The Impact of a Visual Imagery Intervention on Army ROTC Cadets' Marksmanship
Performance and Flow Experiences

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ABSTRACT

This investigation used an experimental design to examine how a visual imagery intervention and two levels of challenge would affect the flow experiences and performance of cadets engaged in Army ROTC marksmanship training. I employed MANCOVA analyses, with gender and prior marksmanship training experience as covariates, to assess cadets' ($n = 127$) marksmanship performance and flow experiences. Findings revealed that the use of visual imagery did not positively enhance flow and improve performance with statistical certainty. The results, however, might be practically significant because they showed that when cadets were faced with a more challenging situation and had engaged in visual imagery exercises, they were more likely to outperform cadets in the same challenge condition who had not engaged in visual imagery exercises. On average, cadets in the high challenge condition who engaged in visual imagery exercises outperformed non-visual imagery cadets in the same condition by over one point on a six-point scale. Additional findings revealed that level of challenge did not affect flow experiences, which is counter to the postulates of flow theory. Level of challenge did, however, negatively impact performance. That is, when cadets were faced with a more challenging situation, they performed more poorly. Prior experience—and by extension skill level—was discovered to better facilitate flow experiences, as opposed to a balance of challenge and skills. Higher levels of prior marksmanship training experience were associated with cadets' potential to enter the flow state. Additionally, males rated flow significantly higher than their female counterparts. Males also significantly outperformed females. Implications for future research investigating how challenge and visual imagery affect flow experiences and performance in the context of Army ROTC marksmanship training are discussed.

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Completing this dissertation and attending graduate school has been one of the most challenging and time consuming endeavors of my life. Not so long ago I remember being just some guy aimlessly wandering the Earth, never reaching for anything not easily obtained, never engaging in anything that remotely resembled a challenge. Today, I have a different perspective on life, my potential, and how to get the two to interact in meaningful ways. A handful of wonderful individuals, including my advisor, graduate professors and committee members, and friends and family, helped me make this change in perception and values. Without their support, guidance, and patience, I could never have achieved at such heights. It is to them that I dedicate this doctoral dissertation.

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COMMONLY USED ARCONYMS

Acronyms

AE	**Athlete engagement** refers to the depth of engagement an athlete exhibits for a particular sport or activity.
CG imagery	**Cognitive-general imagery** refers to the strategies related to a competitive event, such as full court pressure in basketball.
CS imagery	**Cognitive specific imagery** is based on imagery rehearsal of specific skills (e.g., putting in golf or penalty shots in soccer).
DFS	The **Dispositional Flow State Scale** assesses the frequency of flow in a given activity.
EST 2000	The **Engagement Skills Trainer 2000** provides initial and sustainment marksmanship training, static unit collective gunnery and tactical training, and shoot/don't shoot training. There are three modes of training supported: marksmanship, squad/fire team collective and judgmental use of force.
ESM	The **Experience Sampling Method** is a popular and validated method for assessing flow experiences (Csikszentmihalyi & Larson, 1987). Participants carry pagers and are "beeped" at random times at which they fill out a questionnaire.
IM	**Intrinsic motivation** involves engaging in a task for its own sake (there is a lack of external reward).
FSS-2	The **Flow State Scale-2** is a survey designed to measure flow experiences following a just completed task.
MG-M imagery	**Motivational-general-mastery** imagery serves a motivational and mastery function. Such images represent effective coping and the mastery of challenging situations, such as imagining being mentally tough, confident and focused during competition.
MS imagery	**Motivational-specific imagery** represents specific goals and goal orientated behaviors, such as imagining oneself winning an event or receiving praise from referent others.
MG-A imagery	**Motivational general-arousal imagery** represents feelings of relaxation, stress, arousal, and anxiety in conjunction with sport competition.
PMI	**Pre-marksmanship instruction** consists of five main components: clearing, cycles of functioning, modes of fire, peer coaching, fundamentals of weapon firing, and firing positions.
POI	**The Person-object approach to interest** (POI) is a theory of interest that views interest as a relational concept—a relationship between an individual and an object. The person-object-relation is characterized by emotion and value-related aspects. views interest as an outcome of competence, autonomy, and relatedness (Krapp, 2002).
ROTC	**Reserve Officers' Training Corps** is a college elective that is geared toward training future military officers for active duty or Reserve Forces.
SDT	**Self-determination theory** is comprised of four mini-theories that outline, among other things, how to achieve intrinsically motivated behavior through the satiation of three psychological needs: competence, autonomy, and relatedness (Deci & Ryan, 2002).

Chapter 1: Introduction

Background

Think about a time in which you were doing some task or activity that you really enjoyed, perhaps a hobby. Maybe you play golf or a musical instrument, or maybe you play chess or like to read about American history. At some point, did you ever get so wrapped up in what you were doing that you were completely absorbed in the activity? Did you lose track of time to point where hours seemed to pass in minutes? If so, you were likely in "flow." Flow is a state of consciousness in which an individual's attention is completely focused on some task or activity that he or she is participating in, to the point where nothing else really matters (Csikszentmihalyi, 1990).

To achieve the flow state, there needs to be a balance of challenge and skill (Jackson & Csikszentmihalyi, 1999). A skillful chess player, such as my college roommate, for example, will not find me to be a very challenging opponent, due in large part to my lack of knowledge and skill for the game. My roommate considers playing me in chess to be very boring, and thinks I am entirely too easy to defeat. Conversely, I find playing my roommate in chess to be anxiety-provoking, due to the fact that the challenge of the situation far outweighs my skill to compete. We have only played chess once or twice and neither of us found the experience to be enjoyable. The experience was not enjoyable because the challenge was below his skill level and above mine, which thwarts the flow experience.

My roommate and I do, however, have similar skills in playing pool, although when we first played, he was not very skilled. The first few times we played one another I beat him easily. There was now a reversal of experiences: I found playing him boring and he found the

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experience to be too challenging and anxiety-provoking. Unlike my lack of interest in chess, however, my roommate was very interested in pool. He wanted to be able to compete, and to a greater extent, he wanted to be highly competent at playing the game. These motivating factors led him to learn about the game through online video tutorials, and subsequently, to practice with others with a similar skill level. About a year later he was able to compete with me in pool, occasionally winning. His persistence and effort to become better at billiards led him to eventually acquire enough skill to meet the challenge of playing a once superior player. In doing so, he was also able to enter into a state of consciousness where he was not worried about how his performance would be judged (by me in particular); rather, he could focus on the game itself. With less worry and anxiety, and more confidence from experience, he was better able to perform.

The scenario I have just described is not uncommon. I can, albeit anecdotally, think of several individuals who have encountered similar, initially difficult circumstances and go on to persevere through challenging obstacles (e.g., intense effort, sporadic failure) and eventually perform at a higher level. A teenager taking music lessons is one example that comes to mind. The information is new, often abstract, and unlike any other type of leaning experience previously encountered. In no other situation will a guitar player need to contort his or her fingers and hands like he or she does while playing the guitar. Making the chord shapes, noting them properly, and switching quickly between them is difficult. Most individuals struggle early on and experience bouts of success along with interspersed failures and frustration.

Despite challenging experiences of this sort, some guitar players continue onward. Why? I contend that overcoming such challenges makes learning and playing highly rewarding and enjoyable. I personally believe that such experiences not only make learning and playing

rewarding and enjoyable, but also make life worth living. In this manuscript I argue that learning conditions conducive to persistence, cognitive stretching, and enjoyable experiences (i.e., flow) are better suited to meaningful learning experiences, particularly the learning experiences in schooling and athletic environs, than those that are not.

Implementing the flow framework in learning environments has the potential for increasing learner interest and effort. I believe that individuals are not suited to "traditional" classrooms that use lecture and drill as their primary modalities. Rather, I believe individuals, from an evolutionary standpoint, learn best when engaged in material that is interesting and meaningful, in much the same way as what individuals learned as a means to survival was meaningful and important 100 to 100,000 years ago (Csikszentmihalyi, 2002). Whether it was hunter-gatherers or farmers, effort to learn new information and master tasks often had meaning, much of which ensured survival, and some of which, I speculate, ensured enjoyable experiences (not the basic biological kind, like sex, but rather the curiosity-satiating kind, like making music or art).

I want to know what compels artists to engage in their craft. I want to know what impetus was at work 30,000 years ago to make an individual traverse into a cave (such as Chauvet Cave, located in France) through potential danger and toil to paint on stone walls by firelight. Such an undertaking was not necessary for survival (at least not directly). What was the motivation for this behavior? Along the same line, what inspired Jean-Marie Chauvet and his colleagues to explore an unfamiliar cave at such depth nearly 30,000 years after ancient peoples etched their drawings on a canvass of stone? I speculate the two parties' shared similar ends, insomuch as the experience itself (both painting and exploring) were perceived to be worthwhile endeavors, ones worth doing for the sake of the experience itself (i.e., intrinsically motivating).

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Such activities have inherent value and meaning and do not require some external reward; the activity itself is the reward, and therefore is highly motivating.

How, then, can educators motivate learners in much the same way as the persistent musician and cave painter of old were motivated? Answering that question guides the focus of this manuscript: how can an individual engineer conditions conducive to the flow experience; an experience characterized by effortless effort, perseverance, fine-tuned attention, and autotelic experiences (Jackson & Csikszentmihalyi, 1999)? In determining how best to engineer conditions conducive to flow, I use five primary frameworks to address this issue (a) self-determination theory (Deci & Ryan, 2002), (b) interest (Hidi & Renninger, 2006), (c) affect (e.g., Netz, 2007), (d) flow (Jackson & Csikszentmihalyi, 1999), and (e) visual imagery (e.g., Vealey, 2007). Self-determination theory, interest, and affect are incorporated in this manuscript to better understand intrinsic motivation, which allows for a better understanding of how to achieve flow. Visual imagery and flow constitute the primary theoretical frameworks for the empirical investigation undertaken for this manuscript.

Study Context

The context for my investigation was Army ROTC marksmanship training. On college campuses throughout the US, Army ROTC cadets undergo marksmanship training, much of which is conducted under controlled conditions through simulation training. Simulation training involves shooting an M16-A2 rifle that has been converted to shoot at a theater-style screen with a laser. Generally, cadets receive pre-marksmanship instruction and then engage in a "grouping" exercise on the simulator, which allows them to eventually engage in various target training exercises. In order to meet the standard for "grouping," the cadet must place five of six shots

around a four centimeter hole, regardless of where on the target they aim. They are allowed 18 shots total. More skillful shooters typically group in fewer shots than less skillful shooters. Often, a large portion of cadets fail to group in the allotted 18 shots. This leads to more time-consuming training and subsequent retraining of cadets just to get them started on the simulation training exercises that are most desired and valued.

To ameliorate this problem, an investigation is needed to determine what conditions in marksmanship training are conducive to the flow experience. How can marksmanship instructors help get cadets "in the zone" (i.e., flow) and better streamline marksmanship instruction? I propose that a visual imagery intervention could be implemented to achieve this end. Visual imagery interventions have been shown to enhance motivation and improve performance (Calmels, Berthoumieux, & d' Arripe-Longueville, 2003; Cumming & Hall, 2002; Martin & Hall, 1995; Vealey, 2007). It seems logical, then, that a visual imagery intervention should facilitate the flow experience more readily, in addition to boosting performance.

Like visual imagery, flow is also associated with increased performance (Jackson & Kimiecik, 2008). Given this, it is worthwhile to determine the conditions cadets consider challenging during simulation training. I wanted to know what balance of challenge and skills was necessary in the context of marksmanship training and how that balance affected motivation and performance. Finding the correct balance of challenge and skill could potentially enhance motivation and performance in conjunction with or separately from the visual imagery intervention. Such knowledge would be useful regardless of whether or not the visual imagery intervention proves efficacious. In other words, knowing the effects of different levels of challenge on performance and flow could inform marksmanship instructors about the value for such conditions in future training.

Lastly, the role of prior experience in facilitating flow and improving performance is worthy of investigation. Knowing the role that prior experience plays in achieving those ends would prove useful should both the visual imagery intervention and challenge conditions fail to have an effect on flow and performance outcomes. That is, this investigation will help marksmanship trainers and sport psychologists determine the value of prior experience in facilitating flow and improving performance. Additionally, the worthiness of implementing a visual imagery intervention (in terms of performance and flow enhancement) and the efficacy of manipulated challenge conditions to enhance flow are examined. The remaining chapters in this manuscript outline this study in greater detail.

Purpose and Research Questions

The purpose for the present investigation is rendered in large part from the pilot investigation of Rakes and Jones (2012) that examined the effects of a visual imagery exercise and graduations of challenge on participants' performance and flow perceptions while engaged in Army ROTC marksmanship training. Results from that investigation indicated that visual imagery had no effects on performance or flow; however, it indicated that challenge condition affected performance but not flow, and that prior experience affected flow but not performance. Rakes and Jones (2012) speculated that the results could be attributed to the following: (a) a lack of practice for the visual imagery intervention, (b) the non-use of an established visual imagery paradigm, and (c) the inherent difficulty of the zeroing exercise. To remedy these issues, I designed the present study to answer the following research questions:

1. Do cadets who participate in a visual imagery intervention have statistically higher flow perceptions than those who do not participate in the visual imagery intervention?

2. Do cadets who participate in a visual imagery intervention have statistically higher marksmanship performance than those who do not participate in the visual imagery intervention?

3. Are more challenging conditions associated with significantly higher flow perceptions than less challenging conditions?

4. Are more challenging conditions associated with significantly lower marksmanship performance than less challenging conditions?

5. Is prior experience or challenge level more highly correlated with flow perceptions?

6. Do visual imagery and challenge conditions interact to affect cadets' flow perceptions?

7. Do visual imagery and challenge conditions interact to affect cadets' marksmanship performance?

To address these questions, I examined the efficacy of a visual imagery training exercise and its effects on performance and flow within the context of Army ROTC cadets' marksmanship training. I also investigated the role of challenge and skills in facilitating flow. I randomized participants into groups with one group that received a 14 day visual imagery intervention and another group that did not. Additionally, I randomized participants into challenge conditions (low or high) in order to test the holistic model of flow and the importance of challenge-skills balance in promoting flow experiences. I requested that all groups participate in simulation training that involved a "grouping" exercise using a M16-A2 rifle converted for simulation purposes. As soon as participants completed the grouping exercise, I asked them to immediately complete the Flow State Scale-2 (Jackson & Eklund, 2004).

Significance of Problem

This investigation addressed three significant issues. One, this investigation began the process of determining which visual imagery paradigm is most efficacious in terms of increased performance and flow experiences in Army ROTC marksmanship training. Vealey (2007) asserted that this line of inquiry was most appropriate for visual imagery investigations. She pointed out that numerous studies have demonstrated the efficacy of visual imagery interventions, yet there is little research that illuminates which visual imagery paradigm is most effective. Although two paradigms were not investigated simultaneously in this investigation, subsequent comparisons can be made now that this investigation is completed.

Two, the results from this investigation helped determine the integrality of the balance of challenge and skills in the context of Army ROTC marksmanship training. That is, this investigation worked to uncover whether a balance of challenge and skill is the most important factor in achieving flow, or if instead, prior experience is the better determinant. This line of inquiry stems from prior research that suggested prior experience plays a significant, if not more important, role in facilitating flow (e.g., Rakes & Jones, 2012; Schweinle, Turner, & Meyer, 2008).

Third, this investigation sought substantiation or refutation for a particularly critical component of Csikszentmihalyi's (1990) holistic model: challenge/skills balance. His model highlights the importance of nine components, of which the balance of challenge and skill is often considered the crux. If one challenge condition promoted greater flow than the other, the model gains increasing substantiation. If not, the model needs reexamining. Either finding helps

illuminate future research directions and the application of such a holistic model of flow in the

wider context of sport and learning environments.

