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The Relationship between the Distance of an External Focus of Attention and Lower Body Power in Rugby Athletes

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THE RELATIONSHIP BETWEEN THE DISTANCE OF AN EXTERNAL FOCUS OF ATTENTION AND LOWER BODY POWER IN RUGBY ATHLETES

A Thesis

by

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ABSTRACT

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The purpose of this investigation is to examine the relationship between the distance effect on power output during countermovement jumps in Rugby athletes. Hypothesis Testing was conducted utilizing a Repeated Measures Analysis of Variance (RM ANOVA) at a .05 significance level. A Pairwise comparison was conducted to determine if one variable had a greater amount of quantitative property. Statistical insignificance was determined after all data was analyzed Results were unable to show a positive relationship between the distance of an external focus of attention and lower body power output in rugby athletes.

Key Words: Distance Effect, Attentional Focus, Power Output, Rugby

DEDICATION

I would like to dedicate my work to my son for whom I love very much. May you learn and grow from those that have come before you. No matter the challenges you are neither defined by your failures nor by your accomplishments, simply by the impression you made on the world.

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CHAPTER I

INTRODUCTION

Motor Skill learning is fundamental to performance athletics. Whether it is applied in a clinical environment or on the field of play, the question how do we improve athletic performance, has intrigued scientists for years. Adopting an external focus of attention has been well supported in current literature, many agree (Lohse, Wulf, & ITE, 2012; Marchant, 2011; Wulf, 2013; Wulf, Höß, & Prinz, 1998; Wulf & Lewthwaite, 2010), an external focus of attention improves motor skill learning and performance in various sporting events. Theoretically grounded in the Constrained Action Hypothesis, which postulates an internal focus of attention constrains the motor pathways as a result of conscious thought, thus disrupting the autonomic motor control processing centers. Attentional focus has traditionally been categorized as either *associative*, where an athlete is focused on their own body, or *dissociative*, where an athlete blocks out external sensation resulting from physical effort (Weinberg, Smith, Jackson, & Gould, 1984) or in terms of width, being a broad or narrow; and direction, either internal or external (Moran, 2016; Nideffer, 1976). Based on the Constrained Action Hypothesis, neuromuscular expression of force and velocity are inhibited under an internal focus of attention thus resulting in an overall decrease in power output.

An external focus of attention has been shown to benefit athletic elements specifically within the execution of the countermovement jump (CMJ) test (Winkelman, 2018; Wulf, 2013). While the literature about an external focus of attention is well supported, there remains a gap about what is termed, the distance effect (Wulf, 2013). The distance effect is defined as the distance of markers from the starting point to the point of completion. Essentially, it is the target of focus in a given activity. This effect has led researchers to argue the further the target of focus (external focus) the more significant the advantage, as it further separates the individual's thoughts of their body movement (internal focus) (McNevin, Shea, & Wulf, 2003). Better understanding of this effect may further contribute to the current body of knowledge.

Statement of the Problem

Human performance is a multidiscipline collection of scientific theories. Within the constructs of athletic competition, three main areas command the attention of the scientific community: Sport psychology, physiology, and motor learning disciplines. Most commonly associated with sport psychology and motor learning, attentional focus transcends the scientific landscape across both disciplines. The bridge between these elements is the pedagogical construct, or more simply stated, how we coach as opposed to what we coach. Coaching, by its sheer nature is that of a teacher, educator, and instructor of athletic technique shown specifically to enhance sport performance (Benz, Winkelman, Porter, & Nimphius, 2016; Makaruk & Porter, 2014). As such, a certain amount of scientific understanding regarding motor learning is necessary in coaching. After all, the act of learning a motor skill is the foundation to performance regardless of the sport. How athletes think, and feel are vital elements to the execution of physical movement within a sport.

Purpose of the Study

The purpose of this investigation was to examine the distance, relative to the instructional cue (i.e. a high condition of 12ft compared to a low condition of 8 ft) and if they differ in measurement as they relate to their effect on lower body power output in Rugby athletes.

Need for the Study

With adequate scholarly works within the area of attentional focus, specifically an external focus of attention, the application of coaching cues requires additional consideration with respect to the distance of an external cue relative to the body.

Research Question

How does the distance, relative to the instructional cue (i.e. a high condition of 12ft compared to a low condition of 8 ft) differ in measurement as they relate to their effect on lower body power output in Rugby athletes?

Definition of Terms

Within the construct of attention exists attentional focus. This type of focus is defined as directing attention to specific characteristics of an activity or environment (J. M. Porter, W. F. W. Wu, R. M. Crossley, S. W. Knopp, & O. C. Campbell, 2015). Attentional focus differs from attention in that it specifically references the direction in which your attention is targeted. Internal and external focus refer to the relationship between a point of reference identified in a verbal cue and an individual's body position relative to that cue.

Research Hypothesis

Both high (12 ft) and low (8 ft) conditions will be significantly different from the control jump with the high conditioning being greater than the low condition in terms of peak power and peak velocity.

Assumptions

It was assumed that the participants comply with the investigator's request and that participants understand and follow the instructions and necessary requirements. It was also assumed that participants would answer and respond truthfully to any qualifying questionnaires. The instrumentation used in this investigation be valid and reliable.

Limitations and Delimitations

Limitations of this investigation included a clear lack of adequate jump technique on the part of the participants. As a result, there was a degradation in overall jump performance and variations in technique. A statistical power analysis indicated an N of 22 and although met with a population N of 26 this is still a relatively small sample size.

Variables

The dependent variables in this investigation included peak power (w) and peak velocity (m/s). The independent variables were the high condition (12 ft overhead marker) and low condition (8 ft overhead marker).

CHAPTER II

REVIEW OF LITERATURE

The subsequent information entails a literature review of attentional focus as it relates to the production of lower body power output within the sport of Rugby. Specifically, the relationship of an external cue relative to an individual athlete's personal target of reference point, known as the distance effect and their ability to produce power as a result. The purpose of the following review is to discuss the currently established theoretical construct of attention in order to obtain a better understanding about this finite element of distance within an already well understood body of knowledge. The following review will include the historical foundation of attention, information processing, dimensions of attention, the effects of verbal instruction on performance, the effects of an external focus of attention on power output and conclude with a look at the current understanding of the distance effect.

Historical Foundation

The historical accounts of this specific line of research have spanned 159 years, first established as the concept of consciousness as it applies to human performance. William Wundt, generally considered the father of experimental psychology, described in 1859 a person's conscience as a series of fragmented elements that could be combined to influence behavior (Hall et al., 1921). Wundt's influence into psychology was the experimental dimension of conducting exploration under controlled settings. Researchers of the time went on to investigate the interdependence of conscious thought. According to Sir William Hamilton, "*There is no* *cognition, no feeling, and no conation, of which we are not conscious, and whenever we are conscious, it is always of a cognition, a feelings, and conations relative to the conscious mind, we call them states of consciousness: when we wish to treat them each for itself, we call the cognitions, or rather concentrated consciousness"* (Monck, 1881). The modern theoretical construct of attention was first termed concentration in the late 19th century with the work of Sir William Hamilton and subsequent work of the William James (1890) offering one of the earliest definitions of attention, describing it as focalization, concentration, and consciousness. Some of the earliest research by Jacques Loeb in 1890 showed that maximum amount of pressure exerted on a hand dynamometer decreases during cognitive activity (Hackenberg, 1995). Solomons and Stein (1896) supported these findings in their work classifying a loss of attention as a "disease of the attention." As to imply attention is a disorder of one's structure or function, a common reference in the case of disease. Essentially explaining the loss of attention as paralysis or an inability to attend to sensations. Interestingly, (Titchener, 1908) noted *"... the doctrine of attention is the nerve of the whole psychological system, and that as men judge of it, so shall they be judged before the general tribunal of psychology [p 173]."* Prior to the 1950's and starting after Titchener's (1908) assertion that "attention is the nerve of the whole psychological system," attention was quite unpopular within the scientific community, as it was only applied to those interested in describing behavior and less interested in developing theories. It was not until the practical requirements of human performance became a necessity as the second world war came to a head.

