed this activity very much.
   1 2 3 4 5 6 7 8 9 10
   No Enjoyment
   Enjoyable

2. Working on the activity was fun.
   1 2 3 4 5 6 7 8 9 10
   Not Fun
   Very Fun

3. I would describe this activity as very interesting.
   1 2 3 4 5 6 7 8 9 10
   Not Interesting
   Very Interesting

4. This activity did not hold my attention.
   1 2 3 4 5 6 7 8 9 10
   Not Attentive
   Very Attentive

5. I found the activity very boring.
   1 2 3 4 5 6 7 8 9 10
   Not Boring
   Very Boring

6. I found working on this activity very stimulating.
   1 2 3 4 5 6 7 8 9 10
   Not Stimulating
   Very Stimulating

7. While performing the pitch today, I felt capable.
   1 2 3 4 5 6 7 8 9 10
   Not Capable
   Very Capable

8. While performing the pitch today, I felt competent.
   1 2 3 4 5 6 7 8 9 10
   Not Competent
   Very Competent

9. While performing the pitch today, I felt I was improving with practice.
   1 2 3 4 5 6 7 8 9 10
   No Improvement
   Much Improvement

10. I believe I had a choice over which way to pitch to try to learn as I practiced.
    1 2 3 4 5 6 7 8 9 10
    No Choice
    A Lot of Choice
**Instructions**: Please complete the following ratings according to how you feel right now, at the present time.

11. I felt as if it was my own choice how to pitch on each trial.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Choice</td>
<td>A Lot of Choice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

12. I felt that I had control to decide how to perform the pitch.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Choice</td>
<td>A Lot of Choice</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13. During this experiment today, I felt pressured to learn the pitch.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Pressure</td>
<td>Very Pressured</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14a. I am confident that I can achieve a score of 300 on this task (Perfect Score).

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not confident at all</td>
<td>Extremely confident</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14b. I am confident that I can achieve a score of 200 on the task.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not confident at all</td>
<td>Extremely confident</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14c. I am confident that I can achieve a score of 100 on this task.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not confident at all</td>
<td>Extremely confident</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15. How motivated were you to learn this task?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Very motivated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The scale below consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at the present moment. Please fill out EACH feeling with a 1 to 5 rating.
## APPENDIX 2.

Questionnaire Means from Performance and Retention

<table>
<thead>
<tr>
<th>Questions</th>
<th>Autonomy Supportive</th>
<th>Controlling Language</th>
<th>Neutral Language</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 1</td>
<td>Day 2</td>
<td>Day 1</td>
</tr>
<tr>
<td><strong>Intrinsic Motivation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoyed this activity very much.</td>
<td>7.9</td>
<td>7.6</td>
<td>7.9</td>
</tr>
<tr>
<td>Working on this activity was fun.</td>
<td>8.2</td>
<td>7.7</td>
<td>8.1</td>
</tr>
<tr>
<td>I would describe this activity as very interesting.</td>
<td>7.9</td>
<td>7.3</td>
<td>7.8</td>
</tr>
<tr>
<td>This activity did not hold my attention.</td>
<td>7.6</td>
<td>7.3</td>
<td>7.8</td>
</tr>
<tr>
<td>I found this activity boring.</td>
<td>1.8</td>
<td>2.7</td>
<td>2.1</td>
</tr>
<tr>
<td>I found working on this activity very stimulating.</td>
<td>6.6</td>
<td>7</td>
<td>7.6</td>
</tr>
<tr>
<td>How motivated were you to learn this task?</td>
<td>8.3</td>
<td>8</td>
<td>8.1</td>
</tr>
<tr>
<td><strong>Perceived Competence</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>While performing the pitch today, I felt capable.</td>
<td>7</td>
<td>7.2</td>
<td>6.8</td>
</tr>
<tr>
<td>While performing the pitch today, I felt competent.</td>
<td>6.8</td>
<td>7</td>
<td>6.7</td>
</tr>
<tr>
<td>While performing the pitch today, I felt I was improving with practice.</td>
<td>7.4</td>
<td>7.7</td>
<td>8</td>
</tr>
<tr>
<td><strong>Perceived Autonomy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I believe I had a choice over which way to pitch to try to learn as I practiced.</td>
<td>8.5</td>
<td>8.8</td>
<td>6.9</td>
</tr>
<tr>
<td>I felt as if it was my own choice how to pitch on each trial.</td>
<td>9.1</td>
<td>8.6</td>
<td>6</td>
</tr>
<tr>
<td>I felt I had control to decide how to perform the pitch.</td>
<td>8.7</td>
<td>8.8</td>
<td>6.3</td>
</tr>
<tr>
<td><strong>Perceived Stress</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During this experiment today, I felt pressured to learn the pitch.</td>
<td>3.6</td>
<td>3.2</td>
<td>5</td>
</tr>
<tr>
<td><strong>Self-Efficacy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am confident I can achieve a score of 300</td>
<td>5.5</td>
<td>5.1</td>
<td>3.7</td>
</tr>
<tr>
<td>I am confident I can achieve a score of 200</td>
<td>7</td>
<td>7</td>
<td>5.6</td>
</tr>
<tr>
<td>I am confident I can achieve a score of 100</td>
<td>9.1</td>
<td>9.7</td>
<td>8.3</td>
</tr>
</tbody>
</table>
Biomedical IRB – Expedited Review

Approval Notice

NOTICE TO ALL RESEARCHERS:
Please be aware that a protocol violation (e.g., failure to submit a modification for any change) of an IRB approved protocol may result in mandatory remedial education, additional audits, re-consenting subjects, researcher probation, suspension of any research protocol at issue, suspension of additional existing research protocols, invalidation of all research conducted under the research protocol at issue, and further appropriate consequences as determined by the IRB and the Institutional Officer.