Chapter 2: Literature Review

Motivation

Every student is motivated in some way. Some students, for example, are motivated to attend to a lecture, participate in classroom activities, and achieve at a high academic level. Other students may have more interest in social interaction, extracurricular activities, sports, or employment once their school day is complete. Some students may find social interaction, extracurricular activities, and school in general to be undesirable experiences. Their perception of school activities as aversive, may lead them to avoid interaction with school-related activities that involve their participation. Motivation, then, can be viewed as an internal state of arousal that drives us to take action, pursue a particular direction, and stay engaged in certain activities (Ormrod, 2008). Indeed, motivational theories that are psychological in nature, by definition include both the energization and direction of behavior (Deci & Ryan, 1985). Generally speaking motivation can have an effect on: energy and activity level, actualization of goals, initiation and persistence in certain activities, time on task, active thinking or cognitive engagement, and conceptual change (Brophy, 1988; Dole & Sinatra, 1998; Dweck & Elliot, 1983; Eccles & Wigfield, 1985; Maehr & Meyer, 1997; Pintrinch, Marx, & Boyle, 1993).

Intrinsic and Extrinsic Motivation

Some researchers have examined motivation as either extrinsic or intrinsic (Deci & Ryan, 1985). Extrinsic motivation is driven through the use of reward or punishment (internal and external) that entices the individual to perform a task, engage in various activities, or behave in a particular fashion (Deci & Ryan, 1985). Extrinsically motivated students, in comparison to intrinsically motivated students, will likely put forth the least amount of effort (both cognitive

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and behavioral) to meet learning requirements (Brophy, 2004). Intrinsic motivation includes the factors within the individual or task itself that engage the individual to persist, complete, and generally behave and in a particular way (Deci & Ryan, 2002). Increasing students' intrinsic motivation can lead to learning at deeper levels and better performance (Deci & Ryan, 1985; Perlmuter & Monty, 1977; Sadowski & Woodward, 1981).

How researchers moved from an emphasis on extrinsic and behavioral notions of motivation to more diverse conceptions of intrinsic motivation is quite interesting. Freud (1917) and Hull (1943) were two early theorists that spawned decades of empirical and theoretical research that has shaped motivation as it is conceptualized today. Freud (1917) argued that there were two basic human drives—sex and aggression—while Hull (1943) argued there were four: hunger, thirst, sex, and avoidance of pain. Psychoanalytical researchers used Freud's paradigm to investigate drives (mainly the sex drive) in the development of pathology. Empirical researchers, in contrast, studied animal behavior to better understand the theoretical underpinnings of motivated behavior (e.g., Berlyne, 1950; Harlow, 1950).

Both camps would play an integral role in the development of new means of explaining human motivation, as neither alone would prove to be sufficient. White (1959) suggested that drive theories were insufficient in explaining behavior outside that of non-nervous system tissue deficits. White called for a theory that would complement drive reduction, but could also account for the anomalies and inconsistencies encountered by investigators up to that point. His conceptualization of motivation would account for human behavior residing outside the explanatory power of tissue satiation; namely exploration, play, and many other behaviors that do not require reinforcement for their continuance. He termed this new conceptualization

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"effectance motivation," due to, what he asserted, was an individual's need to be effective in dealing with his or her environment.

Building on this new notion of human motivation, many investigators would begin to engage in research that moved beyond limited drive theories to explain human motivation. Deci (1975) was a pioneer in this movement. He asserted that the need for competence was psychological: one that drives individuals to seek and conquer challenges in accordance with their abilities. The development of competence, he argued, was the result of interacting with challenging tasks, activities, and the like. Later, Deci and Ryan (1985) argued that intrinsic motivation was "based in the innate, natural propensity to engage in one's interest and exercise one's capacities, and in so doing, to seek and conquer optimal challenges" (p. 43). As evidence, they cite several studies that investigate the effect of rewards on behavior (e.g., Calder & Staw, 1975; Deci, 1971; Eden, 1975; Pinder, 1976; Prichard, Campbell, & Campbell, 1977). In general, participants in the investigations were less intrinsically motivated as a result of receiving monetary payment or reward for an intrinsically motivating activity, or found activities less enjoyable or satisfactory when extrinsic rewards were introduced into a task or activity.

Many other investigations have demonstrated the benefits of facilitating intrinsic motivation in the context of educational settings, including, but not limited to, impaired learning due to the receipt of reward, improved learning when given choice, improved performance in autonomy-oriented classrooms, improvements in intrinsic motivation when students thought the material would be put to effective use as opposed to testing alone, and decrements in intrinsic motivation when reinforcers are expected for doing an activity (Benware & Deci, 1984; Deci, Koestner, & Ryan, 2001; McGraw, 1978; Perlmuter & Monty, 1977; Sadowski & Woodward, 1981). These findings hold important implications for educational practitioners, in that they

suggest alternative methods to those espoused in the behavioral paradigm when the goal is getting learners to exert more than the minimal effort required for completing a task.

There are, however, some good reasons to use extrinsic rewards in classrooms. First, they have a long history of proven efficacy (e.g., Skinner, 1968; Cipani, 2002). Second, depending on the nature of the learner, extrinsic rewards may be a means to get at least some effort exerted on learning tasks and activities, especially for emotionally disturbed or disorderly children (O'Leary & Drabman, 1971). Third, students are unlikely to be fully intrinsically or extrinsically motivated. That is, they are usually both simultaneously intrinsically and extrinsically motivated (Csikszentmihalyi & Nakamura, 2002; Hidi & Harackiewicz, 2000; Lepper, Corpus, & Iyebgar, 2005).

In sum, students in classrooms designed to promote intrinsic motivation are likely to experience benefits, such as persistent effort, improved learning, and continual engagement without constant need for prodding. Supplementing extrinsic reinforcers when necessary for those students who need it is prudent practice and probably justifiable on many levels. In my opinion, as long as the teacher is not perceived as controlling at every level, student learning and success are not likely to diminish when extrinsic motivators are used and when intrinsic conditions dominate the overall classroom climate. Proper handling of extrinsic rewards can actually facilitate intrinsic motivation, given they provide feedback on performance, competence, and self-efficacy (Schunk & Zimmerman, 1997). This distinction is made clearer through self-determination theory, which I turn to next.

Self –Determination Theory

Self-determination theory (SDT) and intrinsic motivation are inextricably linked. The more intrinsically motivated an individual, the more self-determined the individual, and vice versa. The impetus for a self-determined view of human motivation was borne from the inability of behaviorists and drive theories to account for behavior that was not emitted as the result of expected reinforcements or the need to satiate tissue deficits. Deci and Ryan (1991) argued that human beings have basic psychological needs-- autonomy, competence, and relatedness-- which, when afforded expression, lead to self-determined behavior. This framework serves as an umbrella for the other theories (specifically, interest and flow) that comprise my review in this manuscript, in that it takes the perspective that motivation is intrinsic or extrinsic in nature. With this dichotomous framework, the other theories (particularly flow) can be explicated with greater understanding, as interest and flow are situated as forms of intrinsic motivation.

SDT focuses on the dialectic between the three needs and the environmental contexts that support or hinder experiences of self through integration. Competence, autonomy, and relatedness have the potential to facilitate growth experiences and their subsequent integration, when a task or activity is not already intrinsically motivated. Hindering competence, autonomy, and relatedness has the opposite effect, leading to diminished intrinsic motivation, and potentially amotivation. SDT is comprised of four interrelated mini-theories (Deci & Ryan, 2002): cognitive evaluation theory, organismic integration theory, causality orientations theory, and basic needs theory. Each will be briefly explicated in turn, followed by implications for SDT in the context of educational settings.

Cognitive Evaluation Theory

Cognitive evaluation theory carved the framework that encapsulates the psychological needs of competence, autonomy, and relatedness. It includes the elements of perceived locus of causality, perceived competence, and social context (Deci & Ryan, 1985; 1991). Perceived locus of causality is an internal perception about whether or not a task, activity, or endeavor is the result of volitional energization and direction of behavior. That is, whether or not behavior is perceived as autonomous (emitted due to extrinsic or intrinsic forces).

Intrinsic forces are those that lead to engaging in behavior that is an end in itself. Extrinsic forces lead to behavior that is a means to an end. Take, for example, an individual who engages in an activity such as rock climbing. If the rock climber engages in climbing because he or she enjoys the inherent satisfaction of scaling rock faces at high altitudes and the optimal challenge doing so affords, then his or her engagement is intrinsically motivated. In contrast, if the outdoor enthusiast suddenly faced with the need for rock climbing, say by accident, or perhaps because he or she was duped by a friend to take on what they thought would be simple and easy, their engagement is likely more extrinsically motivated. Stated simply, the more an individual perceives the behavior to be induced as a result of their own volition, the more likely they will perceive the behavior as self-determined, and thus intrinsically motivating. Locus of causality, then, is the degree to which behavior is considered volitional.

Perceived competence is needed in order to begin and continue engagement in an activity. The idea is similar in concept to Bandura's (1986) notion of self-efficacy, or the belief that an individual can attain success in task-specific situations. In the context of SDT, perceived competence works in conjunction with autonomy. When an individual feels both autonomous

and perceives him or herself to be competent in an activity, the probability of increasing intrinsic motivation is elevated. Instead of a rock climber, imagine a guitar player as an example. If he picks up and plays the instrument with the belief that he can be successful, and not just because his parents insisted, intrinsic motivation would be considered high. If, however, he feels that he does not possess the ability to perform the simplest of tasks, he likely will not engage in playing, regardless of whether or not he feels autonomous.

Notably, contexts, and the degree to which they are considered controlling and informational, will affect perceived competence and causality. If the context is perceived as controlling, intrinsic motivation will decrease. If the context is informational, in that it provides the opportunity for positive feedback that supports the guitar player's competent engagement, it will facilitate intrinsic motivation (Deci & Ryan, 2002).

Social contexts are particularly integral to cognitive evaluation theory. Social context can dictate whether or not engagement in an activity is perceived as controlling or not. The more controlling the environment is perceived, the likelihood it will be conducive to intrinsically motivated behavior is lessened. For example, positive feedback that would normally enhance intrinsic motivation may not have the same effect in motivational climates that are perceived as controlling. Climates that include verbal conditions such as "should do well" or "ought to" for a performance, or include extrinsic reward in a non-evaluative context that supports autonomy, may undermine intrinsic motivation (Deci & Ryan, 2002).

The last psychological need, relatedness, is considered a basic need much the same as competence and autonomy are considered basic psychological needs, but nonetheless plays a more distal role in intrinsically motivated behavior (Deci & Ryan, 2002). The aforementioned

guitar player will likely find playing with others who share a similar skill level to be enjoyable. In an environment in which he perceives himself to be competent, engages because he chooses to (autonomously), and gets to be around others who share his passions (relatedness), intrinsic motivation is likely high. However, it is still possible for him to be intrinsically motivated when playing alone, hence the distal role of relatedness.

Organismic Integration Theory

Building on the role of extrinsic rewards in variable contexts, organismic integration theory outlines a continuum of intrinsic-extrinsic regulation. Deci and Ryan (1991; 2002) contend that experiences that begin as uninteresting (i.e., extrinsically motivated) can potentially move through a continuum of regulated behavior until they are integrated fully with the self. The idea is that individuals can potentially, and to varying degrees, integrate external regulation into self-regulation. This is an assertion with important implications, in that it highlights the prospect that an individual can feel somewhat autonomous when they are extrinsically motivated. This suggests that uninteresting activities, along with ones that are not optimally challenging or aesthetically pleasing, can eventually be integrated into intrinsically motivated behavior. And if not fully intrinsic behavior, then potentially less controlled forms of extrinsically motivated behavior. Accordingly, facilitating competence, autonomy, and relatedness will promote internalization of initially extrinsically motivated behavior (Deci & Ryan, 2002).

Figure 1 illustrates the continuum. Beginning at the extreme of the continuum for extrinsic regulation is amotivation. *Amotivation* is characterized by a lack of intention to act. This state is likely the result of perceived incompetence, lack of relevant reward contingency, or lack of value of potential outcomes that may result from the behavior. Moving up the self-

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Integration of Self-Determined Behavior

	Extrinsic Motivation				
Non-self determined					Self-determined
Amotivation	External regulation	Introjected regulation	Identified regulation	Identified regulation	Intrinsic motivation
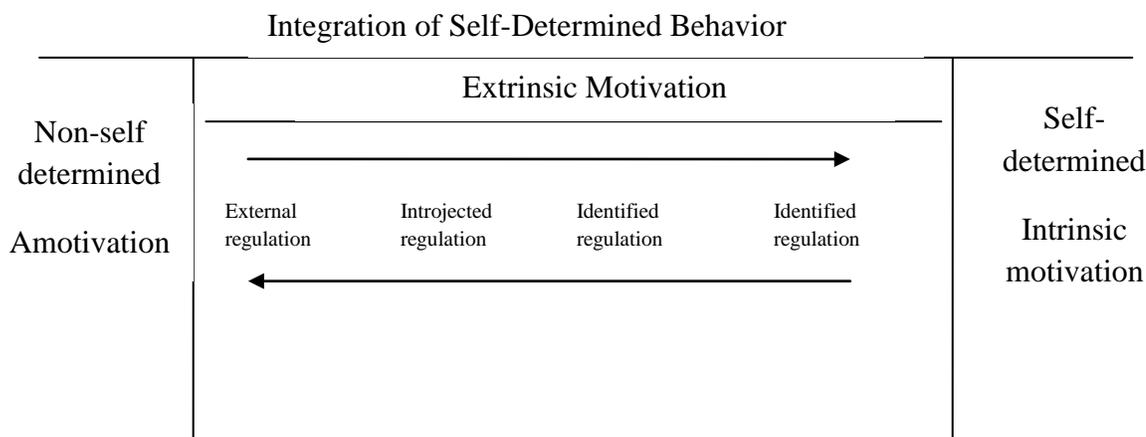
Figure 1: Self-Determination Continuum (Adapted from Deci & Ryan, 2000)

determination continuum is *external* regulation. The sole reason for engaging in a particular behavior that is externally regulated is merely for reward. The perceived locus of causality is external; that is, the behavior is emitted to obtain rewards or avoid punishment. Moving to the right on the continuum is *introjected* regulation. At this point regulation has been internalized to a small extent. Behavior is performed as a function of ego enhancement, based in contingent self-worth. An individual may engage in a task to avoid feeling guilt or because it is the "right" thing to do. Further along the continuum is *identified* regulation. Behaviors begin to take on value at this degree of regulation, and are considered to take on more autonomy and internal causality.

Integrated regulation is the highest degree of extrinsic motivation, and shares qualities with intrinsically motivated behavior. Integrated behaviors, however, unlike intrinsically motivated behavior, are performed not because they are inherently interesting and challenging. Rather, they lead to personally important outcomes. The value of such behavior is not fully integrated with the self.

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Causality Orientations Theory

The third mini-component comprising SDT is causality orientations theory. The theory is concerned with how individuals orient towards social contexts; it helps explain person-environment interactions. Three orientations are outlined by the theory, namely, autonomous, controlled, and impersonal causality, with the assumption that all individuals possess each of the orientations in varying degrees. An autonomous orientation is represented by the regulation of behavior on the basis of interests and self-endorsed values. A controlled orientation is characterized by behavior that is introjected and/or external. It is concerned with "should" and "ought" impositions toward expected behavioral outcomes. Lastly, impersonal causality is a function of behavior that is unintentional, with focus on ineffectance.