Information Processing

The need to understand human performance yielded an interest in the manner in which humans process information. Specifically, how an individual could rapidly select and process multiple skills at a time while filtering out relevant information from the environment, followed by a prolonged focus of long periods of time. Information processing was originally explained as filter theory, a process in which a person could process information in a serial fashion and as such be restrained by an eventual limitation or “bottle neck” as the amount of information increased. This idea was debated for a number of years. An alternative viewpoint to the filter theory is the central resource capacity theories. According to the central resource capacity theories a person’s attention is dependent on a single source of available processing space in which all activity information competes.

Originally defined as focalization, concentration, and consciousness, attention as a resource has evolved to include a myriad of theoretical constructs, offering a formattable understanding of the science. Most notable, the work of Daniel Kahneman's Attentional Theory expanded on the Central Resource Theory which postulates attention as a central resource in which all activities compete for their share of dedicated resources. Kahneman proposed attention as a cognitive effort related to the mental resources required to execute specific actions (Kahneman, 1973). He further outlined attention by four main attributes, to include: (1) Attention is limited, but the limit is variable from moment to moment. Physiological indices of arousal provide a measure that is correlated to the momentary limit. (2) The amount of attention or effort exerted at any time depends primarily on the demands of current activities. While the investment of attention increases with demands, the increase is typically insufficient to fully compensate for the effects of increased task complexity. (3) Attention is divisible. The allocation of attention is a matter of degree. At high levels of task load, however, attention becomes more nearly unitary. (4) Attention is selective, or controllable. It can be allocated to facilitate the processing of selected perceptual units or the execution of selected units of performance. The policy of allocation reflects permanent dispositions and temporary intentions.

Based on this central pool of resources, also referred to as available capacity, emerged the Flexible Central Capacity Theory, further detailing the fluidity of one's attention relative to the situation or task. This central pool of available resources is affected by an individual's level of arousal, defined as the general state of excitability of a person, reflected in the activation levels of the person's psychological, physiological, and attentional demands. Represented in Kahneman's model as the evaluation of demands on the capacity we can appreciate that different tasks require a different amount of attention.

Interestingly this evaluation happens before we even engage in an action. Three general rules apply in such cases. First, we dedicate the attentional demands to complete the task. Second, we commit attentional demands based on our enduring disposition or our involuntary attractions which state we are naturally drawn by what is meaningful to us. Finally, we dedicate attentional demands based on the novelty of the stimulus. This focus of attention refers to our momentary intentions in which, either auditory or visually, a person commits attentional demands based on instruction provided regarding the details of how and where to focus his or her attentional resources.

Kahneman (1973) notes a specific relationship between effort and arousal within the parameters of attention. He associated attention with effort, and selective attention as the selective allocation of effort to some mental activities in preference to others. Because of the connection between effort and arousal, physiological measures of arousal can be used to measure the exertion of effort. He goes on to identify types of information-processing activities and how they can be triggered solely by an input of information. Kahneman (1973) believed the total quantity of effort exerted at any-one time is limited, concurrent activities which require attention tend to interfere with one another. Momentary effort task demands must be distinguished from the total amount of work that is required to complete that task. Momentary effort exerted in running the 60-yard dash is greater than the effort exerted in walking two miles at a comfortable pace, although the total expenditure of energy is surely greater in the second task. In the terms of this analogy, much of our life appears to be carried out at the pace of a very sedate walk. When one reads a book or listens to a lecture, for example, effort is minimal because the material is not actively rehearsed, and because the redundancy of the message reduces any sense of time-pressure. Severe time-pressure may arise in any task which imposes a significant load on short-term memory, because the subject's rate of activity must be paced by the rate of decay of the stored elements. Time-Pressure thus affects momentary effort the most.

Mutual interference between concurrent tasks is sometimes explained in structural terms, on the assumption that the competing tasks simultaneously elicit incompatible responses or impose simultaneous demands on specific perceptual or motor mechanisms. The concepts of capacity and of structure are both needed to explain the phenomena of interference.

Capacity includes two predictions concerning interference between concurrent activities: (1) interference will arise even when the two activities do not share any mechanisms of either perception or response; (2) the extent of interference will depend in part on the load which each of the activities imposes. An example of this is walking and performing complex mathematics in your head. The likelihood of one stopping is high due to the fact that mathematics requires (for the most part) more attention than walking. A second example may be in the case of a person who would use pacing up and down a hall way to slowdown the processing of information, thus giving them a “slow down effect”.

The assumptions of single-channel theory are much more precise and restrictive than those of a limited capacity model which permits parallel processing. In particular, single-channel theory yields precise predictions for the refractoriness paradigm. Trumbo, Noble, and Swink (1967) found that tracking performance was disrupted equally by tasks of different difficulty, thus supporting the single-channel theory. The following two activities, for example, interfered equally with tracking: a complex learning task, in which the subject serially anticipated member in a series of stochastically dependent numbers; and an apparently much simpler task, in which the subject emitted a series of freely selected numbers.

The capacity model assumed that the limit varies with the level of arousal: more capacity is available when arousal is moderately high than when arousal is low. Finally, it assumed that momentary capacity, attention, or effort (the three terms are interchangeable in this context) is controlled by feedback from the execution of ongoing activities.

Researches who set out to support this model performed an easy and a relatively difficult task separately, under varying conditions of monetary incentive and risk. They reported marginal effect on this manifestation of arousal in the easy task condition, and no effect whatever in the more difficult task. The major determinant of arousal was the difficulty of the task (Kahneman, Peavler, & Onuska, 1968). It is important to note the concept that interference occurs only when a limited capacity is exceeded. This seems to exist as capacity appears to be variable, as well as when interference arises even among fairly undemanding tasks. The effort demands of tasks do not always correspond to intuitive notions of task difficulty. For example, subvocal rehearsal, the choice and execution of free responses, and tests of recall on familiar material appear to require considerable effort, although they would be categorized as simple.

The Yerkes ’Dodson Law states that the quality of performance on any task is an inverted U-shaped function of arousal, and that the range over which performance improves with increasing arousal varies with task complexity.

When arousal is low, selectivity is also low, and irrelevant cues are accepted uncritically. When arousal increases, selectivity increases as well, thus improving performance as irrelevant cues are more likely to be rejected. With further increases of arousal, however, the continuing restriction of the range of usable cues eventually causes relevant cues to be ignored, and performance deteriorates again, in accordance with the Yerkes-Dodson law. Easterbrook (1959) explains both the decrement of task performance with increasing arousal, and the observation that this decrement occurs sooner in complex tasks than in simple ones. He proposed that an increase of arousal causes a restriction of the range of cues that the organism uses in the guidance of action. This hypothesis draws on the Yerkes-Dodson law by considering a task which requires the simultaneous processing of a certain number of cues. When arousal is low, selectivity is also low, and irrelevant cues are accepted uncritically. When arousal increases, selectivity increases also increases, and performance improves because irrelevant cues are more likely to be rejected. With further increases of arousal, however, the continuing restriction of the range of usable cues eventually causes relevant cues to be ignored, and an associated performance degradation. With the additional assumption that the range of necessary cues is narrower for simple than for complex tasks, this argument implies that the optimal level of arousal should be relatively high in simple tasks. It also implies that chronically over-aroused individuals should perform poorly in complex tasks and relatively better in simple tasks. There is considerable evidence that both conclusions are valid, however and thus illustrate the need for further research in the area of attention.

The allocation of capacity appears to change systematically when arousal is high, and this change causes a decrement in the performance of certain tasks. Consequently, (1) performance is in tasks that require either the deployment of attention over a broad range of information-processing activities, such as in the case of the running a race with a large audience. The task requires a much broader skill set then for example the second case where (2) the control of selection by fine discriminations is applied as in the case of a police officer determining the precise target to engage while crowd control is in effect.