This memorandum is notification that the project referenced above has been reviewed and approved by the UNLV Biomedical Institutional Review Board (IRB) as indicated in Federal regulatory statutes 45 CFR 46 and UNLV Human Research Policies and Procedures.

The protocol is approved for a period of one year and expires March 15, 2013. If the above-referenced project has not been completed by this date you must request renewal by submitting a Continuing Review Request form 30 days before the expiration date.

PLEASE NOTE:
Upon approval, the research team is responsible for conducting the research as stated in the protocol most recently reviewed and approved by the IRB, which shall include using the most recently submitted Informed Consent/Assent forms and recruitment materials. The official versions of these forms are indicated by footer which contains approval and expiration dates.

Should there be any change to the protocol, it will be necessary to submit a Modification Form through ORI - Human Subjects. No changes may be made to the existing protocol until modifications have been approved by the IRB. Modified versions of protocol materials must be used upon review and approval. Unanticipated problems, deviations to protocols, and adverse events must be reported to the ORI – HS within 10 days of occurrence.

If you have questions or require any assistance, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 895-2794.
INFORMED CONSENT
Department of Kinesiology and Nutrition Sciences

TITLE OF STUDY: Effects on instructions on motor learning
INVESTIGATOR(S): Gabriele Wulf, Ph.D. and Andrew Hooyman
CONTACT PHONE NUMBER: 702-895-0938 (Wulf)

Purpose of the Study
You are invited to participate in a research study. The purpose of this study is to analyze the technique of the cricket pitch.

Participants
You are being asked to participate in the study because you are between the ages of 18 and 45, you are healthy, and you have good visual acuity or corrected vision. Further, you have no experience playing or have ever performed a cricket pitch and are currently on no medication.

Procedure
If you volunteer to participate in this study, you will be asked to do the following: First, there will be a 10 minute rest period before the experiment starts. Then you will be asked to give a saliva sample and then view an instructional video on the cricket pitch. You will then perform 10 pitches to a target approximately 10 meters away. After these first 10 pitches you will watch the instructional video again and then perform another 10 pitches at the same distance. This process will continue until the completion of 60 pitches. After the pitches you will give another saliva sample and then fill out a questionnaire. This will be the first of two days of testing. 48 to 72 hours after you have completed day 1 you will return for day 2. At the start of day 2 a saliva sample will be taken and you will perform another 20 pitches. No instructional video will be used. Once all 20 pitches are completed we will collect a final saliva sample and you will be asked to fill out another questionnaire.

Benefits of Participation
There may not be direct benefits to you as a participant in this study. However, we hope to learn more about how instructional video can help learning of a novel sport skill.

Risks of Participation
There are risks involved in all research studies. This study may include only minimal risks. You may experience delayed-onset muscle soreness a day or two after the experiment.

Participant Initials _____

Approved by the UNLV IRB. Protocol 1202-4070M
Received: 03-16-12 Approved: 03-16-12 Expiration: 03-15-13
TITLE OF THE STUDY: Effects of instructions on motor learning

Cost / Compensation
There will not be financial cost to you to participate in this study. You will be granted extra credit in your undergraduate class if you complete ALL testing days. If you do not complete each day of testing then no extra credit will be rewarded. However, you may be given the option of completing another project for extra credit instead (e.g., writing a short paper related to a topic discussed in class) The study will take 90 minutes of your time (60 minutes on day 1 and 30 minutes on day 2).

Contact Information
If you have any questions or concerns about the study, you may contact Dr. Gabriele Wulf at 702-895-0938 (or gabriele.wulf@unlv.edu). For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted you may contact the UNLV The Office of Research Integrity - Human Subjects at 702-895-2794.

Voluntary Participation
Your participation in this study is voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with the university.
You are encouraged to ask questions about this study at the beginning or any time during the research study.

Confidentiality
All information gathered in this study will be kept completely confidential. No reference will be made in written or oral materials that could link you to this study. All records will be stored in a locked facility at UNLV for 3 years after completion of the study. After the storage time the information gathered will be destroyed.

Participant Consent:
I have read the above information and agree to participate in this study. I am at least 18 years of age.
A copy of this form has been given to me.

____________________________________   __________________
Signature of Participant   Date

____________________________________
Participant Name (Please Print)

Participant note:                       Participant Initials _____

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VITA

Graduate College
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Andrew Hooyman

Degrees:
Bachelor of Science, Kinesiology, 2010
University of Nevada, Las Vegas

Thesis Title: Effects of Controlling versus Autonomy-Supportive Language on Learning a Novel Skill and Cortisol Release

Thesis Examination Committee:
Chairperson, Dr. Gabriele Wulf, Ph. D.
Committee Member, Dr. Richard Tandy, Ph. D.
Committee Member, Dr. Antonio Santo, Ph. D.
Graduate Faculty Representative, Dr. Joel Snyder, Ph. D.