Basic Needs Theory

To suggest a universal psychological need, such as autonomy, competence, and relatedness, a set of criteria, not unlike that of biological needs (e.g., thirst and sex) need to be met. At the basic core of a need is diminished well-being when deprived of said need. In addition, to qualify as a need, the assumption of universality must be met. In other words, the need should not be culture specific, but rather it should be human specific. Culture may, however, affect the nature and degree to which a need is salient. The need is pervasive nonetheless. Within the context of SDT, competence, autonomy, and relatedness are considered a part of a full-functioning individual, and thus are considered eudaimonic. This is a characterization made in contrast to hedonic well-being, which is akin to happiness. The notion of competence, autonomy, and relatedness being innate needs has been substantiated through

empirical means (e.g., Ryan & Frederick, 1997; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Sheldon, Ryan, & Reis, 1996).

Implications of SDT in Educational Contexts

Implications for SDT in educational contexts are many. Four implications are outlined here, one implication each for: intrinsic motivation, competence, autonomy, and relatedness. Intrinsic motivation is achieved through facilitating competence, autonomy, and relatedness (Krapp, 2002). It is an educational implication because facilitating intrinsic motivation can improve learning (Benware & Deci, 1984; Brophy, 2004; Deci, Koestner, & Ryan, 2001; Perlmuter & Monty, 1977; Sadowski & Woodward, 1981). Specifically, intrinsic motivation leads to the experience of pleasure in activities in which students engage. The experience of pleasure leads to repeated willful exposure to content time and time again. That is, the positive emotions experienced as a result of intrinsic motivation become associated with the activity, which lead to subsequent reengagement of the content in order to experience positive feelings again (Csikszentmihalyi, 1990). Furthermore, intrinsic motivation improves student learning by helping them maintain attention on a task (Csikszentmihalyi & Nakamura, 1989), which can help them achieve at high levels (Gottfried, Fleming, & Gottfried, 2001).

Furthermore, SDT provides a framework for how to turn uninteresting activities and subjects into more intrinsically motivated endeavors. Uninteresting activities are ones that result in extrinsic regulation, and potentially external and introjected motivation (Deci & Ryan, 1985). In other words, the activity or subject is not internalized with the self, is not perceived to have value, and therefore, is not inherently interesting and challenging. Educational practitioners can help students internalize behaviors by showing them the value of activities and subject matter.

Demonstrating the relevance and usefulness of subject matter are two means to achieving this end. Some extrinsic prodding may be necessary at first, but it is possible to get learners to internalize such behaviors to the extent that they begin to find value and worth in those tasks and activities in which they are asked to participate. The more they internalize the behavior, the more they are likely to be engaged. The more engaged the learner, the more they are likely to learn at deeper levels.

The second implication involves facilitating competence. The competence need refers to an individual dealing effectively with his social environment interactions and experiencing opportunities to express and exercise his capacities (Deci & Ryan, 2002). Competence is a perceived sense of confidence and effectance felt during interaction with an individual's environment (Deci & Ryan, 2002). Therefore, students who believe they can be successful at tasks the teacher requests them to perform are more motivated to engage in those tasks. To enhance students' competence, classroom tasks should allow for students' ability to succeed at challenging tasks. Easy tasks do little to foster a sense of competence (Ormrod, 2008). The level of challenge, then, should match students' abilities in order to avoid their discouragement with respect to a particular task or subject (Csikszentmihalyi, 1990). Notably, feelings of competence do not enhance intrinsic motivation unless they are accompanied by a sense of autonomy (Deci & Ryan, 2000).

To foster autonomy, educational practitioners should consider three points. First, when designing and implementing instruction, building in opportunities for choice, within reasonable limits that allow for true selection in course of action, is recommended. Doing so promotes greater interest and engagement in class-related activities, along with fewer task-irrelevant behaviors (Paris & Turner, 1994; Powell & Nelson, 1997; Stipek, 1996; Vaughn & Horner,

1997; as cited in Ormrod, 2008). Second, limiting threats and deadlines to the best extent possible is recommended (Deci & Ryan, 1985). Allowing for revision and early submission of work are two means of facilitating this recommendation. Along the same line, educational practitioners should avoid controlling statements, and instead focus on ones that are informational in nature (Koestner, Ryan, Bernieri, & Holt, 1984). This includes the use of positive feedback that is immediate and specific.

The concept of relatedness, which leads to the fourth implication, can promote self-determination in classroom contexts through two important means: teacher-student interaction and student-student interaction. Teachers who foster a sense of caring, both academically and personally, facilitate relatedness (Davis, 2003; Jones, 2009; Roeser, Eccles, & Sameroff, 2000). Caring can be demonstrated by showing concern for students' success and failures, listening to and valuing their ideas and opinions, and allotting time to help students as needed (e.g., sending and responding promptly to emails; Jones, 2009). Student-to-student interaction can be facilitated as easily as allowing students to work together on various assignments, projects, and in-class activities. Developing a community of learners (e.g., Wenger, 1998) may be one means to achieve this end.

In sum, SDT as a framework for motivating learners provides a great starting place for how to build a classroom and curriculum that are motivating to learners. Providing opportunities for competence-building, choice (within reason) in learning objectives, and opportunities for relatedness on teacher-student and student-student fronts can lead to internalization of behavior that is initially perceived as controlling and lacking value. This process can further lead to motivation that is intrinsic in nature. SDT illuminates the path to engaged learning and a motivating classroom climate. SDT's focus is on the environment and psychological needs in the

facilitation of intrinsically motivated behavior. Intrinsically motivated behavior, according to Deci and Ryan (2008), is based on interest. Promoting interest, then, is a means to promoting intrinsically motivated behaviors and vice versa.

Interest

Although SDT is focused on the environment and the person, interest involves affective and cognitive aspects as separate but interacting components (Hidi & Renninger, 2006). When individuals engage, and therefore devote cognitive resources to something they like (i.e., find interesting) they generally feel good about that experience (Schiefele, 1998; Hidi & Renninger, 2006). Engagement is given direction through an individual's environment and the salient content therein. This is an important consideration for educators, in that it makes explicit the ability to engineer environments to include what can be considered interesting content, activities, and interactions. Another important consideration stems from differences among learners. While environments can indeed be engineered to foster interest, variables within the individual, such as self-efficacy, goal setting, and self-regulation of behavior, play a role in the progression or recession of interest between situational interest and individual interest phases (Renninger & Hidi, 2002).

Situational interest and individual interest constitute the two general types of interest distinguished among theorists. Situational interest involves focused attention and affective reaction, and is typically short-lived and environmentally salient. A magazine article, for example, may pique curiosity and spur some form of brief engagement with the information contained therein. Individual interest, in contrast, involves reengaging with some task, activity or information over time. It is characterized by an assigned value, is not externally driven, and is

topic-specific (Schraw & Lehman, 2001). At this stage of interest, stored knowledge, positive feelings, and reengagement of content over time serve as distinguishing characteristics (Hidi & Renninger, 2006). The initial reading of the magazine article may provide the impetus to reengage its content over time, so much so that a brief encounter becomes a sustained endeavor. If so, the initial interest could lead to an individual interest.

Two prominent interest theories are Krapp's (2005) person-object approach to interest (POI) and Hidi and Renninger's (2006) four-phase model of interest. The former views interest as an outcome of competence, autonomy, and relatedness. The latter views interest as having a reciprocal relationship with competence, autonomy, and relatedness. Both theories build on SDT and intrinsically motivated behavior and provide insight into how to foster each.

Krapp's Person-Object Approach to Interest

Krapp (2002) defines interest as a relational concept—a relationship between an individual and an object. The person-object-relation is characterized by emotion and value-related aspects. Cognitive aspects are considered to be appropriate identifiers of interest for small children, but probably not older age groups. The object of interest can be either perceptual (an idea, abstraction, etc.) or something more concrete. Engagement with an object is a situation-specific interaction. If the interaction has intention and purpose, then the engagement is an action of interest. Intentional learning or vocational training with conscious and intentional control serves as examples for this type of engagement. If an object receives interaction over time repeatedly, the relationship with the object will stabilize, leading to willful reengagement with contents related to the domain of the object. This reengagement is part of the process of developing personal interest. Furthermore, the POI approach is centered on the influence of

competence, autonomy, and relatedness in the emergence and stabilization of interest and interest-related motivational orientations (Krapp, 2005). In other words, predispositions to reengage a particular content of interest will only be realized if a person satisfies the basic psychological needs of competence, autonomy, and relatedness in regards to the domain of a particular content.

Hidi and Renninger's Four Phase Model

Hidi and Renninger's (2006) four phase model is based on the premise that both situational and individual interest have two phases. Situational interest is first triggered through environmental stimuli followed by a subsequent phase where interest is potentially maintained. Individual interest includes an emerging individual interest and a well-developed individual interest. Situational interest provides the impetus for each of the subsequent phases in both situational and individual interest. An emerging individual interest does not occur without first being initiated by situational interest, which is then (potentially) perpetuated through continued support from relevant others, and reengagement of content over time (Hidi & Renninger, 2006; Renninger, 2000; Renninger & Hidi, 2002).

Phase one of Hidi and Renninger's four phase model is triggered situational interest, and is denoted by short-term changes in affective and cognitive processing. Triggering is typically a function of salient environmental stimuli, which may include content that is incongruous, surprising, intense, or relevant. In the context of educational environments, activities and instruction that involve group work, puzzles, technology, etc., and stir a likeable encounter, have demonstrated efficacy in spurring situational interest. If such triggered interest serves as the

impetus to reengage content over time, then it is possible to progress into more developed stages of interest.

Phase two of the model involves an evolution from triggered situational interest to maintained situational interest. Like triggered situational interest, attentional resources are devoted to a content which is typically externally driven (environmentally salient). The difference is that maintained situational interest involves the persistence of devoted attentional resources over an extended period of time. Tasks that are meaningful and relevant help sustain this type of interest. Therefore, including activities that include project-based learning, group work, and individualized tutoring can promote maintained situational interest.

Phase three continues the evolution of interest, transitioning from brief, contextually driven engagement with stimuli in the environment, to an emerging individual interest. This phase of interest is marked by a relatively enduring predisposition to seek recurrent engagement with an area of content or tasks over time. In addition, it is characterized by positive feelings, stored knowledge, and stored value. If given the choice to engage in tasks involving this particular area of content, an individual will do so willfully. Other notable characteristics of this stage of interest include self-set challenges, self-generated questions, resourcefulness, anticipation of subsequent steps or events, and exertion of effort that feels effortless. This type of interest typically involves external support from peers, experts, etc., and can be fostered through properly engineered learning environments.

The final phase in the model, well-developed individual interest, is an amplification of the third phase of the model. There is an enduring predisposition to reengage content over time, positive feelings associated with that engagement, along with increased amounts of stored

knowledge, and internalized value of the domain of content. Essentially, the same prominent characteristics of phase three (resourcefulness, effortless effort, etc.) are intensified. Frustration will not prevent perseverance as easily. And, like phase three, external support may prove beneficial, though the intensity of scaffolding will not need to be as strong. Instructional conditions can foster well-developed interest by providing opportunities for interaction and challenging conditions that promote knowledge building.

Contrast Between Models

Hidi and Renninger (2006) outline three important similarities between Krapp's POI approach (2005) and their (2006) four phase model. One, interest is viewed as a specific relationship formed between an individual and an object. Two, interest is not general in terms of content, rather it is content-specific. Three, interest development and positive feelings are sine qau none—without one there is not the other.

Hidi and Renninger (2006) also identified differences between models, which are subtle, but important nonetheless. In the POI approach, interest is comprised of value-related and feeling related valances, which is not a shared assertion of the four phase model. Affect in the four phase model is considered integral to engagement with interesting content, and when combined with knowledge, informs valuing. Additionally, cognitive and affective factors are part of each stage of interest development in the four phase model. In the POI approach model, the cognitive aspect of interest is only considered appropriate as an identifier of the interest of young children (Krapp, 2002). The four phase model, in contrast, suggests differing levels of stored knowledge and stored value are a criterion in interest development and comprehension for all ages (Hidi & Renninger, 2006). Lastly, Krapp's POI approach to interest is grounded in cognitive evaluation

theory (Deci & Ryan, 2002), with particular emphasis on the satiation of competence, autonomy, and relatedness. Hidi and Renninger, however, view interest as having a reciprocal relationship with competence, autonomy, and relatedness. That is, they view engaging with content to potentially contribute to perceived competence and foster greater autonomy, not to necessarily be an outcome of either's satiation.

Implications for Interest in Educational Environments

In the context of education, situational interest can be promoted by inclusion of topics such as sex, romance, destruction, and danger (Hidi & Renninger, 2006; Renninger, Hidi, & Krapp, 1992). Additionally, topics or activities that involve novelty, culture, current events, or a high activity level are considered to be more interesting. Individual interest can be promoted by providing resources and creating opportunities for group interaction, challenging activities, and competence enhancement. In sum, the potential for an upward spiral of intrinsic motivation, positive emotion, and learning at deeper levels can be realized through the promotion of self-determined behavior and interest development.

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Affect

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Affect is an important aspect of student motivation and engagement within the context of academic motivation (Boekarts, 1993; Csikszentmihalyi & Rathunde, 1993; Op't Eynde, De Corte, & Verschaffel, 2001). Given the role of affect in promoting interest (Hidi & Renninger, 2006), and its integral role in flow theory (which I will discuss in sections that follow) I felt that a review of the concept should be included in this manuscript. It serves as one more piece of the puzzle in understanding intrinsic motivation, and serves as an excellent segue into flow theory.

Generally speaking, affect can be thought of as how a person, event, or situation makes one feel (Netz, 2007). Affect (emotions) constitutes the feelings (both physiological and psychological in nature) that people have in response to relevant experiences as they work to satisfy their needs and goals (Campos, Frankel, & Cameras, 2004). Whereas motivation, according to Deci and Ryan (1985), is the energization and direction of behavior, emotions provide the energization of thinking and acting, which in turn help facilitate adaptive responses to the circumstances humans encounter (Goleman, 1995; Saarni, Mumme, & Campos, 1998). Boredom, for example, may lead an individual to seek out more exciting activities; anxiety may invoke a physiological response to flee an unpleasant event; and happiness may prompt an individual to share moments of joy with others and seek out similar experiences in the future (Sarrani, et al., 1998).

Positive experiences facilitated by individuals such as educators and coaches can lead to states of affect that are desirable, insofar as they bring about enjoyable experiences (Csikszentmihalyi, Rathunde, & Whalen, 1993; Csikszentmihalyi & Schneider, 2000; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003). Students and athletes who find activities enjoyable are more likely to seek out such experiences again over time, which can lead to an upward spiral of effort and learning for a particular activity or domain. Furthermore, learning experiences that foster a good mood are more likely to get individuals to cognitively engage new material and persist in trying to understanding information related to that experience (Linnenbrink & Pintrich, 2004). Therefore, facilitating conditions conducive to enhanced states of psychological affect (i.e., flow) and intrinsic motivation are worthwhile goals in the context of schooling and academic settings. Doing so will likely facilitate positive associations with

material presented and create conditions conducive to reengagement with content over time (Hidi & Renninger, 2006; Schweinle, Turner, & Meyer, 2008).

Summary of SDT, Interest, and Affect

Up until this point I have explained the topics of self-determination theory, interest, and affect. I selected these topics because they provide insight about how to engineer environments conducive to intrinsic motivation, and in particular flow, an intense state of intrinsic motivation (Deci & Ryan, 1985). With SDT, I outlined how satiating competence, autonomy, and relatedness can lead to intrinsically motivated behavior. Interest theory built upon this notion, particularly with Hidi and Renninger's (2006) Four Phase Model, by showing that well developed individual interest and intrinsically motivated behavior are inextricably linked. In general, fostering one has the potential to facilitate the other (i.e., there is a reciprocal relationship between self-determined behavior and interest-engaged activities and tasks). The role of affect in interest and cognition further clarifies how to promote intrinsically motivated behavior, in that affect is how individuals feel about a particular task or subject. If individuals enjoy a domain-specific task, they are more likely to revisit that domain again. If, however, they feel frustrated and anxious when engaging a particular domain (e.g., math), they are likely to develop disdain towards that domain (Shepperd & McNulty, 2002), and thus less likely to reengage willfully.