The pattern of physiological responses which is elicited by novel stimuli is variously named the orientation reaction, response, or reflex (OR) states of high arousal, such as pain or fear, share several components: EEG desynchronization (alpha blocking) and manifestations of sympathetic dominance, including the galvanic skin response and the dilation of the pupil.
Sokolov (1963) distinguished the orientation reaction to novel stimuli from the defensive reaction to aversive and painful stimuli. The arousal pattern is commonly identified with a defensive reaction. The most important difference between orientation and defense is that the OR is characterized by vasoconstriction in the limbs and vasodilation in the head, while the defensive reaction includes generalized vasoconstriction.

Dimensions of Attention

Within the construct of attention exists attentional focus which is defined as directing attention to specific characteristics of an activity or environment (Jared M. Porter et al., 2015). Consider attentional focus regarding width and breadth relative to the environment and direction relative to an internal or external perspective of cues offered to the individual during problem-solving activities. Dr. Robert Nideffer (1976) first stated that principles of attentional control training (ACT) are based on the general outline of attentional and interpersonal style. These principles outline an athlete's need to engage in four different attentional styles while maintaining the capability to transition from broad to narrow and internal to external.

Nideffer, Sagal, Lowry, and Bond (2001) were instrumental in The Elite Athletic Development Project established by the US Olympic community attempted to organize professionals from the fields of biomechanics, exercise physiology, and sport psychology into an Olympic preparation program. The data they collected paved the way in identifying the most effective elements within an athlete's arsenal, most notably the factors that affect an athlete’s concentration. They found this to be unique to high-level athletes as opposed to lower level athletes. As a result, the psychological implications of athletic performance proved to be of great value. These various performance disciplines are once again transitioning into a unified team of interdependent specialties operating under a single performance model. Referred to as The Integrated Performance Model, we can appreciate how the mental skills associated with attentional focus affect the physical performance of an athlete in competition. How the athlete performs in one aspect of training may directly affects their performance in another. An athlete's ability to cultivate their cognitive skills affects their ability to control their overall effectiveness in either environment. It is, therefore, reasonable to consider the integration of these various performance disciplines in the long-term development of athletes.

Nideffer et al. (2001) attempts to outline the psychological profile of Olympic level athletes concluding that athletes who won multiple Olympic medals had higher levels of focus than those who only won one. This speaks to the importance of attentional focus where a split second can be the deciding factor at this level of competition. Further elements emerged from this investigation as they showed the importance of balance within an athlete's attentional limits, identifying their ideal level of focus. Finally, they reported the willingness to sacrifice time and personal relationships with an increase in age and performance levels. They reported an increase in introversion and decrease in extroversion within athletes with increased age as the cause of this finding.

Attentional focus has received considerable research interest from sport psychologists, most notably in recent years with three main aspects of attention; alertness, limited capacity or resource, and selectivity (Howland, 2007). Attentional focus as defined by Porter et al. is an altering of one's attention towards a specific element within their environment (J. M. Porter, W. F. Wu, R. M. Crossley, S. W. Knopp, & O. C. Campbell, 2015). Nideffer (1976) stated that principles of attentional control training (ACT) are based on the general outline of attentional and interpersonal style. These principles outline an athlete's need to engage in four different attentional styles while maintaining the capability to transition between broad to narrow (attentional breadth) and internal to external (attentional direction). An athlete's transitions between attentional styles are predicated on the ever-changing situations within the competitive environment.

Many misunderstand the separation between arousal and other psychological terms such as anxiety. These terms relate to the overall construct of the psychological implications of sports performance, ultimately leading to a generalization of the concepts (Zaichkowsky & Naylor, 2004). Although many of these terms are similar in general conversation, they are not the same concerning the central and autonomic nervous system. Arousal is defined as the level of behavioral intensity, used interchangeably with activation. Anxiety, on the other hand, is an emotional state characterized by unpleasant feelings of intensity and apprehension (Williams, 2006). It is important to note that arousal is a key element in an athlete's ability to focus as supported in the Inverted-U Hypothesis mentioned earlier. Characterized by a continuum from less alertness to more alertness the inverted-U hypothesis suggests an optimal state of arousal is balanced within the middle of the inverted U as the name implies. As a result, an athlete's state of arousal is an essential element in achieving their ideal psychoemotional state. The Individual Zone of Optimal Function Model represents an athlete's point of optimal arousal, attributed to their cognitive, emotional, and physiological levels of arousal at a specific point in time (Kamata, Tenenbaum, & Hanin, 2002). As arousal moves out of the moderate range athletes are more likely to revert to their dominant attentional style. It is when arousal increases above the optimal levels an involuntary narrowing occurs and an athlete shifts to an internally focused style (Williams, 2006). As stated in the literature, the ability to direct attention externally enhances performance (Benz, Winkelman, Porter, & Nimphius, 2016; Makaruk & Porter, 2014; Perkins-

Ceccato, Passmore, & Lee, 2003; J. Porter, Nolan, Ostrowski, & Wulf, 2010; Jared M Porter et al., 2015). Further, the more novice the athletic skill level results in more significant effects on an internal direction of attentional focus (Perkins-Ceccato et al., 2003). Attention plays an enormous role in the overall construct of mental skill development. Moreover, its effect on sports performance and skill acquisition is also multifactorial (Howland, 2007). Abernethy and Russell (1987) explained this idea of experience based attentional direction. They concluded that experts were better able to anticipate body positions as a result of exposure to those movement patterns and therefore were less focused on their internal mechanics.

This overall body of knowledge can be traced back to the Test of Attentional and Interpersonal Style (TAIS). Described as a means to obtain a baseline for one's attentional style, the 144-question test includes seventeen subscales of which six define the individual differences within attentional styles (Nideffer, 1976). Three of these scales measure an effective attentional style (see Table 1): *broad external attentional focus* (BET), broad internal attentional focus (BIT) and *narrow attentional focus* (NAR). The remaining three subscales measure ineffective attentional styles (see Table 1): *overloaded external focus* (OET), *overloaded internal focus* (OIT) and *reduced attentional focus* (RED). Through the use of the TAIS Scale, sport psychologists have demonstrated cognitive strategies affect performance, and attentional focus can be altered through specific training protocols (Ziegler, 1994). The ability to transition between attentional width and direction as situational requirements change in sport demonstrate the application within a sport. The athletic skills required for competition have their notable intricacies and depth of knowledge.

More recently, attentional focus research has targeted the efficiency and effectiveness of motor learning and the associated learning process. Since first investigated, the benefits of an external focus of attention in athletic performance have been demonstrated in numerous investigations (Lohse et al., 2012; Marchant, 2011; Wulf, 2007; Wulf & Lewthwaite, 2010). William James (1890) may have been the first to argue that directing attention to the "remote effects" would lead to better performance than attention to the "close effects." Interestingly this line of research has seemed to have come full circle with the work of Wolfgang Prinz (1997) introducing the Action Effect Hypothesis. It states actions are best planned and controlled by their intended effects. In other words, actions are best performed when considering the outcome vice, the action.

The Constrained Action Hypothesis postulates an internal focus of attention constrains the motor pathways as a result of conscious thought, thus disrupting the autonomic motor control processing centers. Attentional focus has traditionally been categorized as either *associative*, where an athlete is focused on their own body, or *dissociative*, where an athlete blocks out external sensation resulting from physical effort (Weinberg et al., 1984) or in terms of width, being a broad or narrow; and direction, either internal or external (Moran, 2016; Nideffer, 1976).

Based on the Constrained Action Hypothesis, neuromuscular expression of force and velocity expressed as power are inhibited under an internal focus of attention. An external focus of attention has been shown to benefit athletic performance, specifically within the execution of the countermovement jump (CMJ) test (Nicklaas, 2018; Winkelman, 2018; Wulf, 2013).

Effects of Verbal Instruction on Performance

The action effect hypothesis has been tested and supported in two primary ways. Through the use of verbal cueing, a short, concise phrase directing an individuals' attention towards either, a particular element within the environment, or towards key movement patterns within a motor skill. First by presenting instruction in a way that establishes a discovery learning situation, thus creating a situation where the individual focuses on the action goal of the motor skill. Second, through the use of metaphoric imagery, or in a way that directs the individual's focus of attention to move in a way similar to the image. Research has shown that most athletes fail to self-regulate their attentional focus and as such require the direction of a coach, thus supporting a pedagogical application of attention based training among performance coaches (Makaruk & Porter, 2014). Moreover, the Hick’s-Hyman Law states that the time required to make a decision is a function of the number of available options. It is used to estimate how long it will take for people to make a decision when presented with multiple choices, further demonstrating the necessity to articulate the specific intent of the coaching cue delivered in a precise manor.