With these three frameworks explained, I will now turn to the focus of this review, flow theory, which incorporates components of self-determination, interest, and affect to describe an intense state of intrinsic motivation. So far I have outlined SDT, interest, and affect in the context of educational settings. That being said, the nature of the population I intend to study

(Army ROTC) and the particular activity under investigation (marksmanship training), while situated in an educational setting, is better addressed through a variety of theories. Therefore, the following review of the flow literature will span a variety of settings, including educational, non-educational, and sport contexts. I think using a variety of frameworks and theories provides the best approach to understanding the current state of the flow paradigm. In my opinion, by examining multiple contexts, the applicability of the theory can be better understood. Additionally, the generalizability of the theory is better examined when approached from multiple contexts, which helps make determinations about its use in this and future investigations.

Flow Theory

Background and Theoretical Underpinnings

Flow theory is grounded in positive psychology. It does not focus on the alleviation of depression and anxiety, but instead, promotes the creation of conditions conducive to joy (Seligman & Csikszentmihalyi, 2000). The theory was developed to better understand motivation through the dynamic interrelations between affect, motivation, and cognition (Csikszentmihalyi, 1975; Csikszentmihalyi & Nakamura, 1989). In early research, patterns began to emerge from people's experience with rewarding activities (i.e., intrinsically motivating activities) that would eventually lead to the concept of optimal experiences. It was discovered, that under a certain set of circumstances, the ability to experience an intense state of affect known as flow (akin to "being in the zone") could be realized. Flow was discovered to be the product of balanced skills and challenges. If the challenge is high and the individual believes he or she possess the efficacy to meet that challenge, the ability to achieve a flow state is more readily realized

(Csikszentmihalyi, 1997; Jackson & Csikszentmihalyi, 1999). Notably, the level of challenges and abilities for a particular task are likely perceived as above average when in the flow state (Csikszentmihalyi, 1997; Jackson & Csikszentmihalyi, 1999). The flow channel is akin to Vygotsky's (1978) notion of the zone of proximal development, in that that there is a stretching of previous ability. That is, activities that are learning-intense, optimally challenging, and foster positive emotions better facilitate stretching of cognitive structures and physical capability (Shernoff et al., 2003).

Flow may or may not result under conditions of perceived challenges and skills for a particular situation. Just because such conditions exist, the flow experience is not guaranteed. There are many factors and conditions that can impede the flow experience, such as anxiety (Csikszentmihalyi, 1990), lack of self-determination (Deci & Ryan, 2002), lack of interest, and idiosyncratic personality dispositions (Csikszentmihalyi, 1997; Jackson & Eklund, 2004). The experience of flow is dependent upon *concentration*, *interest,* and *enjoyment* in an activity occurring simultaneously (Csikszentmihalyi, 1997). Given this assertion, self-determined behavior, interest, and affect acting together holistically play an integral role in whether or not flow will be experienced.

Operationalization and Dimensions of Flow

The flow state is often used interchangeably with peak experience and peak performance. To better operationalize the framework, it is necessary to distinguish similarities and differences between the peak experience, peak performance, and flow. Peak experiences are moments of intense happiness or joy in one's life (Maslow, 1968). They are rare and fleeting, but important because they facilitate self-actualization and growth. Peak experience is more closely aligned

with positive emotions, with fulfillment, significance, and spirituality serving as major themes (Privette & Bundrick, 1991). Peak performance, on the other hand, is an episode of superior functioning (Forbes, 1989). An individual may have a peak performance but not necessarily a peak experience, and vice-versa. However, extremely positive psychological states often underlie peak performances (Privette & Bundrick, 1991). Flow is more likely to accompany a peak performance, but not necessarily a peak experience (Jackson, 1993). Why this is the case is not clear at this time (Jackson & Kimiecik, 2008).

Given the definitions for peak experience and peak performance, discriminating what constitutes the flow experience is better achieved. Flow is operationalized as a "positive psychological state that typically occurs when a person perceives a balance between the challenges associated with a situation and his or her capabilities to accomplish or meet these demands" (Jackson & Kimiecik, 2008, p. 382). The experience denotes moments of full absorption and concentration in a task (Jackson & Kimiecik, 2008) whereby an individual's efficacies are used in an efficacious manner. It is necessary for relevant skills to be engaged in a manner befitting a challenge. The challenge should be one that is just the right amount for individual's capabilities, and is usually above average (Csikszentmihalyi, 1997). This does not mean that flow is reserved for those who are skillful masters of a task or domain. In fact, everyday mundane experiences can induce flow, just so long as the task is perceived as challenging, and has goals, rules, and requires attention (Csikszentmihalyi, 1990). A mundane experience that leads to flow is probably not deep in nature, but rather on a microflow level.

The depth of flow is a function of perceived skills and perceived challenge. To enter a flow state, individuals must perceive a task to be challenging, as well as believe they have the efficacies to meet the demands of the task. If the perceived challenge is too high and perceived

skill level too low, a potential result is anxiety. If the perceived challenge is too low and perceived skill level to low, boredom or apathy is a likely result (see Figure 2). For example, if a master chess player takes on a novice, the master chess player is likely to experience boredom or relaxation, while the novice is likely to experience anxiety. However, if the master chess player has an opponent with similar skills and capabilities, the potential to enter flow, and experience it at deeper levels, is possible.

Deeper states of flow require all of a person's relevant skills to cope with the challenges of a situation. Coping requires that a person's attention be entirely absorbed in the activity (Csikszentmihalyi, 1990). It is here that optimal experience can take place. Optimal experience is achieved when individuals becomes so absorbed they no longer separate themselves from their actions; their actions take on automaticity and spontaneity. The activity becomes its own reason for achieving, and extrinsic motivations become diminished. Notably, hard work, physical exertion, or highly disciplined mental activity is required to achieve the sensation of deep flow. Complete concentration is necessary to maintain this deep state of flow, and that concentration is given its potency through an individual's efficacies (Csikszentmihalyi, 1990).

Flow was found to consist of nine major dimensions, which became apparent in Csikszentmihalyi's early research efforts on the construct (Csikszentmihalyi's 1990). The dimensions have been subsequently substantiated in various contexts, such as sport (e.g., Jackson & Marsh 1996). The dimensions are: merging of action and awareness, sense of control, an altered sense of time, balanced challenges and skills, clear goals, unambiguous feedback, concentration on the task at hand, loss of self-consciousness, and autotelic experience (Jackson & Csikszentmihalyi, 1999). Although these dimensions are part of the flow construct, all are not
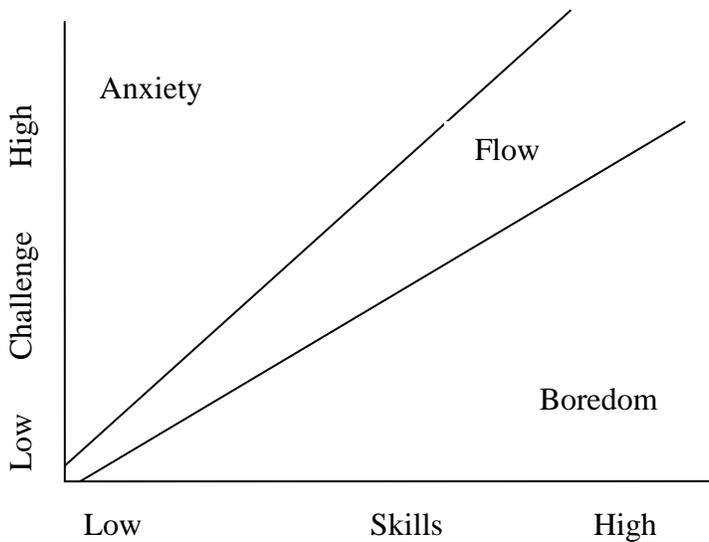
Figure 2: The Flow Channel (Adapted from Csikszentmihalyi, 1990)

necessarily experienced when in flow. I summarize Jackson and Csikszentmihalyi's (1999) explication of the nine dimensions below.

Merging of action and awareness. Action-awareness merging is a total absorption into a task in which the body and mind perform effortlessly and the individual feels at one with his or her actions. This absorption is so intense, the individual has no cognitive capacity left for worries or fears; the outside world becomes irrelevant. Effortless effort is the result of automatic cognitive processing, where the individual becomes one with the activity. The individual must feel that they have the skills necessary to meet the challenge, and must focus all of their attention on the task at hand. "The unified consciousness brought about by the merging action and awareness is perhaps the most telling aspect of the flow experience" (Jackson & Csikszentmihalyi, 1999, p.20).

Sense of Control. Sense of control frees an individual from fear of failure and empowers them to actualize goals and meet challenges. The individual feels in control, but isn't worried about losing control. This requires just the right balance, as too little control will lead to boredom and too much to anxiety. The person must believe they have the required skills for the task at hand.

An altered sense of time. Transformation of time involves having an altered sense of the way time proceeds, usually experienced as a shortening, in which it seems hours pass in minutes, although the reverse is possible. This requires total concentration, as being focused/absorbed doesn't allow the individual to track time, unless time is integral to the task. A runner, for example, may perceive a competition to have lasted less time than it actually did. A surgeon, on the other hand, may be very aware of time during an operation, particularly one in which minutes in the procedure translate into the difference between life and death.

Balance of challenge and skills. Challenge-skills balance is, for most, the result of perceived ability being capable of meeting relevant challenges. To achieve flow, challenges and skills are needed to be in balance and above an average subjective experience (Csikszentmihalyi & Csikszentmihalyi, 1988, as cited in Jackson & Kimiecik, 2008). According to Csikszentmihalyi (1997), situations in which challenges exceed ability, anxiety will result. If ability exceeds challenges the situation affords, then boredom is the likely result. In the instance in which both challenges and skills are low and below average, apathy is the likely result.

Clear goals. By defining short-term and long-term goals, especially short-term process and performance goals, direction and focus can more easily be harnessed. By specifying intention, individuals can help themselves avoid distraction, as requirements are clear; there is no

need for second guessing. Short-term goals should be used in conjunction with long-term goals and potentially outcome goals to help facilitate this process.

Unambiguous feedback. With clear goals, feedback is readily available while performing a task. Feedback lets the individual know how they are doing in relation to actualization of goals. One of the most important forms of feedback for performers (e.g., athletes, dancers) is that provided by the body, such as kinesthetic awareness or knowledge of where the body is in space. External forms may come from coaches, instructors, peers, parents, or the performance itself.

Concentration on the task at hand. With clear goals (focus), immediate and relevant feedback, and the right balance of challenge and skill, attention is attuned to the demands of the task. Concentration on the task requires attentional focus that is complete and purposeful, with no extraneous thoughts distracting from the task at hand. This is not an easy task to master, but essential to flow experiences.

Loss of self-consciousness. Loss of self-consciousness involves the loss of ego or self along with worries and negative thoughts. A person may be tuned to the body, just not concerned with extrinsic factors that arise from the conscious. There is a loss of self or ego, not to the point of loss of necessary skills, but more so a loss of consciousness of the self. There simply is no room left in working memory to process extraneous thoughts while in flow. Loss of self-consciousness, after the flow experience, may result in the perception of self as stronger and more positive (in/through reflection).

Autotelic experience. Csikszentmihalyi coined the term autotelic (auto meaning self, telic meaning goal) to describe intrinsically motivated experiences (activity performed for its own sake). Such experiences denote moments of full involvement.

Outcomes of Flow

The outcomes of the flow experience are what make it rewarding as an experience and so important for educational and sport practitioners to foster. This assertion is attributable to individuals reporting flow to be an optimal and enjoyable experience (e.g., Csikszentmihalyi & LeFevere, 1989; Jackson 1992, 1996). Jackson and Kimiecik (2008) point out some valid research findings regarding positive outcomes of the flow experience. For example, one investigation found that people at work who experience flow regularly had greater positive affect and potency (e.g., active, alert, strong) than coworkers not in flow (Csikszentmihalyi & LeFevere, 1989). Another investigation that examined children's physical activity at a summer sports camp showed flow experiences to be positively related to "feeling good" and "perceived success" (Mandigo, Thompson, & Couture, 1998).

Csikszentmihalyi (1997) points out that a positive emotional state, such as flow, can help focus attention, which in turn can improve learning outcomes. Hektner and Asakawa (2000) further substantiated flow states being associated with high concentration, and also found associations between flow and self-worth. Furthermore, positive emotional states during tasks and activities can lead to the desire to reengage that task and activity time and time again (Hidi & Renninger, 2006). This has the potential to lead to a positive motivational cycle in which flow experiences help perpetuate positive emotional experiences, which in turn enhance intrinsic motivation (Kimiecik & Harris, 1996). Over time, such experiences have the potential to become

autotelic (Csikszentmihalyi, 1997). This transitory process has the potential to promote

complexity and growth in consciousness (Csikszentmihalyi, 1997). That is, the self becomes

more complex (Jackson & Kimiecik, 2008).

Researching Flow

Flow has been examined in a variety of educational and non-educational contexts. I have

selected a few studies I believe to be important in the ongoing investigation of flow in order to

achieve two ends. One, by gleaning information from a variety of contexts, a more nuanced

interpretation of flow and its applicability in educational contexts can be achieved. Inferences

can be extrapolated from other contexts to inform potential applications of the theory in other,

similar contexts. Two, a variable-context approach will help illuminate potential gaps and

inconsistencies that exist within the flow paradigm. The studies I have chosen are situated in the

context of education or sport or lean toward such contexts, and are empirical in nature. They

highlight the potential application of flow theory in various contexts, and also demonstrate flaws

and weaknesses used in gathering data on the latent construct. I focus first on non-sport contexts

and then examine multiple investigations in sport. After reviewing selected investigations, I

focus on measurement of the flow construct, psychological skills training, and the intended

research population.

Flow and Regulatory Compatibility

Keller and Bless (2008) proposed that the experience of flow represents a regulatory

compatibility experience. Regulatory compatibility is broadly defined as the compatibility of

person characteristics and environmental characteristics (roughly equivalent to challenge-skills

balance). To investigate this proposition, they conducted two studies in which they examined the

consequences of compatibility of skills and task demands during task engagement. In doing so, they moved away from correlational research, and instead utilized an experimental design from which the causal impact of skills/demands compatibility on the emergence of flow could be determined. They conducted an experiment that examined participants' self-reported flow under varying conditions of an adapted computer game similar to Tetris.

Participants were 72 undergraduate students randomly assigned to one of three game conditions representing a boredom condition (low task demands), an adaptive condition (task demands automatically and continuously adapted to participants' level of skill), and an overload condition (very high task demands). After eight minutes of playing time, participants were asked to complete a questionnaire designed to assess dimensions of flow. Participants were assessed on their performance, perception of time passing, feeling of control, involvement and enjoyment, and perceived fit of skills and task demands.

Results for performance revealed that participants in the adaptive playing mode condition reached higher performance scores on the task than their counterparts in the boredom and overload conditions. A significant effect was discovered for perception of time passing in the adaptive condition as well, as compared to the boredom, and the overload condition. These findings are consistent with the experience of intrinsic motivation (Conti, 2001) and supports the notion that task demands and perceived fit of skills are involved in the emergence of intrinsic motivation (Keller & Bless, 2008).

The findings reported in the five conditions (performance, perceived time on task, perceived control, involvement, and perceived fit) highlight the importance of matching task demands to skill capabilities. This adds to the literature base by reaffirming the importance of

balancing challenge and skill in order to experience flow-like affect (see Schweinle, Meyer, & Turner, 2006).

There are three limitations with this investigation. First, the investigators did not assess prior experience of participants, which may affect flow perceptions. In a recent investigation of Army ROTC cadets (Rakes & Jones, 2011), I found that prior experience played a role in whether or not cadets experienced flow during marksmanship training. Based on these findings, I speculate the degree of transfer and prior knowledge participants in Keller and Bless' investigation had may distort perceived challenges and skills. Knowing the level of prior experience would help illuminate whether similar conditions in similar contexts would lead to flow. Said differently, by assessing prior experience, one could better infer whether it was the challenge-skill conditions or some other variable (e.g., prior experience) that lead to flow perceptions. Two, the sample size for this investigation was small, which makes generalizing to other contexts difficult. Three, the notion of losing track of time has been shown in other empirical investigations to be the weakest of the flow dimensions (e.g., Jackson & Eklund, 2004), and therefore may not represent a very telling aspect of the flow experience.

Despite these limitations, the experimental nature of their work does provide causal, as opposed to correlational, data for what aspects of flow theory contribute to the flow experience and to what degree. This type of research within the flow paradigm is atypical, yet is needed in order to make causal as opposed to correlational interpretations of flow experiences.

Flow and Procrastination

Procrastination and cramming are undesirable learning behaviors and have particular significance in educational settings. Both procrastination and cramming are types of learning

behavior that produce superficial memorization, and not deep understanding of material provided by the instructor (Brinthaupt & Shin, 2001). Procrastination involves postponing actions necessary to attain a goal. Cramming instructional material is often the result of such procrastinating behavior. Cramming is basically massed practice, which involves a heavy burst of studying just prior to an exam or similar event after an extended period of neglect.

Explanations for procrastination or cramming stem from the inherent boredom and monotony course materials may afford, making waiting to begin studying more challenging and interesting. Students may engage in cramming because it brings about desired states of affect, such as flow. To investigate this hypothesis Brinthaupt and Shin (2001) designed experimental conditions to test whether the experience of flow would be more likely experienced by crammers than non-crammers. If results indicated crammers to report higher levels of flow experiences than their non-crammer counterparts, a different perspective could be developed for studying and understanding cramming behavior.

Participants were 161 undergraduates enrolled in an undergraduate psychology course at a large southeastern university. There were two components of interest. The first component used self-report measures in the assessment of student study habits and general flow experiences. The second component involved a simulation in which participants were subjected to a mock cramming session and then administered the Flow State Scale.

Results showed support for the researchers' hypothesis that positive effects to cramming exist, in that students who engage in cramming behavior experience flow as a result. Self-reported crammers performed better in the simulation and reported a greater amount of flow-like experiences during the simulation. Importantly, self-reported procrastinators were not as likely to

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experience flow during the task as were non-procrastinators. The data indicated a positive correlation between procrastination and cramming, yet their relationships to flow were opposite. That is, self-reported crammers performed better on the task and reported a greater amount of flow-like experiences while they worked on it. However, self-reported procrastinators were less likely to experience flow during the task than were non-procrastinators. The authors' speculate that crammers may engage in such behavior to make academic tasks more challenging and engaging. Challenging and engaging activities are ones that generally have potential for creating flow experiences. Procrastinators, however, may engage in such behaviors due to a lack of intrinsic interest in certain academic tasks. Under such conditions, flow is less likely, especially if the task is perceived as stressful or burdensome.

Although Brinthaupt and Shin provide insight into potential explanations for students' cramming and procrastination, the conditions set forth in this experiment may not simulate conditions like those students actually encounter in academic environments. This is due to a variety of factors that lab simulations do not afford, such as the administering of grades, the desire of students to impress classmates or the instructor, and time pressures. Because of these limitations, it is hard to determine whether Brinthaupt and Shin's results would generalize beyond similar, unrealistic conditions. Also, because students were assessed on flow after taking a multiple choice test, it is hard to determine whether flow was the result of test taking or cramming. Future research should attempt to investigate cramming and procrastination under more natural circumstances. One way to do this might be to administer the Experience Sampling Method (ESM) forms (Csikszentmihalyi & Larson, 1987) to student participants, page them at various times before and after an exam date, and then assess students' flow perceptions. Doing so would produce data more indicative of "real world" cramming and procrastination scenarios.

Flow and School Environment

As students reach middle school age, many experience a decrease in academic motivation (McDevitt & Ormrod, 2005). This decrease is partially attributable to the motivational climate fostered by the students' learning institution. Researchers wondered whether an environment that fostered a more personalized context for learning, like that of Montessori schools, may be able to partially alleviate some of the issues concerning academic motivation (Rathunde & Csikszentmihalyi, 2005).

To examine whether school motivational climate facilitates optimal experience as related to students' academic motivation, Rathunde and Csikszentmihalyi (2005) assessed flow experiences of 290 demographically matched students from Montessori and traditional schools. The Experience Sampling Method (ESM) was utilized to measure student affect, potency, salience, intrinsic motivation, and flow. To assess affect, students rated their emotions such as happy (vs. sad), relaxed (vs. worried), sociable (vs. lonely), and proud (vs. ashamed). Potency was assessed using the average of three semantic differential items strong (vs. weak), active (vs. passive), and excited (vs. bored). Intrinsic motivation was assessed with items like: "Did you enjoy what you were doing? Was this activity interesting? and Did you wish you had been doing something else?" (p. 352). Salience measures were based on the items: "Was this activity important to you? How important was this activity to your future goals? How challenging was the activity?" (p.352). Background data were acquired through questionnaire items similar to those used in National Education Longitudinal Study (NELS) data. ESM data collection at the traditional middle schools occurred 9 years before data collection at the Montessori schools.

In the comparison of motivation and quality of experience variables across school type, school context and ESM variables showed Montessori students reported more flow, higher

affect, potency, and intrinsic motivation while students completed their schoolwork. The traditional students, however, reported higher salience. The data revealed that students in the two school contexts reported differences in motivation (low or high) and importance (low or high). Traditional students more often perceived their school activities as having high importance and low intrinsic motivation, whereas the Montessori students' mean percent of divided interest/drudgery (26%, $SE = 1.9\%$) was lower than the traditional students' mean (44%, $SE = 1.8\%$).

With respect to quality of experience for nonacademic activities at school, five ESM variables revealed that students at both Montessori and non-Montessori school contexts reported higher levels of affect, potency, and intrinsic motivation in nonacademic activities, as well as lower levels of salience and flow in nonacademic tasks. Intrinsic level and potency were similar for both school contexts as well. Students in the traditional group reported significantly more flow experiences in nonacademic activities, although the Montessori students reported better overall affect. The traditional students reported higher levels of activity importance than students in the Montessori schools.

From these data, it would seem that a Montessori school environment may indeed promote greater academic motivation. Most critically, Montessori students reported greater affect, potency, intrinsic motivation, flow experience, and undivided interest while engaged in academic activities at school compared to their traditional school counterparts. This suggests that fostering a motivational climate similar to that of the Montessori schools in this study, may prove beneficial in promoting optimal experience for students.

However, the results from this study should be used with caution. For one, the (ESM) data gathered from traditional schools were gathered nearly a decade prior to the gathering of data from the Montessori schools. History, selection, and maturation threats are exist as a result (Grembowski, 2001). Specifically, history threats are positive findings may be due to other events or the experiences of students that take place from the time data are gathered in one instance to another (in this case 9 years). Selection threats refer to difference in the composition of the groups that account for observed outcomes. In this study, selection threats result from the use of groups that may be different (though demographically matched) in terms of cultural attitude, or potential shifts in norms. For example, the pervasive use of technology (cell phones, video gaming, and access to the Internet) may create differences between groups that affect level of engagement in various contexts. Maturation threats may be caused by mental or physical changes occurring within the participants themselves, which in this case could be caused by changes in school cultures (due to reforms such as No Child Left Behind, new research in teaching methods, or a wave of recently graduated educational practitioners).

Lastly, Rathunde and Csikszentmihalyi fail to provide data correlating motivational climate with testing scores. With the current standardized testing culture and accountability in American schooling, demonstrating optimal experience to have an impact on students' standardized test scores would likely prove beneficial in arguing for system-wide change in academic climate among traditional schools. This is not to discount the importance of greater affect, potency, intrinsic motivation, flow experience, and undivided interest while engaged in academic activities at school. Indeed, these important motivation variables would likely be considered by many to be valuable. Their importance, however, would be bolstered if correlated with performance on outcomes such as learning.

Flow and Music Creativity

Creating conditions conducive to music creativity is deemed an important part of curriculum practices in music education programs (MacDonald, Byrne, & Carlton, 2006). Teaching composing and improvising effectively is generally a standard part of the curriculum. Creativity is, in the context of music education, considered the creation of music that is new to the originator (MacDonald et al., 2006). Creativity comes about through experimentation, trial and error, sharing ideas, and collaborative work, and may or may not be written down in some form or the other. MacDonald et al. (2006), informed through literature linking flow and creativity (see Csikszentmihalyi, 1996), investigated student creativity under flow conditions to examine associations between the two. The investigators contended that fostering an environment conducive to flow may also foster an environment conducive to creativity.

To determine whether conditions of flow (i.e., challenge-skills balance, clear goals, unambiguous feedback, and sense of control) fostered creative composition, MacDonald et al. investigated the relationships between the creative product of a composing project and students' own reflections on the quality of their experience (i.e., flow) while engaged in the project. The intention of the researchers was to discover whether group composition would correspond with ratings of creativity while under flow conditions. Participants were 45 (25 male, 20 female) undergraduate music students. Groups of three students met for three sessions to complete a group composition. After each session students were instructed to individually fill out the Experience Sampling Form (ESF). After three sessions had been completed, compositions were rated for creativity by specialists (postgraduates and lecturers) and participants. A staff criteria form was used to rate creativity; raters rated creativity based on their own definition of creativity.

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Pearson correlations were used to compare ESF scores with creativity rating of specialists and participants. Results indicated statistically significant relationships between group flow score and individual flow scores (if one person was in flow, the others were also likely in flow), as well as between mean group flow and mean creativity rating by all staff (the higher the ratings for flow, the higher the rating for creativity). Interestingly, there was no statistical correlation between staff ratings of creativity and individual flow scores. This finding suggests that group flow is more important to creatively composing music.

The findings in this investigation highlight a couple of important implications for educational environments. First, flow may be a function of group dynamics. That is, if one individual within the group experiences flow, it is likely other group members would also experience flow. Therefore, it appears that flow might be contagious (Bakker, 2004). In terms of performance, this finding may have significant implications for environments in which group performance at a high level is desired, like that of interactive sports teams. In the classroom, teachers who are aware of flow conditions may be able to help students form productive small groups and develop successful group-oriented learning tasks (Armstrong, 2008).

Second, this investigation contributes to the growing body of literature linking the experience of flow and creativity, in that correlations were discovered linking group flow and ratings of creativity. The impact, however, could have been more substantive if the investigators had gone beyond mere correlational data and designed a true experiment. By comparing group composition creativity between groups under flow conditions to those under a different set of conditions, a more definitive interpretation about the relationship between flow and creativity could have been ascertained. By setting two different sets of conditions the investigators would

also have to distinguish exactly how they set conditions of flow. This distinction is not made clear in the study, and as a result, makes generalizing findings difficult.

Flow in Virtual Environments

As education in online learning environments becomes more pervasive, maintaining student engagement has become an increasingly relevant topic for research and discourse. To uncover relationships between constructs of flow and learning in internet-based virtual courses, Shin (2006) investigated students' responses to a virtual-course flow measure. Shin's measure was developed in accordance with a flow model, and was comprised of flow antecedents, flow, and flow consequences. Flow antecedents consisted of skill, challenge, and individual differences (i.e., concentration, clear goals, and gender). Flow was operationalized as consisting of enjoyment, telepresence, focused attention, engagement, and time distortion. Flow consequences consisted of achievement and satisfaction.

Participants were 525 undergraduate students enrolled in 23 virtual courses. Students were administered the virtual-course flow measure in order to examine the relationships between flow antecedents, flow experiences, and flow consequences (course satisfaction and achievement). Correlational analyses revealed several important findings. First, students' level of skill and challenge specific to each course are critical in determining level of flow (i.e., flow condition correlated with challenge) because flow condition correlated with skill. Second, flow is a significant predictor of course satisfaction. Regression analyses confirmed the effect of flow as a significant predictor of students' satisfaction when other individual differences were controlled for. Third, other than flow, individual differences (e.g., gender, having clear goals) can make a significant difference in the level of flow experienced in a virtual course. Although there was no

gender effect on flow, males reported statistically higher values on measures of perceptions of concentration, skill, and flow condition than females.

Shin's findings suggest that individual differences play a crucial role in an individual's ability to experience flow. Factors such as concentration, clear goals, and gender, were found to be associated to an individual's ability to experience flow. These associations suggest that educators may need to facilitate goal-setting and provide instruction that is captivating. The author contends that setting conditions conducive to flow will not necessitate students' experience of flow. He asserts that an individual's motivation is a strong determinant of flow experience, thus course content and design are only partial determinants in facilitating flow.

Although the implications of this study are notable, they nonetheless should be interpreted with caution. First, participant data were taken from 23 different virtual courses. Utilizing nonrandomized participant data from this widely dispersed group makes the data open to selection bias (differences between groups, not instructional conditions lead to observed outcomes), and leaves too many questions about conditions that facilitate flow. Frankly, it is difficult to determine if individual differences are primarily responsible for facilitating flow, or if, and to what extent, the content of the course contributed to student flow experiences. Since there was no randomization of participants into the courses, outcomes could be contributed to extraneous factors (idiosyncratic personal differences) and not instructional conditions (i.e., maybe those students who take virtual course have an autotelic personality disposition). Second, without experimental conditions, it is difficult to determine exactly how flow antecedents, flow, and flow consequences contribute to students' flow experience. If educators are going to create conditions conducive to flow, then knowing what those conditions look like and how they might

be manipulated are imperative. This is true for both regular classrooms and virtual classrooms alike.

Flow and Academic Settings

Schweinle, Turner, and Meyer (2008) created a study to examine exactly how students' motivational, cognitive, and affective quality of experience is explained by flow theory. The investigators had two specific goals. The first was to determine whether classroom experience was stable or variable for individuals. They predicted more variability across situations than in individuals. The second goal was to determine which cognitive, motivational, and affective aspects of experience are most related to the interaction of challenge and skill. Participants were 42 elementary students (21 male, 21 female) randomly selected by sex from seven fifth and sixth-grade classrooms. Teachers were asked to choose a high, average, and low achieving student from each sex in their selected classrooms. Students were asked to complete the ESF following 12 class sessions; the form measured cognition, affect, and motivation. There were 427 experiences after omitting select data.

Pertaining to the researcher's first goal, to determine whether classroom experience was stable or variable for elementary students, intraclass correlation statistics revealed little consistency of scores in individuals across experiences. This finding is consistent with the hypothesis that scores should be a reflection of each specific experience and in contrast to research with adults and teenagers that demonstrated affective stability (Csikszentmihalyi & Larson, 1987).

For the second goal of determining which cognitive, motivational, and affective aspects of experience are most related to the interaction of challenge and skill, the following results were

obtained. Low challenge experiences saw little variation in affect or efficacy across skill levels. In high challenge experiences, personal affect and efficacy declined only when skill level was low (i.e., low skills and high challenges led to reduced efficacy and decreased affect). In high skill experiences, increases in perceived challenge did not necessarily result in changes in affect. The lowest affect (anxiety) occurred in high challenge and low skill conditions. That is, skill significantly predicted affect, and importance. Challenge was not as strong of a predictor as skill on affect, or efficacy (low skill), efficacy (high skill), or efficacy (medium skill).