The benefits of an external focus of attention are well accepted as superior to an internal focus of attention with immediate improvement of performance and the lasting benefits of motor learning (Winkelman, 2018).

External Focus of Attention on the Force Velocity Curve

The force velocity curve graphically represents the scale in which force and velocity are inversely proportionate to each other. Essentially the greater the force the slower the velocity of the movement. The overall contribution of these two variables equates to an athlete’s power output represented in watts.

The motor unit represents the simplest element of neuromuscular activation of which attentional focus has been shown to improve coordination within the muscular system, specifically within the motor unit (Peh, Chow, & Davids, 2011). This improved movement execution, when analyzed through both kinematics and kinetic methods support the fact that whole-body coordination patterns are improved with an external focus of attention (Lohse, Sherwood, & Healy, 2010; Parr & Button, 2009; Southard, 2011; Wulf & Dufek, 2009). An external focus of attention has been shown to benefit athletic performance, specifically power within the execution of the countermovement jump (CMJ) test (Winkelman, 2018).

Current research supports the idea that specificity training is superior and at least ten elements are included in this defense: type of muscle contraction, movement pattern, range of movement, force of movement, muscle fiber recruitment, metabolism, biochemical adaptation, flexibility, and fatigue (Verkhoshansky & Siff, 2009). 1970 marked the introduction of velocity as a training consideration when researches showed that's low velocity isokinetic improved low velocity strength with little effect on high velocity strength (Verkhoshansky & Siff, 2009). This finding is interesting considering athletic competition is rarely performed at low velocity. The important takeaway from this is that in order to develop movements at a speed relative to the athletic movement one must condition the neuromuscular system at that same speed.

In order to adequately discuss the practical applications of velocity-based training consider what is known about a muscular contraction. As the muscle increase in cross sectional development, an increased motor unit recruitment occurs, thus yielding greater force production. Simultaneously improving neuromuscular efficiency increases the nervous impulse to the muscle fibers resulting in increased neuromuscular coordination and where applicable movement velocity. Verkhoshansky and Siff (2009) showed that maximum strength is produced for an optimum, not maximum, frequency of nerve firing (Verkhoshansky & Siff, 2009). Specific adaptation to imposed demands (SAID) is the underlying principle in the execution of strength and conditioning (Baechle, 2008). What we often fail to understand is how we impose that demand in training. Every athletic movement has a specific form of muscular strength associated with it. Literature has supported the effectiveness of tools such as a Linear Position Transducer (LPT) as an effective tool in the measurement of such variations in strength ranges (Cronin, Hing, & McNair, 2004).

LPT have been used to investigate velocity as influenced by fatigue. Limited not only the ability of the muscle to generate force but maximum velocity as well resulting in a decrease of overall power production. This becomes an enormous concern in the application of power in performance athletics (Sanchez-Medina & González-Badillo, 2011). Sanchez-Medina and González-Badillo (2011) analyzed the acute mechanical and metabolic response to resistance exercise protocols (REP) noting the number of repetitions (R) performed in each set (S) with respect to the maximum predicted number (P) affected the adaptation and the configuration of the stimuli typically associated with acute resistance exercise variables. They defined this as the type, order, loading, repetition scheme, number of sets, rest duration, and movement velocity. With that they pointed out that the literature is abundant in most areas with the exception of one area where they posed the question, is the possibility of manipulating the number of repetitions actually performed in each set with respect to the maximum number that can be completed? They went on to point out that it is likely that this lack of attention in the literature is due to the assumption that resistance training should always be performed to muscular failure. Although the concept of muscle fatigue is recognized as a complex, task-dependent and multifactorial phenomenon whose etiology is controversial and still a matter of much debate it has stimulated a more comprehensive investigation into velocity as an independent measure of athletic performance, specifically in the case of this investigation a major element of power output in rugby athletes.

The Distance Effect

While the literature about an external focus of attention is well supported, there remains a gap about, what is termed, the distance effect (Wulf, 2013). The distance effect is defined as the distance of markers from the starting point, of which an individual target in an activity. This effect has lead researchers to argue, the further the point of focus (external focus) the more significant the advantage, as it further separates the individual's thoughts of their body movement (internal focus) (McNevin et al., 2003). Better understanding of this effect may further contribute to the current body of knowledge.

The distance effect is quite limited with a total of five studies conducted over the last two decades. (Banks, 2012; Bell & Hardy, 2009; McKay & Wulf, 2012; McNevin et al., 2003; J. M. Porter, Anton, & Wu, 2012). McNevin et al. (2003) first investigated the distance effect in their study of external focus utilizing the stadiometer balance platform. They adjusted the external focus of attention by altering the distance markers relative to the individual’s feet. They argued the more significant the focus of attention to the body the more distinguishable the external cue was to the body thus improving performance. The retention test administered during their investigation resulted in enhanced motor learning demonstrating the residual effects verbally expressed external coaching cues. Another study on Kayaking found an increased level of performance when the athlete focused on the finish line vice the manner in which they stabilized the kayak (Banks, 2012). Both foci were in this case external; however, the finish line reference was considerably further from the athlete than the kayak reference. McKay and Wulf (2012) determined an increased inaccuracy of dart throwing by implemented a reference cue to bullseye (Distal) vice the flight of the dart (Proximal). Follow on studies investigating projectiles showed an increased accuracy when an athlete focused on the landing point of the ball vice the trajectory of the ball (Bell & Hardy, 2009). Most recently, and perhaps the most significant, relative to this investigation was a study conducted by J. M. Porter et al. (2012). They investigated jump performance by focusing an athlete's attention closer to the target (distal point of reference) vice farther away from the start line (proximal point of reference). The participants jumped further when they focused on jumping as close as possible to a target (Distal) than when they focused on jumping as far past the start lines as possible (proximal). These findings help validate this idea of a ‘distance’ effect. Moreover, it further supports the need for further exploration considering the limited representation in the academic literature. It is with that purpose this investigation was designed, as to assess the effects of increasing the distance of an external focus of attention on lower body power output in rugby athletes.

Research within the sport of rugby is limited in any pedogeological investigations involving attentional focus. Demonstrating the effects of coaching cues on tests which measure lower body power output, such as the countermovement jump (CMJ) test, may show a correlation to improved performance on the pitch.

CHAPTER III

METHODS

Participants

G* Power (Faul, Erdfelder, Lang, & Buchner, 2009) was used to conduct a priori power analysis. Conducted to determine the total sample size required for this investigation. Testing parameters were set for a Power (1-β err prob) value of 0.8 with an α err probability value set at 0.05. The effect size $f(V)$ was set to 0.5 with three groups and two measurements. The output parameters yielded a total sample size of 22 with a critical F of 2.56.

Participants included 26 Male Rugby athletes with an age range of 19-40. Participants were actively involved in athletic competition. Ethnic backgrounds of the participants in this study were comprised of White or Caucasian (n = 11), African-American (n = 1), Hispanic or Mexican-American (n = 1), and Pacific Islander (n = 13). All participants in this investigation volunteered to participate in this investigation under full consent. Participants were recruited through USA Rugby Hawaii Rugby Union Administration. Inclusion criteria included Rugby athletes between 18-40 years old, who have completed at least 30 minutes of moderate to vigorous exercise at least three times per week for six weeks, free from any physical, mental, or physiological conditions that may otherwise preclude them from safely executing a maximal vertical jump test. Participants were not required to have any previous jump training experience. This investigation was given ethical clearance by the institution's Human Research Ethics Committee. All participants recruited for this study completed it in its entirety with no data excluded from analysis. All testing took place at similar testing locations with similar environmental considerations.