There are several important implications from this study. First, classroom experiences (as reported on the ESF) vary for each student, as opposed to remaining stable across lessons. In essence, classroom experiences are situation specific, rather than person-specific. Second, it appears that challenge is important when accompanied by low skill. In other words, students were happier when their skills were greater than the perceived challenge. If skill level was low, and challenge high, students tended to demonstrate reduced efficacy and personal affect. It also appears that skill level, not challenge, is more important in mathematics classrooms in terms of quality experiences. This is counter to the postulates of flow theory, but it has been documented in other studies as well (e.g., Csikszentmihalyi & Nakamura, 2002; Jackson, 1995).

The findings reported by Schweinle et al. are very interesting. For one, they demonstrate that age and student development may have very important implications in achieving a flow-like state. It could be possible that elementary-aged students have not learned to enjoy challenging situations or activities. This could be due to a lack of challenging opportunities, either facilitated by the instructor or sought by the student. Another notable finding is that skill, not challenge, in math class is the important variable in determining quality of experience. This seems somewhat intuitive, in that students would be motivated and happier if they can actually perform what's

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asked of them. The key to promoting learning, as proffered by the authors, may be to address affect through supportive instructional practices, while also providing opportunities for engagement in challenging activities. Of course more research that utilizes larger samples and more diverse populations (across age and ethnicity) should be endeavored before generalizing results.

Summary of Flow Research in Various Contexts

Getting students to engage in learning activities for intrinsic, as opposed to extrinsic means is a worthy endeavor for educational practitioners. Flow theory provides educators with a viable framework from which to promote optimal experiences, and thus intrinsic motivation. Setting conditions conducive to flow requires that a proper balance between perceived challenge and skill be addressed (Keller & Bless, 2008; Csikszentmihalyi, 1990; Jackson & Csikszentmihalyi, 1999). This may be more important for older populations than younger ones, context-specific (Schweinle et al., 2008), and a function of group dynamics (MacDonald et al., 2006).

Some interesting findings were cultivated from the above investigations, the first of which is the notion that explicit conditions can be created to foster flow experiences. This notion is specifically substantiated with Rathunde and Csikszentmihalyi's (2005) investigation with Montessori and traditional schools in which they documented that Montessori students reported greater affect, potency, intrinsic motivation, flow experience, and undivided interest while engaged in academic activities at school compared to their traditional school counterparts. Second, there is support both for *and* against matching challenges and skill level in order to achieve flow. Keller and Bless (2008) provide further substantiation for Csikszentmihalyi's (1990; 1997) assertions, whereas Schweinle et al. (2008) found that high skill level and low

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challenge was a better predictor for flow conditions. This inconsistency has been reported by other researchers (e.g., Carli, Fave, & Massimini, 1988; Csikszentmihalyi & Wong, 1991; Stein, Kimiecik, Daniels, & Jackson, 1995).

Third, it appears that content can be inherently interesting, yet still produce boredom through tedious and monotonous tasks associated with instructional assignments (Brinthaupt & Shin, 2001). To overcome this monotony, students may cram material to increase the challenge of a task, and thereby better match their skill level with such demands. This implies that at any point during the interaction with a particular domain of content, an individual can create cognitive perceptions of challenge with a level of skill that surpasses such challenges. It would be worth finding out what role SDT plays in such perceptions, for example, by assessing satiation of basic needs alongside flow perceptions during a cramming exercise. This would lead to a better understanding of how and to what degree such satiation can foster interest and intrinsic motivation with boring tasks.

Flow in the Context of Sport

Examining the psychological factors contributing to successful athletic performance is an important undertaking for sport science. Understanding the conditions and factors that promote positive experiences for athletes encourages a variety of desirable behaviors, and suppresses other behaviors that are not desired. For example, coaches who facilitate flow experiences potentially enhance athlete performance, encourage perseverance, and diminish dropout rates (Jackson, Thomas, Marsh, & Smethurst, 2001). Therefore, an understanding of the antecedents of the flow state in sport and the relationship between flow and athletic performance will shed light on factors that contribute to successful athletic performance.

Susan Jackson has been a prolific researcher in the sport psychology field with her contributions to the literature on flow. Her research program on the construct began with seminal works in the early 1990s, which led to a book coauthored with Mihalyi Csikszentmihalyi in 1999, and the development of validated measurement scales with corresponding manual in 2004 (with Eklund as co-author). Her work continues today. Throughout much of this section I outline and summarize her efforts towards investigating flow experiences in the context of sport. I begin with two of her early works, and finish with some more recent publications. The use of her work with Csikszentmihalyi (1999) and Eklund (2004) is highlighted in other sections of this manuscript.

Jackson's early work on flow. Jackson (1992) conducted in-depth interviews with elite figure skaters in order to uncover factors that influence flow. Using Csikszentmihalyi's (1990) theoretical framework, she found the following factors (among others) to facilitate flow during performance: positive mental attitude, positive pre-competitive and competitive affect, maintenance of focus, and physical preparedness. She also discovered certain factors that served to impede flow experiences, among them: physical problems and mistakes, problems maintaining focus, and negative mental attitude. She followed up this investigation with another qualitative investigation with 28 elite athletes (Jackson, 1995). She asked the following research questions:

1. What helps you get into the flow state?

2. What prevents you from getting into the flow state? and

3. What, if anything, disrupts you once you are in flow?

Similar themes to those discovered in the Jackson (1992) investigation were revealed. Factors facilitating flow were: pre-competitive and competitive plans and preparation, confidence and positive attitude, physical preparation and readiness, optimal arousal level before competition, motivation to perform, performance feeling good, focus, optimal environmental and situational conditions, positive team play and interaction, and prior experience/expectations with flow. Factors preventing flow were essentially the antithesis of the factors that facilitate flow. Factors that disrupt flow were: non-optimal environmental and situational influences, problems with physical readiness, problems with team performance and interaction, inappropriate focus, performance errors, and doubting or putting pressure on self. Lastly, the majority of athletes (79%) believed that the flow state was something within their control.

These two qualitative investigations highlight some important implications for practitioners who wish to engineer conditions conducive to the flow experience. Specifically, athletes believe they can control the flow state, so long as a certain set of perceived conditions are met (e.g., optimal physical readiness, appropriate focus, prior experience). These are tangible means by which practitioners can influence the flow experience. For example, the implementation of visual imagery exercises may contribute to the perception of physical readiness (Cox, 2007), as well as foster a sense of extensive experience (Jackson, 1995). Psychological skills also play a role in confidence perceptions (Cox, 2007), which are integral to achieving the flow state. Lastly, Jackson (1995) concluded the data obtained from athlete interviews "indicate that athletes may have more self-determination over experiencing flow than typically believed" (p.164). This assertion suggests the plausibility of engineering conditions conducive to the flow state through means of promoting competence, autonomy, and relatedness.

Progression of Jackson's early efforts. To better determine psychological antecedents of flow in sport, Stein et al. (1995) conducted a series of three studies in three different contexts (39 adult recreational athletes participating in a first-round tennis tournament, 26 students enrolled in basketball activity classes at a major university (learning environment), and 8 male golfers, whom, on average, were 65 years old and had been playing for 33 years, 3-4 days per week). The first study had participants rate flow experiences pre-match, during the match, and post-match, while the other two studies used the ESM method to assess flow. Activity classes were structured to help students learn about basketball, with little emphasis on competition. The goal in this study was to examine the relationship between psychological antecedents (goals, competence, and confidence) and flow. For the second study, the main goals were to assess the effectiveness of using the ESM in sport and examine the influence of state goals on flow. The objective of the third study was to again examine psychological antecedents (goals, competence, and confidence) and their effect on flow.

Results from study one showed no differences between individuals in flow and non-flow with respect to task goals, ego goals, competence, or confidence. That is, the potential psychological antecedents showed no relationship with flow. Study two results showed that students found low skills, high challenge situations to be somewhat enjoyable. Students also perceived success in situations in which challenge was low, but skill level was high. Lastly, it appears that students with ego goals experienced more enjoyment than students with task goals. In study three, golfers had more enjoyable experiences in situations in which low challenge and high skills were perceived. The boredom context was not perceived as more enjoyable than flow, however. The findings for psychological antecedents were negligible in study three.

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The findings from the three studies highlight some important issues with flow research. For one, it would appear that flow is difficult to pin down, in that experiences that should lead to its experience often do not. That is, low-challenge, high-skill situations seem to be more conducive to flow than high-challenge, high-skill situations (at least in learning environments). Situation, it appears, plays an integral role in this occurrence. Stein et al. (1995) contend that in situations that emphasize competition or performance, like a tennis match and golf environs, high skill level, regardless of challenge level, is optimal. In learning environments, like that of the basketball activity class, it would appear that high skill should accompany high challenge in order to achieve optimal experiences.

Psychological Correlates of Flow

To further investigate possible psychological correlates of flow, Jackson, Kimiecik, Ford, and Marsh (1998) examined flow experiences in a group of 213 older male (61%) athletes (mean age = 46.1 years) participating in a variety of sports (swimming, cycling, track and field, triathletes). Both state and dispositional flow, along with intrinsic/extrinsic motivation, goal orientation, trait anxiety, and perceived ability were assessed. Participants could take one survey assessing demographical and dispositional characteristics anytime, but were asked to take an additional survey that assessed event-specific measures immediately following a competition (e.g., the FSS). Data were analyzed with canonical correlations and regression statistics.

Results showed that perceived ability, anxiety, concentration disruption, anxiety-worry, and "intrinsic motivation to experience" explained flow. The investigators further conclude that a high perception of sport ability is crucial in facilitating flow states, acknowledging strong relationships with flow across analyses. Lack of a relationship between challenges rating and the

flow subscales was also documented. This finding is similar to that of Stein et al. (1995) in that the challenges variable correlated with quality of experience in recreation, but not in competition samples. Concerning anxiety, there was a link discovered between low perceived ability and high anxiety. Lastly, flow was found to be associated positively with intrinsic motivation. These two associations are in accordance with Csikszentmihalyi's (1990) flow model. Intrinsic motivation being associated with flow also provides further substantiation for Deci and Ryan's (1985) assertion that flow more frequently occurs when people are highly interested in what they are doing.

Building on these findings, Jackson et al. (2001) designed a study to investigate both antecedents of flow and the factors that contribute to athletic performance. The investigators predicted that self-concept and psychological skills would be related to athlete flow experiences and performance. Participants were 231 athletes across three sports (orienteering, surf life-saving, and road cycling) that competed at a broad range of performance levels (10.4% were competing at an international level, 41.6% national, 6.1% junior national, 35.9% state, and 6.1% at club level). Years of participation in their sport ranged from 0.25 to 45 years. All three sports involved male and female participants (34% female, 66% male), with an age range of 16 to 73 years.

Athletes were asked to complete (at their leisure) the Dispositional Flow Scale (DSS) and the Flow State Scale (FSS) as measures of psychological factors and the Elite Athlete Self-Description Questionnaire (EASDQ) and the Test of Psychological Skills and Strategies (TOPS) as measures of self-concept at a dispositional level. They were also asked to provide performance data in the form of self-report and finishing position after a competition. Predicted relationships between flow, self-concept, and psychological skills were assessed using

hierarchical regression and canonical correlation analyses. The relationship between flow state and performance was assessed using standard multiple regressions, with FSS responses as the predictor variables.

Results revealed positive relationships existed between flow and aspects of self-concept, and that perceptions of competence served as a strong predictor of state and dispositional flow. Relationships were also discovered between flow and psychological skill use, with 30% of initial variance explained, although there was overlap between self-concept and psychological skill use. Lastly, post-event overall performance ratings were predicted by flow state. Significant contributing variables of flow were autotelic experience and challenge-skill balance.

The findings from this study contribute to the ongoing debate about what psychological factors (e.g., challenge-skills perceptions, goal setting) do and do not contribute to the experience of flow. They also highlight the associated nature of flow experiences and self-concept and competence. The association between competence and dispositional flow is somewhat expected (see Deci & Ryan, 2000). The link between self-concept and flow is also expected, in that it is not uncommon for athletes who experience flow to report an unshakeable self-confidence (Jackson & Csikszentmihalyi, 1999), which is a related to construct.

The relationship between flow and performance is also an interesting finding, insomuch that it suggests that a positive state of affect is associated with high levels of functioning. This result should be taken with precaution, however, because the researchers link flow with level of placement in a competition (1st, second, and so on), which is only one way to define performance. Certainly performance can be perceived as individual-level, in that an athlete can

have a better than average personal performance without finishing in the top spots in competition.

A more recent investigation examining antecedents and consequences of flow with elite athletes was conducted by Hodge, Longsdale, and Jackson (2009). Using an exploratory design, the researchers examined basic psychological needs (competence, autonomy, and relatedness) and athlete engagement relationships (antecedents), athlete engagement –flow relationships (consequences), and the mediating role of athlete engagement between basic needs and flow. The researchers hypothesized that sated (satisfied) needs would be positively associated with athlete engagement (AE) and flow (hypotheses 1 & 2), and that AE would be positively associated with flow and would mediate the relationship between needs satisfaction and flow (hypotheses 3 & 4). Fifty-one sports were represented, with 201 participants (60.2% female, mean age = 22.92 years, age range = 14-61 years). The mean number of years participants had participated in their sport was 9.52 years. An online survey assessing basic needs, athlete engagement, and dispositional flow served as the means of data collection. Confirmatory factor analyses, Pearson correlations, and structural equation modeling were the primary modes of statistical analysis.

Results showed support for positive associations between sated needs (competence, autonomy, and relatedness) and athlete engagement, and basic needs and flow, athlete engagement and flow, and the mediating role of AE and basic needs and flow. The researchers suggest AE and basic needs satisfaction (particularly competence and autonomy) to be a logical relationship, as both are positive experiences. The investigators also suggest a logical relationship between flow and sated needs (Jackson, Kimiecik, Ford, & Marsh, 1998; Longsdale, Hodge, & Rose, 2008, study 3), citing previous research which revealed a positive relationship

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between self-determined motivation and flow at the contextual level and situational level (Kowal & Fortier, 1999).

Concerning AE and flow, the researchers found the strongest associations between enthusiasm and autotelic experience. This suggests continued engagement to be a function of positive thoughts and emotions associated with an athlete's sport. As far as the mediating relationship between AE and basic needs and flow, strong associations were found between the three variables. Competence and autonomy were the strongest predictors of flow, with relatedness having a nearly negligible effect. Lastly, basic needs and flow were not fully mediated by AE. This suggests knowledge of an athlete's AE is not sufficient to predict flow; basic needs for autonomy and competence should also be evaluated (Hodge et al., 2009).

This research builds on previous research (e.g., Fullagar & Mills, 2008; Jackson et al., 1998) in that it adds to the literature on flow and the conditions, both physical and psychological, that contribute to its experience. Hodge et al. (2009) found strong relationships between basic psychological needs and flow, and how AE affects both. However, though this investigation does add to the literature, it serves as mounting correlational, not causal support for how best to facilitate flow experiences. Coupled with selection bias threats present in online survey methods, a truly substantive interpretation of what facilitates flow experiences is hard to discern. This is compounded by the inability to generalize findings beyond mostly female elite athletes.

Summary of Flow Research

Based on my literature review, I have identified two important themes. One, there are inconsistencies that exist with regard to whether high-challenge, high-skill level facilitates flow in all contexts. While there exists some evidence that high-skill, high-challenge situations

promote flow (e.g., Brinthaupt & Shin, 2001; Jackson, 1992; Keller & Bless, 2008), there exists evidence that such conditions are not necessary to optimal experience (e.g., Carli, Fave, & Massimini, 1988; Csikszentmihalyi & Wong, 1991; Schweinle et al., 2008; Stein et al., 1995). Due to these inconsistencies, there is a need to better operationalize what constitutes anxiety and boredom, validate measures of flow in various contexts, and use larger participant pools. Doing so will better determine the applicability of the flow model (i.e., Csikszentmihalyi, 1990) in various contexts.

Two, much of the research conducted on the flow construct is correlational in nature. There exists a dearth of research investigations in which a causal interpretation can be made. Future research should be geared toward examining flow constructs under variable conditions, with true experimental designs. True experiments will allow researchers to better distinguish conditions conducive to flow. The experimental designs used by Brinthaupt and Shin (2001) and Keller and Bless (2008) provide nice frameworks for how to achieve that end in the investigation of flow experiences. Furthermore, if engineering conditions conducive to the flow experience are to be endeavored by practitioners, larger participant samples, randomized designs, and more sophisticated means to capturing flow perceptions are needed outside of qualitative interviews and correlational research. With a better conception of conditions conducive to flow, educational practitioners will likely find engineering such conditions to be a viable and worthwhile undertaking.

Conclusions and Further Research

SDT, interest, affect, and flow are inextricably linked theoretical frameworks. In an attempt to show the relationships between these frameworks, I have created Figure 3 (see below). SDT provides the overarching framework for understanding the intrinsic forms of motivation interest and flow, in that satiation of competence, autonomy, and relatedness can lead to intrinsic
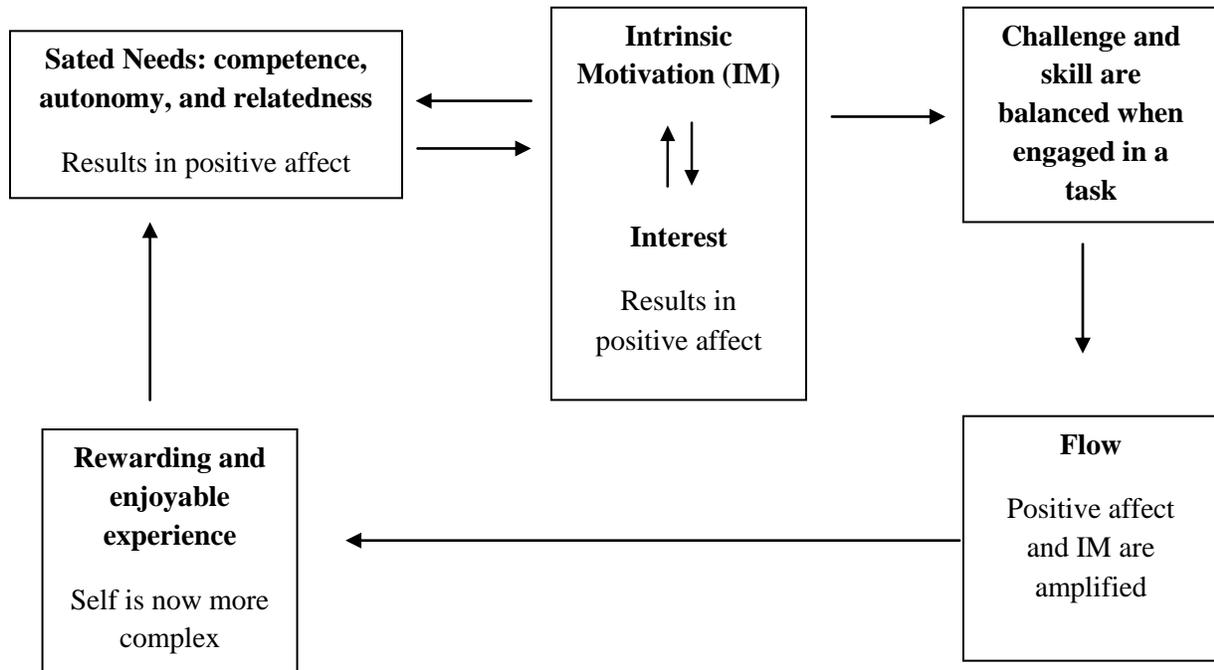
Figure 3: The Interrelationships between Intrinsic Motivation, Interest, Positive Affect, and Flow.

motivation and interest. SDT is focused on environmental conditions that are conducive to or thwart perceptions of the basic psychological needs of competence, autonomy, and relatedness. Interest and flow are the potential cognitive and positive-affective products of those sated psychological needs. This assertion is substantiated by research showing competence, autonomy, relatedness, and interest serve as the psychological antecedents to the flow experience (Deci & Ryan, 2008; Fullagar & Mills, 2008; Hodge et al, 2009; Kowal & Fortier, 1999; Longsdale, Hodge, & Rose, 2008, study 3).

Explained differently, environmental conditions conducive to self-determination have the potential to lead to intrinsic motivation. Intrinsic motivation is based on interest (Deci & Ryan, 2008), which has a reciprocal relationship with self-determination (Hidi & Renninger, 2006). Intrinsically motivated individuals experience positive affect (i.e., liking and enjoyment) and generally feel good about their experiences (Deci & Ryan, 2002). Under the right conditions of challenge and skill, an intense state of intrinsic motivation and positive affect, known as flow, can be experienced (Csikszentmihalyi, 1997).

The flow experience is both rewarding and enjoyable, and includes autotelic experiences which are facilitated through interest in the activity in which an individual is engaged (Csikszentmihalyi, 1997; Deci & Ryan, 2008). This transitory process has the potential to promote complexity and growth in consciousness (Csikszentmihalyi, 1997), which generates a more complex self (Jackson & Kimiecik, 2008). Because the flow experience is rewarding, it has the potential to promote a cycle of intrinsic motivation, effort, and learning (Kimiecik & Harris, 1996), and lead to the seeking out of such experiences again over time. Therefore, setting conditions conducive to self-determination, interest, and flow experiences are worthwhile endeavors in educational contexts.

That being stated, issues exist within in the flow paradigm than need to be addressed, particularly with regard to which components of flow (e.g., challenge-skills balance, time distortion, and autotelic experience) are necessary for the experience. Csikszentmihalyi (1990) states that all of the components are not necessary for the flow experience, but does not clearly articulate which ones are most necessary. Based on my reading of flow literature, I am left wondering "Can an individual experience flow without having an autotelic experience?" That is, can individuals who have integrated regulation experience flow? I also wonder, "Can an

individual experience time distortion and not experience flow?" It certainly appears that an individual can experience flow and not time distortion (see, for example, Jackson & Eklund, 2004). If time distortion is consistent with the experience of intrinsic motivation (Conti, 2001), how can an individual experience flow, an intense state of intrinsic motivation and not experience time distortion?

Furthermore, it appears that an individual can experience flow when a balance of challenge and skills does not exist. For example, Carli, Fave, and Massimini (1988), Csikszentmihalyi and Wong (1991), Schweinle et al. (2008), and Stavrou, Jackson, and Zervas (2007) all found that flow was more likely experienced when skills outweighed challenges, and not in balance as flow theory suggests as necessary. Although evidence does exist for the experience of flow in accordance with Csikszentmihalyi's (1990) framework (e.g., Jackson, 1992, 1996; Keller & Bless, 2008), it generates more questions than answers about how to implement conditions conducive to the flow experience. This leads me to my next point. Because the balance of challenge and skills is not the most important characteristic of the flow experience, should educational practitioners and researchers instead focus on the most telling aspect of the flow experience - merging of action and awareness (Jackson & Csikszentmihalyi, 1999) - in their efforts to implement and investigate the flow experience? Quinn (2005) argues the case for such a shift.

According to Quinn (2005, as cited in Beard & Hoy, 2010), "Flow may best be defined as the experience of temporally merging one's situation awareness with the automatic application of activity-relevant knowledge and skills" (p. 615). In other words, Quinn purports that flow is produced by the merging of action and awareness, which involves total absorption into a task in which the body and mind perform effortlessly and the individual feels at one with his or her

actions. He divides the nine dimensions of flow into antecedents and consequences. Antecedents of flow are goal clarity, challenge-skill balance, concentration, and unambiguous feedback. Consequences are a sense of control, autotelic experience, loss of self-consciousness, and time transformation. This is in contrast to a holistic model like that of Csikszentmihalyi's (1990).

Beard and Hoy (2010) tested Quinn's (2005) flow model against a holistic model of flow developed by Jackson and Marsh (1996) in a study designed to measure flow in a population of mostly white, female elementary school teachers in Ohio. Using confirmatory factor analysis and structural equation modeling, the researchers found that the traditional model developed by Jackson and Marsh, and based on Csikszentmihalyi's (1990) framework, provided a better explanation of flow than did the Quinn model.

This finding provides substantiation for Csikszentmihalyi's (1990) flow framework, but fails to clarify which components are most necessary to the flow experience. Quinn's (2005) model does, however, provide further evidence of inconsistencies and difficulties that exist with regard to empirical investigations using the flow paradigm. His model serves as a new conceptualization for the flow experience, and may eventually spawn new directions and implications for the flow literature. At this time, however, utilizing Jackson and Csikszentmihalyi's (1999) holistic framework is probably a better and viable means to assessing flow experiences. Although a new theoretical framework for the flow experience is a worthwhile endeavor, it is probably useful to continue investigating the flow experience within the traditional model of flow, like the one set forth by Jackson and Csikszentmihalyi (1999). There is still much to be sorted out within this framework to determine its viability in varying contexts. I speculate the Quinn (2005) model would have similar issues with regard to contextual inconsistencies and need empirical validation in much the same way.

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Therefore, it is my opinion, that more research is needed within a traditional flow paradigm that works to distinguish how perceptions of challenges and skills facilitate the flow experience. Given that research within the flow paradigm demonstrates the framework to be viable and applicable in some environments, but not as much in others, adaptation of the balance of challenge and skills may be necessary depending on the nature of the context in which flow conditions are implemented (e.g., learning vs. competitive; elementary school vs. high school).

Furthermore, investigations using the flow paradigm should attempt to uncover how flow experiences can be facilitated in environments that include learning, performance, and competition (e.g., military training), as well as attempt to uncover the role of skill level through prior experience in such environments. In the studies I outlined in this manuscript, none of the environments examined (athletic, academic, or other) met the criteria of being learning, performance, and competition oriented. Instead, environments were usually one or the other, or at most included performance and competition. The role of prior experience was inferred through skill level (e.g., Schweinle et al., 2008), and not explicitly addressed. Lastly, the use of experimental designs could help distinguish conditions that facilitate the flow experience, as opposed to qualitative interviews and correlational research typically employed in empirical investigations of flow. My dissertation study will be designed to address some of these issues.

Measures of Flow

Several methods, including both quantitative and qualitative, have been employed to capture the highly subjective, phenomenological experience of flow. The Flow Questionnaire (Csikszentmihalyi & Csikszentmihalyi, 1988) presents participants with passages about the flow state and asks whether or not they have had the experience of flow, how often, and in what activities. The Flow Scale (Mayers, 1978) uses 10 items to estimate the frequency in which

respondents experience dimensions of the flow state. The Experience Sampling Method (ESM) is a popular and validated method for assessing flow experiences (Csikszentmihalyi & Larson, 1987). Participants carry pagers and are "beeped" at random times at which they fill out a questionnaire. The idea is to gain a clearer picture of everyday experiences as they occur, rather than through retrospective means. Even so, getting beeped undoubtedly bumps the participant out of flow, and cannot capture the true essence of the experience as it is occurring. For that matter, any empirical assessments of flow are only partial reflections of the experience (Jackson & Eklund, 2002; Jackson & Marsh, 1996).

The Dispositional Flow Scale (DFS) and its subsequent revision (DFS-2) assess the frequency of flow in a given activity, and the Flow State Scale (FSS) and its subsequent revision FSS-2 measures the degree to which flow dimensions characterize a just completed experience or event (Jackson & Eklund, 2002, 2004; Jackson & Marsh, 1996). Although the DFS and FSS were initially developed for measuring flow in sports, they have also been used successfully in other contexts, such as music, computing, and theater. Recently, two short flow scales have been developed for general use, though the reliability estimates are lower than desired (short DFS-2 and short FSS-2 reliability estimates range from .74-.81; Jackson, Martin, & Eklund, 2008; Martin & Jackson, 2008).

The Flow State Scale-2 (FSS-2) is of particular interest to me, as it is designed to measure a recently completed experience and yields acceptable psychometric properties. The FSS-2 is a 36 item self-report instrument that measures the degree to which flow dimensions characterize a just completed experience or event (Jackson & Eklund, 2002, 2004). The instrument is designed with the nine dimensions of flow conceptualized by Csikszentmihalyi (1990), along with other self-repot scales designed to measure flow, and qualitative descriptions

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of flow from elite athletes (Jackson & Eklund, 2004). The nine subscales include challenge-skills balance, merging of action and awareness, clear goals, unambiguous feedback, sense of control, concentration on the task at hand, loss of self-consciousness, an altered sense of time, and autotelic experience. Each of the nine subscales has four items. Taken cumulatively, the nine dimensions constitute the psychological state of affect that is flow. As individual components, they represent conceptual elements of the state.

The FSS-2 is comprised of items on a 5-point Likert-style scale that requires the participant to choose how much they agree or disagree with a statement. Lower item averages represent disagreement with statements proposed, while higher averages represent agreement. Low scores indicate an individual did not likely have a flow-like experience. Conversely, high scores would be indicative of achieving a flow-like state. The FSS-2 can be scored on the subscales or as a global measure of flow. Dimension scoring has demonstrated greater strength psychometrically, but the global measure has satisfactory statistical properties, which I explain in the next paragraph. Jackson and Eklund (2004) recommend removing the time transformation subscale if global scores are desired, due to weak higher-order factor loadings for the time transformation scale obtained in validation analyses. Global scoring of the dimensions has demonstrated acceptable statistical properties, as Rakes and Jones (2012) reported the reliability estimate for flow items (time dimension removed) at $\alpha = .94$.

To validate the FSS-2, it was administered to 449 participants in one study and 391 in another by individuals who participated in some form of physical activity at least twice a week, which included, among others, dance, yoga, rugby, and football (Jackson & Eklund, 2002). Reliability estimates ranged from .80-.90, with a mean alpha of .85. In study 1, using confirmatory factor analyses, the item identification sample yielded item loadings in the range of

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.51 to .89 (M = .78) in study 1, and .43 to .91 in study 2 (M = .80). The global scale yielded a .925 score on Comparative Fit Index in study 1, and .939 in study 2, which indicates a good fit. Positive correlations between items again supported a nine factor model, ranging from .13 to .76 in study 1, and .06 to .74 in study 2 (Jackson & Eklund, 2004). Jackson and Eklund (2004) do not provide information about weighting the scales.

Although initially developed for measuring flow in sports, the FSS (Jackson & Marsh, 1996) has also been successfully implemented in other contexts, such as music (Wrigley, 2001), web-based instructional activity (Chan & Repman, 1999), and academic settings (e.g., Brinthaupt & Shin, 2001; Beard & Hoy, 2010; Guo, 2004; Rossin, Ro, Klein, Guo, 2009). The newer FSS-2 has not been used as much as the FSS in empirical investigations, but has been implemented successfully and with acceptable reliability estimates (e.g., Rakes & Jones, 2011; Rogatko, 2009). Its efficacy in assessing flow experiences rivals, if not exceeds in certain respects, its predecessor's. This can be attributed to the addition and replacement of items in the FSS that demonstrated weaker statistical properties (Jackson & Eklund, 2004).