Instrumentation Validity and Reliability

This investigation will utilize Linear Position Transducer (LPT) optical encoding technology. The specific instrument utilized in this investigation is the GymAware Power Tool

(Kinetic Performance Technology, Canberra, Australia). To accurately analyze data, we must first ensure the methodological considerations relative to the instrumentation are both valid and reliable, in this case first analyzing the instrument technology followed by the specific manufactured device. Reliability refers to the reproducibility or consistency of repeated performance by the same individual where Validity is where the instrumentation measures what it is supposed to measure (Harris, Cronin, Taylor, Boris, & Sheppard, 2010). Researchers have reported good reliability for LPT force related measurements utilized during a countermovement jump test (Cronin et al., 2004). They reported a coefficient of variation (CV) values between 2.1 and 7.4%. Hori et al. (2009) reported similar reliability with CV ranging from 2.5 to 11.1%. Some factors to consider in in the review of these findings is the experimental design may be responsible for some variations observed specifically on the concerning the equipment used sampling rate and filtering technique (Harris et al., 2010). Validity as mentioned earlier, questions if the instrumentation measures what it is supposed to measure. Correlation between an LPT and force platforms, generally referred to as the "gold standard" of force and power measurements, has been supported in the literature (Glatthorn et al., 2011). Cronin et al. (2004) reported a high correlation (r = 0.86-0.99) with small difference in mean force (0.1-0.4%), peak force (3.2-7.9%), and time to peak force (0.7-2.1%) during countermovement jumps. Other researchers have concurred with these findings reporting similar results, concluding the LPT technology was a valid and reliable method of collecting force data (Chiu, Fry, Schilling, Johnson, & Weiss, 2004).

Specific LPT features have been recommended in the literature to ensure high research standards. (Harris et al., 2010), recommend a minimum resolution of 1/10 of 1% of full scale for human power output testing concerning the resolution, or the smallest change in which an LPT can detect. For testing movements such as a vertical jump researchers have also recommended a 3.5 m cable length (Harris et al., 2010) and a device sampling rate, or the number of data points collected every second measured in hertz (Hz) greater than 200 Hz with 500-1000 Hz ideal (Hori et al., 2009). The parson correlation coefficients for jump height has been shown to be very strong (r = 0.90) with a typical error of estimate (TEE) of 2.4 cm. (11.8%) associated with a mean bias of 7.0 +/- 2.8 cm. (O'Donnell, Tavares, McMaster, Chambers, & Driller, 2018). Unfortunately, the literature has also demonstrated an overestimated vertical height measurement of 7.0 +/- 2.8 (p= <.01) overestimating the jump height compared to the force plate data (O'Donnell et al., 2018). Other studies have also demonstrated an overestimation of vertical jump performance specifically in peak force of 11% and peak velocity of 30% in comparison to force plate devices (O'Donnell et al., 2018). Despite this data, researchers still recommend LPT devices as a valid method of data collection and analysis with a recommendation to minimize fluctuation between devices.

Research Design

This investigation included a counterbalanced within-subject design quantitatively analyzing participants' lower body power output during the conduct of a countermovement jump (CMJ) test with arm swing. All participants performed one controlled jump to identify baseline data. All participants were counterbalanced for one of the two experimental groups, either the "Low Condition" group of which the overhead marker was set to eight feet or to the "High Condition" of which the overhead marker was set to 12 feet. The dependent variable for this investigation were peak power output (w) and peak velocity (m/s). Each participant was given one of two cues "Jump as far past the target as possible" [High Condition] or "Jump as far past the target as possible" [Low Condition], with the control group to execute the Countermovement Jump without a verbal cue. Verbal cues were given in an authoritative conversational tone at or about a distance of three feet from the participant. Environmental acoustics were minimal and standard across all participants. All participants acknowledged the verbal instruction indicating adequate hearing and comprehension. The independent variables will be the low condition (8ft target), or the high condition (12ft target) with a vertical jump marked with a visual distance maker above the participants head.

Upon commencement of each testing session, immediately prior to the CMJ, participants completed a standardized two-step warm-up protocol including a joint range of motion phase consisting of general movement patterns linked into a repeatable sequence for three minutes followed by a neuromuscular activation phase consisting of rapid movements conducted with the intent to prime the body for explosive movement.

Following the warm-up participants assigned to the control group were instructed to secure a waist belt just above the iliac crest utilizing assistance from the investigator to control for a consistent fit between participants. Participants were instructed to initiate the vertical jump with arm swing using a self-selected depth for the squat phase jump while maintaining straight legs during the flight phase of the jump (O'Donnell et al., 2018). Participants were required to perform each jump in accordance with the verbal cue followed by a 2-minute rest interval between each jump.

The GymAware Power Tool was used to objectively measure the participant's results. The power tool was attached to the participant's waist belt and connected via a Bluetooth signal to the LPT manufacturer software GymAware application version 2.4.1 (The Kinetic Performance Technology, Canberra, Australia) operating on Apple iPad 5th generation IOS 9.0. (Apple, Inc., USA). The LPT was placed between the participant's feet secured magnetically to a weight plate. The LPT was calibrated and "zeroed" with a fully retracted tether before each participant jump. Jump height was determined within the application software based on the change in displacement from the starting position to peak positive displacement (zero displacement = standing erect with feet shoulder width apart) to positive peak displacement (maximum jump height). Velocity from the LPT was calculated (velocity = displacement /time), with peak velocity being the highest value during the jump. The highest data points were retained for future analysis.

Data Analysis

After all responses were received and prior to the hypothesis testing a Repeated Measures Analysis of Variance (RM ANOVA) at a .05 significance level to determine any significant differences among the distance markers (i.e. High and Low Conditions) relative to power and velocity measures. In order to examine the hypothesis both Power and Velocity were analyzed. A multivariate test was conducted followed by Mauchly’s Test of Sphericity in order to verify if sphericity was violated. A Pairwise comparison was conducted to determine if one variable had a greater amount of quantitative property than another.

CHAPTER IV

DATA RESULTS

Hypothesis Testing

A MANOVA was calculated examining any significant differences among the distance markers (i.e. High and Low Conditions) of 12 ft and 8 ft respectively, relative to power measured in watts (w) and velocity measured in (m/s). It was hypothesized that both high (12 ft) and low (8 ft) conditions would be significantly different from the control jump with the high conditioning being greater than the low condition in terms of peak power and peak velocity. Initially, to test the hypothesis an RM ANOVA was used to determine any differences among the two conditions, high and low conditions, 12 ft and 8ft respectively. A Mauchly's sphericity tests was used to validate the repeated measure of analysis of variance. Finally, a Pairwise Comparison was performed to compare the data for significant differences.

Findings

Descriptive statistics were analyzed per variables yielding a standard deviation (*SD*) of 1813.89 with a mean of 8393.27 for Power at the high condition, 1578.30 *SD* with a mean of 8038.31 for Power at the low condition, and 1553.80 *SD* with a mean of 7990.53 for Power with a controlled condition. Descriptive statistics yielded 0.31 *SD* with a mean of 3.48 for Velocity with a high condition, 0.33 *SD* with a mean of 3.52 for Velocity with a low condition, and 0.25 *SD* with a mean of 3.43 for Velocity with a controlled condition. Both variables had an n=26.

The Pairwise Comparison of the high and low condition within the dependent variable Power resulted in a mean difference of 354.962 with a std. error of 243.272, a 95% confidence interval of [-146.067, 855.990] and a $p = 0.157$. Comparison of the high condition to the control resulted in a mean difference of 402.731 with a std. error of 268.352, a 95% confidence interval of [-149.951, 955.412] and a p = .146. Comparison of the low condition to the control resulted in a mean difference of 47.769 with a std. error of 275.653, a 95% confidence interval of [-519.949, 615.488] and a p = .864

The Pairwise Comparison of the high and low condition within the dependent variable Velocity resulted in a mean difference of -.039 with a std. error of .040, a 95% confidence interval of [-.122, .044] and a p = .344. Comparison of the high condition to the control resulted in a mean difference of .048 with a std. error of .047, a 95% confidence interval of [-.048,.144] and a p = .312. Comparison of the low condition to the control resulted in a mean difference of .087 with a std. error of .051, a 95% confidence interval of [-.018,.192] and a p = .101.

In summary, contrary to expectation neither the high (12 ft) or low (8 ft) conditions proved to be significantly different from the control jump relative to both peak power and peak velocity. The results of the pairwise failed to determine significance greater than P=.05 however it did show a slight difference between the low condition and control within the power data of .864.

Figure 1: POWER-Mean and standard deviation values under three conditions.

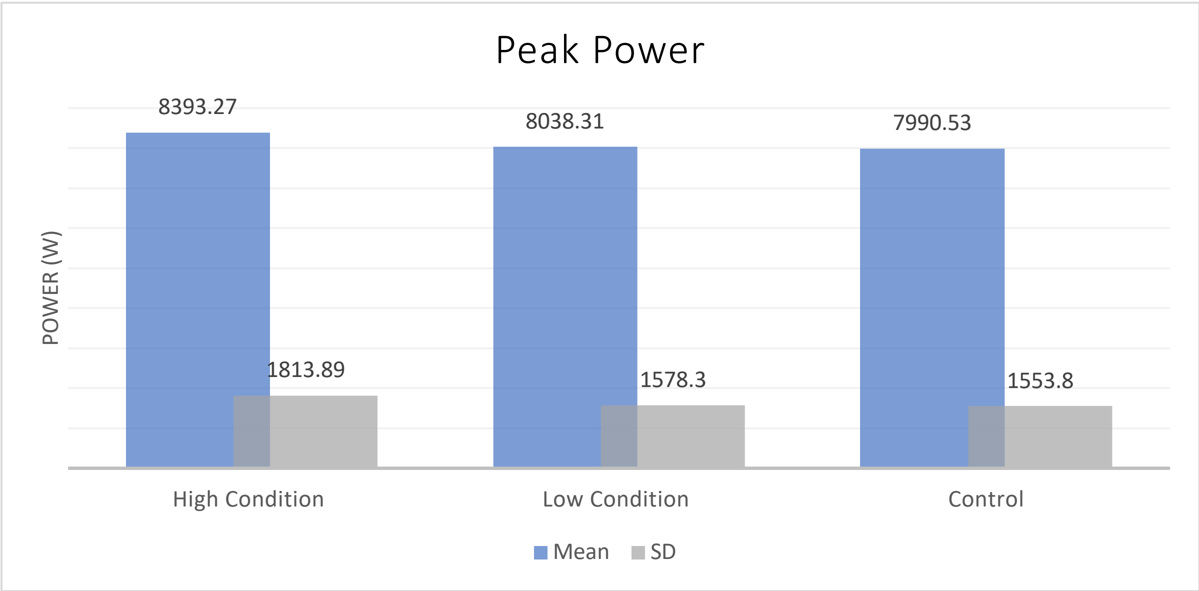


Figure 2: POWER-Mean value compared to standard error.

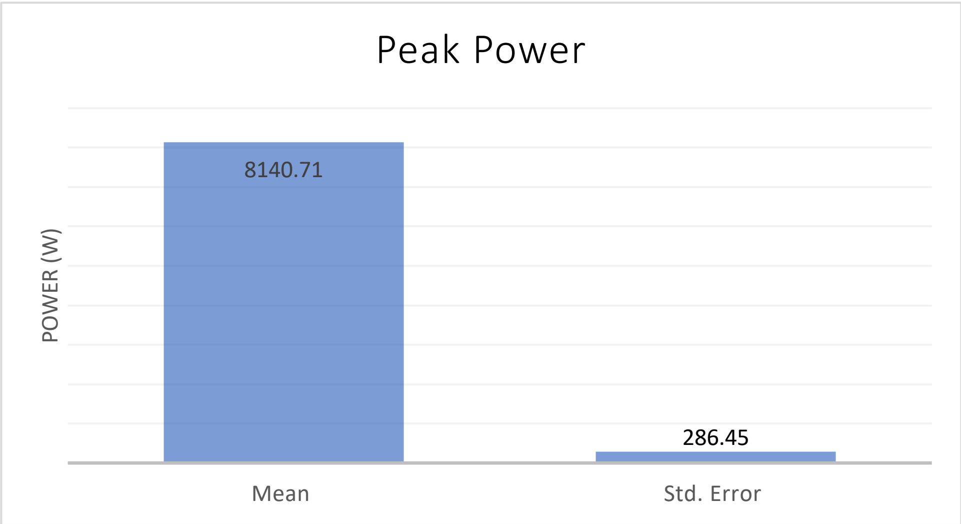


Figure 3:VELOCITY-Mean and standard deviation values under three conditions.

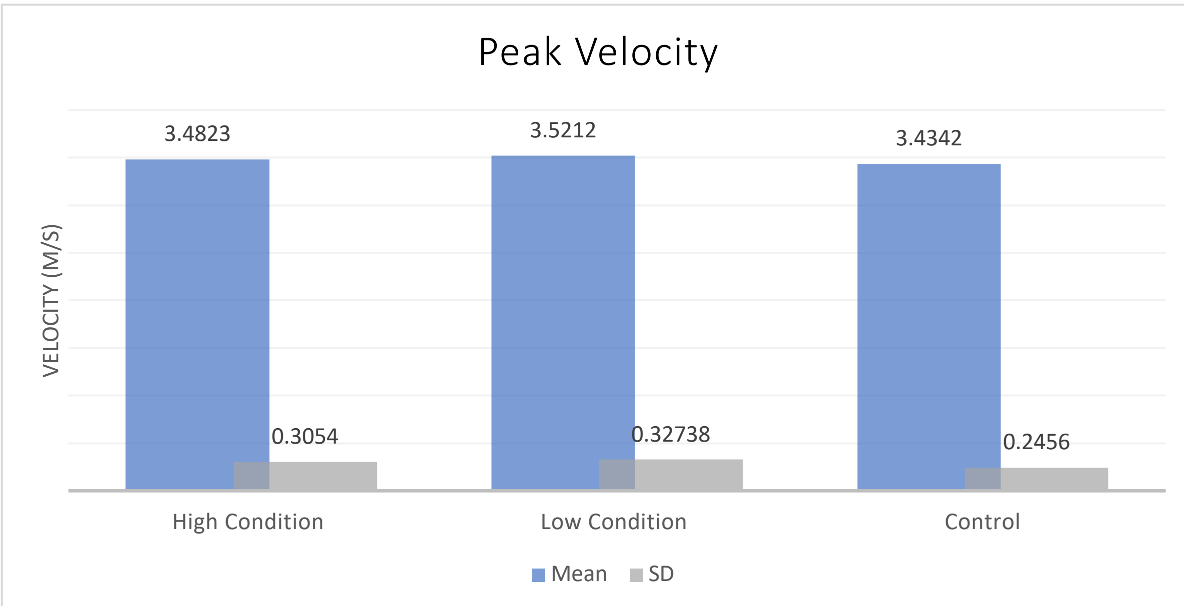
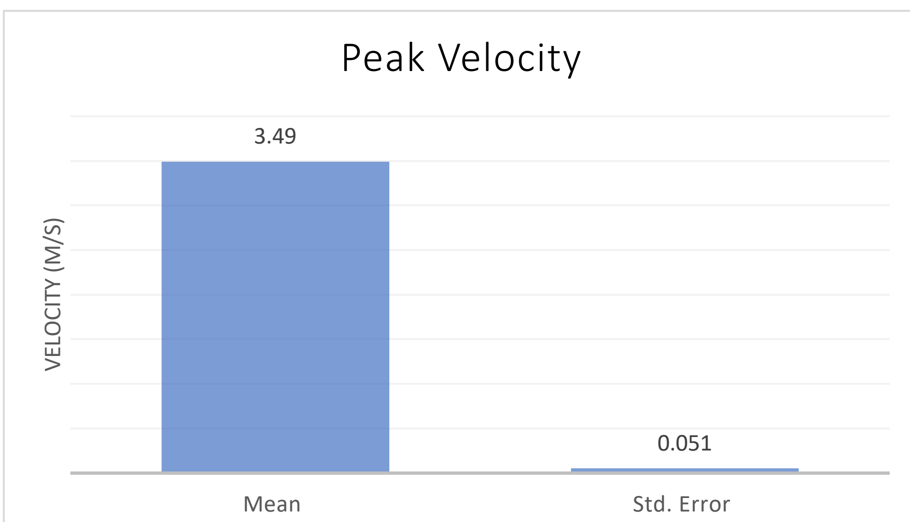


Figure 4: VELOCITY-Mean value compared to standard error.



CHAPTER V

SUMMARY AND CONCLUSIONS

Discussion

This research was undertaken to examine the multidimensional concept of human performance in sport. Serving as the bridge between sport psychology and motor learning, the pedagogical construct, or more simply stated, how we coach as opposed to what we coach, facilitated the foundation of this line of research. Coaching, by its sheer nature is that of a teacher, educator, and instructor of athletic technique shown specifically to enhance sport performance (Benz, Winkelman, Porter, & Nimphius, 2016; Makaruk & Porter, 2014). As such, a certain amount of scientific understanding regarding motor learning is necessary in coaching. After all, the act of learning a motor skill is the foundation to performance regardless of the sport. How athletes think, and feel are vital elements to the execution of physical movement within a sport. Therefore, the purpose of this investigation was to examine the distance, relative to the instructional cue (i.e. a high condition of 12ft compared to a low condition of 8 ft) and the difference in measurement as they relate to their effect on lower body power output in Rugby athletes. A comparison across previous experiments involving the distance effect (Banks, 2012; Bell & Hardy, 2009; McKay & Wulf, 2012; McNevin et al., 2003; J. M. Porter et al., 2012) indicate the distance of an external reference point does in fact influence the already well-established understanding of the benefit of an external focus of attention relative to an individual's personal space. It was then hypothesized that the distance between an individual's body and the target reference point would affect the overall power output produced by the athlete. Both high (12 ft) and low (8 ft) conditions will be significantly different from the control jump with the high conditioning being greater than the low condition in terms of peak power and peak velocity.

To examine this hypothesis, two dependent variables were investigated, peak power (w) and peak velocity (m/s). They were compared to two independent variables and one control group, the high condition (12 ft overhead marker) low condition (8 ft overhead marker) and no cue control respectively. This investigation included a counterbalanced within-subject design quantitatively analyzing participants' lower body power output during the conduct of a countermovement jump (CMJ) test with arm swing. All 26 Male Rugby athletes with an age range of 19-40 participants performed one controlled jump to identify baseline data. Followed by two counterbalanced experimental groups, either the "Low Condition" group of which the overhead marker was set to eight feet or to the "High Condition" of which the overhead marker was set to 12 feet. The dependent variable for this investigation were peak power output (w) and peak velocity (m/s). Each participant was given one of two cues "Jump as far past the target as possible" [High Condition] or "Jump as far past the target as possible" [Low Condition], with the control group to execute the Countermovement Jump without a verbal cue. Verbal cues were given in an authoritative conversational tone at or about a distance of three feet from the participant. Environmental acoustics were minimal and standard across all participants. All participants acknowledged the verbal instruction indicating adequate hearing and comprehension. The independent variables will be the low condition (8ft target), or the high condition (12ft target) with a vertical jump marked with a visual distance maker above the participants head. Upon commencement of each testing session, immediately prior to the CMJ, participants completed a standardized two-step warm-up protocol including a joint range of motion phase consisting of general movement patterns linked into a repeatable sequence for three minutes followed by a neuromuscular activation phase consisting of rapid movements conducted with the intent to prime the body for explosive movement. The GymAware Power Tool was used to objectively measure the participant's results. Contrary to expectations, the distance between an individual's body and the target reference point did not affect the overall power output produced by the athlete. Both high (12 ft) and low (8 ft) conditions failed to demonstrate a significant difference between the control jump and neither the high nor low condition.

Limitations and Recommendation

Limitations of this investigation included a clear lack of adequate jump technique on the part of the participants. As a result, I believe there was a degradation in overall jump performance and variations in technique. A statistical power analysis indicated an $n = 22$ and although met with a population n = 26 this is still a relatively small sample size. Future research including a larger sample size, a multigender and multisport population, as well as a minimal standard jump instructional protocol administered prior to testing is recommended.

Conclusion

These results were unable to show a positive relationship between the distance of an external focus of attention and lower body power output in rugby athletes. Although similar research in the field led to confidence in the research hypothesis with experimental expectations reasonable, the overall statistical measurements were below a significant threshold to positively conclude a measurable relationship.

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APPENDIX

APPENDIX A- EXPERIMENTAL PROTOCOL

STANDARIZED WARM UP PROTOCOL

NOTE: The performance preparation protocol may be taught prior to the conduct of the experiment however must be performed individually immediately before the experimental data is collected.

Joint Range of Motion 3 minutes
(Note: This is the main element to a dynamic warm up. Complete in a continuous pattern.)

1	Reach for sky	1	Spinal Range of Motion (ROM)
2	Reach for toes with a shoulder shuffle	1	Spinal Range of Motion (ROM) with Scapula range of motion
3	Sit to stand with 6-way neck	1	Spinal/Hip ROM with Cervical Focus
4	Alt single arm overhead with rainbow arc	1	Spinal, Scapula Thoracic, ROM
5	Flow in to lunge with inside knee to Spider-Man	1	Multi Directional Hip ROM
6	Spider-Man to taping rotation	1	Multi Directional HIP ROM/ Spinal ROM
7	Cat stretch with overhead extension	1	Thoracic Extension
8	Quadruped taping rot	5	Thoracic Rotation
9	Repeat 9 with reach	5	Thoracic Rotation
10	Down dog to dive bombers	5	Thoracic Extension
11	Inchworm up to rotations	5	Thoracic Extension

SPECIFIC WARM UP I: Neuromuscular Activation 2 minutes
(Note: Complete your warm up with a neurological activation. Here you are elevating your body's ability to move fast.)

13	Frankenstein kicks	10	Rapid eccentric activation of the posterior hip
14	Hip hinge single leg with knee to chest	5 EA	Rapid concentric activation of the anterior hip
15	Quick squats	10	Rapid activation of the squatting pattern
16	Figure 4 single leg stand alt	5	Alternate single leg stability and internal rotation of the hip
17	Quick alt lunge front	5	Single leg multi directional activation
18	Quick alt lunge back	5	Single leg multi directional activation
19	Quick lateral lunge	5	Single leg multi directional activation

JUMP PROTOCOL

1	Administer the warm up protocol
2	Mark the floor with a cross using tape - instruct athletes in accordance with the appropriate experimental cue. With the countermovement. Reposition each time between reps.
3	Place the GA Power Tool sensor between the participants feet and attach tether to waist belt positioned on the participant directly above the iliac crest.
4	Instruct the athlete to in accordance with the experimental cue- Do not give the athlete feedback
5	Only press the START button once the athlete is in place - standing tall prepared to initiate the CMJ.
6	Press the STOP button immediately following the last CMJ - to prevent additional reps being measured.

APPENDIX B- INVITATION TO PARTICIPATE

My name is Donald Pump, I am a graduate student from the Department of Kinesiology at the University of Texas Rio Grande Valley (UTRGV). I would like to invite you to participate in my research study to test the relationship between the distance of an external focus and lower body power in Rugby athletes.

This research study has been reviewed and approved by the UTRGV Institutional Review Board for the Protection of Human Subjects (IRB).

In order to participate you must be a Rugby athlete between 18-40 years old, who have completed at least 30 minutes of moderate to vigorous exercise at least three times per week for 6 weeks, free from any physical, mental, or physiological conditions that may otherwise preclude them from safely executing a maximal vertical jump test.

Participation in this research is completely voluntary, you may choose not to participate without penalty.

As a participant, you will be asked to participate in a randomized selection each testing day for one of three groups; control, high condition, and low condition. Based on the group identified for that testing day the participant received a predetermined coaching cue immediately prior to executing a countermovement jump (CMJ). Upon commencement of each testing session, immediately prior to the CMJ, participants completed a standardized two step warm-up protocol including a joint range of motion phase consisting of general movement patterns linked into a repeatable sequence for three minutes followed by a neuromuscular activation phase consisting of rapid movements conducted with the intent to prime the body for explosive movement. Following the warm-up participants will be instructed to don a waist belt just above the hips utilizing assistance from the investigator. Participants were instructed to initiate the movement in an upright position with hands on their hips, using a self-selected depth for the squat phase jump while maintaining straight legs during the flight phase of the jump. Participants will be required to perform three CMJs with a 20 second rest interval between each jump. The results of the CMJ will produce data to analyze in order to identify which distance condition (High or Low) facilitates the most power production during an explosive jump.

This is a confidential study meaning all data in this study is confidential, identifiable only to the researcher via an encrypted data sheet.

If you have any questions or if you would like to participate in this research study, please contact me at 808 295 8510 or email me at donald.pump01@utrgv.edu

You may also contact my faculty advisor Dr. Zasha Romero PhD, at 956-665-2881 or by email at zasha.romero@utrgv.edu

APPENDIEX C- INFORMED CONSENT

ID Code:

Date:

The University of Texas Rio Grande Valley

Informed Consent Form

Study Title: The Relationship Between the Distance of an External Focus of Attention and Lower Body Power in Rugby Athletes

Principal Investigator(s): Donald Pump

Faculty Advisor (if applicable): Zasha Romero, PhD

Purpose

Researchers have devoted countless resources to the sport psychology, physiology, and motor learning disciplines. Most commonly associated with sport psychology and motor learning. Attentional focus transcends the scientific landscape across all three disciplines. The bridge between these elements is the pedagogical construct, or more simply stated, how we coach as opposed to what we coach. The nature of coaching by its definition is that of a teacher, educator, and instructor of athletic technique. As such it is inherent to this position, a certain amount of scientific understanding of motor learning. After all, the act of learning a motor skill is the foundation of performance regardless of the sport. How athletes think, and feel are vital elements to the execution of physical movement within a sport. The purpose of this investigation is to examine the relationship between the distance of one's attention and lower body power output (i.e., peak velocity, peak force, peak power) during on countermovement jumps in Rugby athletes.

Procedure

You will be asked to participate in a demographic questionnaire to include height and weight along with a brief medical history section in order to assess your eligibility for the study. If you meet the minimal inclusion criteria, you will be assigned to the control group to identify baseline data. Following experimental day one all participants will be counterbalanced for one of the two experimental groups, either the "Low Condition" group of which the overhead marker will be set to eight feet or to the "High Condition" of which the overhead marker will be set to 12 feet, on each of the remaining two days. A total of three one-hour testing sessions will be required. The dependent variables for this investigation are the peak power output (W) and peak velocity output (m/s) and peak force (N). Each participant will be given one of two cues "Jump as far past the target as possible" [High Condition] or "Jump as far past the target as possible" [Low Condition], with the control group to execute the Countermovement Jump without a verbal cue. The independent variables will be the low condition (8ft target), or the high condition (12ft target) with a vertical jump marked with a visual distance maker above the participants head. Upon commencement of each testing session, immediately prior to the CMJ, participants completed a standardized two-step warm-up protocol including a joint range of motion phase consisting of general movement patterns linked into a repeatable sequence for three minutes followed by a neuromuscular activation phase consisting of rapid movements conducted with the intent to prime the body for explosive movement.

Following the warm-up participants assigned to the control group were instructed to secure a waist belt just above the iliac crest utilizing assistance from the investigator to control for a consistent fit between participants. Participants were instructed to initiate the vertical jump with arm swing, using a self-selected depth for the squat phase jump while maintaining straight legs during the flight phase of the jump. Participants were required to perform three CMJs with a 20-second rest interval between each jump.

Possible Risks and/or Discomforts Associated with Participation in the Study.
The risks of this experiment are no greater than those associated with moderate exercise in healthy adults. The procedures are standard practice within the field of sport performance.

Benefits of Participation
The benefits of participating in this study include: first, an improved understanding of jump performance; second, a better understanding of your body and its composition; and finally, a better understanding of your ability to perform under various coaching conditions. This study is designed to learn more about the relationship between the distance of an external focus and lower body power output (i.e., peak velocity, peak force, peak power) during on countermovement jumps in Rugby Athletes. The results of this study may be used to help other athletes in the future.

Voluntary Participation
Participation in this study is voluntary; you may withdraw from this study at any time. You will not be penalized in any way for deciding to stop participation. If for any reason you decide to discontinue participation, merely tell the researcher that you wish to stop.

Anonymity and/or Confidentiality
The data from this investigation will be confidential; it will be collected via the GymAware application version 2.4 (The Kinetic Performance Technology, Canberra, Australia) and stored in a digital cloud account. Hard copy back up information will be kept under lock and key separate from any identifiable documentation. Physical data will be kept under lock and key at 91-1411 Keoneula Blvd #2103 Ewa Beach Hawaii, 96706. The lead researcher is only one that will have access to identifiable data. Data will be stored for three years and then processed for confidential destruction. Results of this study may be used in publications and presentations.

Who to Contact for Research Related Questions
For questions about the research itself, or to report any adverse effects during or following participation, contact the researcher, Dr. Zasha Romero at 956-665-2881, zasha.romero@utrgv.edu, 1201 W. University Drive Edinburg, TX 78539-2999 EHPE2 107

Who to Contact Regarding Your Rights as a Participant
This research has been reviewed and approved by the Institutional Review Board for Human Subjects Protection (IRB). If you have any questions about your rights as a participant, or if you feel that the researcher did not adequately meet your rights as a participant, please contact the IRB at (956) 665-2889 or irb@utrgv.edu.

Signatures: By signing below, you indicate that you voluntarily agree to participate in this study and that the procedures involved have been described to your satisfaction. The researcher will provide you with a copy of this form for your own reference. In order to participate, you must be at least 18 years of age. If you are under 18, please inform the researcher.

____ ____/_____/______
Participant's Signature Date

Under certain circumstances, a waiver of signed consent may be approved by the IRB. The most common scenario justifying a waiver is when the only data linking the participant to the study is his/her signature on informed consent. Anonymous questionnaires/scales generally do not require a signed consent form, but the signature line should be replaced with the following text: "Your completion and the return of this questionnaire indicates your consent to participate in this research. "Under other circumstances, it may be necessary to have an additional witness signature on the informed consent. Minors cannot give legal consent, and thus a child "assent" form is commonly required in addition to parental informed consent. The language should be simplified to be appropriate for the child's age and should include the statement that "You can refuse to participate even if your parents have agreed to let you participate. The parental consent form should include a signature line labeled as "Parent/legal guardian signature." The parental consent form should also state that the child may refuse to participate even if the parent agrees to let his/her child participate. Whether one or both of the parent's signatures are required depends in part on the nature of the research.

BIOGRAPHICAL SKETCH

Donald Pump was born in Stamford, Connecticut on the 10th day of June 1981 to Donald and Jean Pump. He graduated from St. Joseph Regional High School in Montvale, New Jersey in June of 1999. He attended Sacred Heart University in Fairfield, Connecticut from August 1999 to June 2003 where he graduated with a Bachelor of Science in Human Movement Sport Science with a concentration in Exercise Science. He spent the next decade in the armed service with two deployments to the middle east in support of Operation Iraqi Freedom. Donald then enrolled in the University of Texas Pan American, later Rio Grande Valley in the spring of 2015. His concurrent employment included Don Pump Performance, LLC, a sport performance organization dedicated to human performance in sport. In addition, Donald has been actively involved in the National Strength and Conditioning Association as a member of the Hawaii state board of advisors as well as a frequent lecturer at professional events. Donald is currently an Anatomy and Physiology Lecturer in the Math and Science department within the University of Hawaii Systems, Kapiolani Community College. He received a Master of Science in Kinesiology from the University of Texas Rio Grande Valley in 2018. Donald currently resides at 91-1411 Keone'ula Blvd #2013 Ewa Beach, Hawaii, 96706 with his wife Amanda and son Jadon. His email address is Donald.Pump01@UTRGV.edu.