Psychological Skills Training and Visual Imagery

Visual imagery plays an important role in cognitive processes surrounding learning and performance. The use of visual imagery can play a significant role in long-term memory storage (Bruck, Cavanagh & Ceci, 1991; Levin & Mayer, 1993), especially when presented alongside verbal information (Sadoski & Paivio, 2001). Instruction that includes directions to form mental representations can promote effective understanding and remembering of information presented (Dewhurst & Conway, 1994; Sadoski & Paivio, 2001). In the context of sport psychology, the

use of visual imagery is one of the most utilized mental skills by athletes. And those athletes who are most successful also happen to use imagery more extensively and more systematically than less successful athletes (Calmels, Berthoumieux, & d' Arripe-Longueville, 2003; Cumming & Hall, 2002; Vealey, 2007).

Imagery has been shown to enhance motivation (Martin & Hall, 1995), increase attentional control (Calmels, Berthoumieux, & d'Arripe-Longueville, 2004), improve self-confidence (Callow, Hardy, & Hall, 2001; Evans, Jones, & Mullen, 2004; Garza & Feltz, 1998; Vealey, 2007), and make goals seem more real and performance more effortless (Jackson & Csikszentmihalyi, 1999). And although the effects of imagery use in sport are well documented, there is a dearth of research investigating the effects of imagery on flow experiences. I am aware of two such investigations. Straub (1996) used a time series design to investigate the use of a mental imagery program on flow experiences with five collegiate wrestlers over the course of 5-10 weeks. Results showed that four of five athletes increased self-reported flow frequency, with one athlete showing 44% increase in frequency.

Similar results were demonstrated with an individualized visual imagery training program implemented over 12 weeks on four high-performance amateur golfers (four males, one female, aged 20-23 years old) (Nicholls, Poltnan, & Holt, 2005). Specifically, the researchers utilized an intervention that incorporated visual imagery content identified by Hall, Mack, Paivio, and Hausenblas (1998) in the development of the Sport Imagery Questionnaire. Different types of imagery are used for different athletic goals, and are used by athletes to achieve a variety of cognitive, affective, and behavioral changes (Murphy, Nordin, & Cumming, 2008).

The Hall et al. model uses a taxonomy developed for classifying the different types of images generated by athletes. There are five types of imagery within the taxonomy: (a) Motivational-Specific (MS), (b) Motivational General-Mastery (MG-M), (c) Motivational General-Arousal (MG-A), (d) Cognitive Specific (CS), and (e) Cognitive General (CG). MS-imagery represents specific goals and goal orientated behaviors, such as imagining oneself winning an event or receiving praise from referent others. MG-M imagery serves a motivational and mastery function. Such images represent effective coping and the mastery of challenging situations, such as imagining being mentally tough, confident and focused during competition. MG-A-imagery represents feelings of relaxation, stress, arousal, and anxiety in conjunction with sport competition. CS imagery is based on imagery rehearsal of specific skills (e.g., putting in golf or penalty shots in soccer). Most of the mental practice literature focuses on CS imagery (Nicholls et al., 2005). Cognitive General (CG) imagery refers to the strategies related to a competitive event, such as full court pressure in basketball.

It is recommended that athletes use one of the five types of imagery that best serves their desired outcome. For example, a golfer wishing to improve putting proficiency would employ skill-based imagery, whereas mastery-based imagery might be employed by a field-goal kicker wishing to improve self-confidence (Nicholls et al., 2005). With this in mind, Nicholls et al. (2005) interviewed participants to determine desired outcomes. All participants in that study most desired improvements in self-confidence; and thus, the researchers tailored a mastery-based (MG-M) intervention for use by participants. The participants were given an audiocassette of the imagery script and asked to practice the script five times per week during the course of the intervention. Results showed three of four athletes increased their flow intensity, and all participants increased their flow frequency and improved performance.

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Although the results from these two studies are promising, such small samples and the use of convenience sampling limit the generalizability to other contexts. Future researchers, therefore, should strive for larger samples, experimental conditions, as well as the use of an empirically substantiated visual imagery paradigm (e.g., Hall et al., 1998; Murphy & Martin, 2002; Watt, Morris, & Anderson, 2004). In fact, Vealey (2007) recommends comparing the effectiveness of visual imagery paradigms on dependent variables such as performance and flow, and not expending the resources and effort required to provide future substantiation of the effectiveness of visual imagery solely on athlete performance. Said differently, investigations that compare visual imagery paradigms on their contextual effectiveness would better serve the literature (theory) and practitioners (application) than investigations that work to establish the effectiveness of visual imagery on athlete performance.

Chapter 3: Methodology

Pilot Study

Rakes and Jones (2012) conducted a pilot study to investigate the effects of a visual imagery exercise on Army ROTC cadets' performance and perceptions of flow following a marksmanship training exercise. In this section, I provide a brief summary of the study because the present study builds upon the findings of this study.

Context and Background

The context of the pilot study involves students and classroom experiences that are atypical from most college students' experiences. Army ROTC is a college elective that is geared toward training future military officers for active duty or Reserve Forces. Career fields include combat arms, combat support, and combat service support branches. There are six Senior Military Colleges that offer ROTC training in the United States, two of which are at predominantly civilian universities. However, there are more than 1,400 colleges and universities across the U.S. that offer Army ROTC training. Upon meeting ROTC requirements, cadets usually have the option to become a commissioned officer in the U.S. Army, Army Reserve or the Army National Guard (VT Army ROTC, 2011). The pilot study occurred at a large, public, civilian university in a mid-Atlantic state.

As part of the ROTC curriculum, all undergraduate cadets undergo marksmanship training. This training typically involves two stages, pre-marksmanship instruction (PMI) and engagement skills trainer (EST 2000) simulations, which often occur in back-to-back sessions. PMI consists of five main components: clearing (freeing the weapon of ammunition), cycles of functioning (feeding, chambering, locking, firing, unlocking, extracting, ejecting, and cocking),

modes of fire (knowing semiautomatic, automatic, and burst modes, and their proper usage), peer

coaching (cadets of approximate skill level working together), fundamentals of weapon firing

(steady position, aiming, breath control, and trigger squeeze), and firing positions (e.g., basic

prone unsupported and individual foxhole-supported) (U.S Army Rifle Marksmanship Training

Manual, 2003).

EST 2000 simulation training is described as follows:

EST 2000 simulation training provides initial and sustainment marksmanship

training, static unit collective gunnery and tactical training, and shoot/don't shoot

training. There are three modes of training supported: marksmanship, squad/fire

team collective and judgmental use of force. EST 2000 training scenarios are U.S.

Army Training and Doctrine Command validated (U.S. Army, 2011, para. 1).

To study Army ROTC marksmanship training and how it facilitates flow experiences, my

advisor and I reached out to the administration of Army ROTC program at one of the public

universities that have ROTC available as part of curriculum options. The research proposal was

met with enthusiasm and resources necessary to create experimental conditions for PMI

instruction and EST 2000 simulation training.

Research Questions

The primary purpose of the pilot study was to investigate the effects of a visual imagery

exercise on Army ROTC cadets' performance and perceptions of flow following a

marksmanship training exercise utilizing the EST 2000 simulator. We created the visual imagery

exercise based on prior research (Cox, 2007; Reese, 2005), but did not use a paradigm suggested

by Vealey (2007) (e.g., Hall et al., 1998; Murphy & Martin, 2002; Watt, Morris, & Anderson,

2004). Furthermore, the imagery exercise was implemented moments prior to cadets'

marksmanship performance exercise (i.e., they had no time to practice the visual images outside

the short time allotted just prior to their engagement in shooting). We investigated the following

research questions:

1. How do low and high challenge conditions in EST 2000 simulation training affect flow

and marksmanship performance?

2. Will a mental skills training (i.e., visual imagery) exercise just prior to target shooting

affect flow and performance?

3. How do mental skills training and challenge conditions interact to affect flow and

marksmanship performance?

4. Is there an association between flow and marksmanship performance?

Participants and Procedure

Participants were 153 undergraduate Army ROTC cadets (125 men and 25 women; three

participants did not report gender). Ages were assessed using the following ranges: between 18

and 19 ($n = 122$), 20 and 21 ($n = 34$), and 21 and over ($n = 2$). The experimental design was a 2

X 2 factorial design with visual imagery group (yes or no) and challenge condition (low or high)

as between-subject variables, with gender and prior experience as covariates. Flow and

performance served as dependent variables. Participants were randomly assigned individually to

either the visual imagery ($n = 77$) or no visual imagery ($n = 76$) groups and either low challenge

($n = 81$) or high challenge conditions ($n = 72$). Immediately following a marksmanship training

exercise, both with and without visualization, participants were administered the FSS-2. Performance was tallied and entered on each corresponding questionnaire form.

Results

Results of the multivariate MANCOVA showed that gradations in challenge level failed to impact flow experiences. Prior experience - and by extension skill level - did, however, seem to impact flow experiences. The more experienced the cadets were with PMI instruction and EST 2000 simulation training, the greater their potential to achieve flow-like states (see Appendix D). This finding is similar to the results of other investigations, in that high-skill, low-challenge, not high skill, high challenge conditions produced flow-like states (e.g., Schweinle et al., 2008; Stein et al., 1995).

Psychological skills training involving visual imagery also failed to impact cadets achieving flow-like states or performing better compared to those not receiving the visual imagery exercise. Other significant findings included gender differences in flow experiences, with males experiencing flow-like states more intensely than their female counterparts. Lastly, low challenge conditions produced better performance than high challenge conditions.

Present Study

Changes from the Rakes and Jones (2012) Study

In this section, I describe four ways in which I built upon the results of prior research, including the Rakes and Jones (2012) study. First, I included two levels of challenge for the cadets, as in the Rakes and Jones (2012) study, but this time I used camouflage netting that was easier to see through. Second, I again collected data related to the cadets' prior experience with

EST 2000 simulation training and used this information to examine the role of prior experience in cadets' flow experiences. Third, instead of having the cadets "zero" their rifle, they were asked to undergo only a "grouping" exercise. Fourth, I extended the length of time for the visual imagery exercise for cadets from what Rakes and Jones (2012) had implemented.

Several issues arose from the results of the pilot study that spawned new research questions that could further inform this line of inquiry. In the Rakes and Jones (2012) study, there were two graduations of challenge: low or high. In the low challenge condition, there was daylight on the EST 2000 simulation screen and the lights were off above the shooters. In the high challenge condition, the conditions were the same, but shooters were asked to shoot with camouflage nets placed over their heads to simulate shooting in heavy brush. Results indicated that the type of challenge condition did not affect cadets' flow perceptions, but that cadets in the low challenge condition did *perform* better than those in the high challenge condition. However, regardless of challenge condition, most cadets found zeroing their rifle in 18 shots to be difficult, as most failed to zero their rifle in 18 shots. Although it could be that another graduation of challenge could result in differences in flow perceptions between groups, the challenge afforded under normal conditions is already perceived as very challenging. Therefore, I again created two challenge conditions, but used a less challenging camouflage netting system.

In the Rakes and Jones (2012) study, prior experience of the cadets affected their flow perceptions. That is, more experience on the EST 2000 simulator facilitated flow perceptions more readily. This finding is important in that prior experience was found to be a better predictor of flow than a balance of challenge and skill. In other words, as skill level improved so did the potential to experience flow, regardless of challenge condition. It should be noted, however, that prior experience was not statistically significant as a covariate on flow at the .01 level (employed

using the Bonferroni correction). It was, however, significantly correlated with flow ($r = .20$).

This finding suggests a need for further inquiry into the greater importance of prior experience in

facilitating flow experiences than balance of challenge and skill. It appears that this finding

serves as mounting evidence against the need for challenge and skill to be in balance to

experience flow (e.g., Schweinle et al., 2008).

Given the ambiguity surrounding the efficacy of challenge conditions for this

investigation, I again investigated the importance of level of perceived challenge versus skill in

the attainment of flow experiences in the present study. Additionally, the role of prior experience

was again assessed through a survey item that queried the number of times the cadet has had

EST 2000 simulation training. Continuing this line of inquiry helped to further examine the

dynamics of challenge and skill to better determine whether balance of the two or higher skill

alone is the better facilitator of flow in this population and context.

Concerning visual imagery, results from the pilot study revealed that the visual imagery

exercise did not have an effect on flow perceptions or performance. These results could be

attributed to several factors. For one, visual imagery, like all mental skills, requires practice

(Cox, 2007; Reese, 2005). In the pilot study, participants spent one session with the researcher in

groups of 10-31 participants for approximately 10 minutes. Given the short amount of time

preceding the simulation training, and the potential lack of prior experience with mental skills

training involving visual imagery, it seems reasonable to attribute a lack of practice to this

finding. Second, the visual imagery exercise was implemented with varying numbers of

participants. Prior research demonstrating the effectiveness of visual imagery on flow was

conducted on an individualized level (Nicholls et al., 2005). Since group dynamics affect flow

(Bakker, 2004; MacDonald, Byrne, & Carlton, 2006), the conditions (i.e., group size) under

which the visual imagery exercise was administered could have had deleterious effects. It could be that visual imagery sessions with fewer participants or on an individualized level would facilitate flow experiences more readily. Third, the script itself, while using guidelines informed from prior research (i.e., Cox, 2007; Reese, 2005), may not have been sufficient for participants to construct images in such a way to promote flow or improve performance.

Therefore, with regards to visual imagery effects on flow and performance, I proposed some changes this study to build upon the Rakes and Jones (2012) study. First, based on the recommendation of Vealey (2007), this study incorporated an established visual imagery paradigm. Specifically, I used the model Nicholls et al. (2005) used in their investigation of visual imagery effects on flow and performance of amateur golfers. The model was created by Hall et al. (1998), and serves as the theoretical framework for the Applied Model of Imagery developed by Martin, Mortiz, and Hall (1999). Second, participants assigned to the visual imagery group were afforded the opportunity to practice the visual imagery script over the course of 14 days. Although imagery interventions vary on time of implementation (e.g., five weeks to twelve weeks; Nicholls et al., 2005; Straub, 1996), I believed that practicing the imagery script over the course of 14 days would allow for a more substantive interpretation of results relative to the 10 minute intervention implemented in the pilot study.

Research Questions

The seven research questions presented below address the issues outlined in the prior section and serve as the focus of this study. These questions refer to an experiment in which some cadets participated in a visual imagery intervention related to marksmanship training and others did not; and during the marksmanship activity, the two groups of cadets (visual imagery

and no visual imagery) participated under two different challenge conditions (high and low challenge).

1. Do cadets who participate in a visual imagery intervention have statistically higher flow perceptions than those who do not participate in the visual imagery intervention?

2. Do cadets who participate in a visual imagery intervention have statistically higher marksmanship performance than those who do not participate in the visual imagery intervention?

3. Are more challenging conditions associated with significantly higher flow perceptions than less challenging conditions?

4. Are more challenging conditions associated with significantly lower marksmanship performance than less challenging conditions?

5. Is prior experience or challenge level more highly correlated with flow perceptions?

6. Do visual imagery and challenge conditions interact to affect cadets' flow perceptions?

7. Do visual imagery and challenge conditions interact to affect cadets' marksmanship performance?

Methodology

Participants. Participants for this investigation included 246 undergraduate Army ROTC cadets at a large public university in the southeastern US. There were 98 freshman, 82 sophomores, 58 juniors, and 8 seniors that participated in this study. I randomized the

participants into two groups: receiving a visual imagery intervention or not. I also randomized

participants into challenge conditions: low or high. Once I had the participants randomized into

groups, I then began the process of gaining informed consent by meeting in-person with

participants and having them sign a consent form. At the end of this process 147 participants

remained: 70 assigned to the visual imagery group and 77 assigned to the non-visual imagery

group. Any participants assigned to the visual imagery group who did not attempt at least six

visual imagery audio sessions were removed from the analyses, leaving 50 visual imagery

participants and 77 non-visual imagery participants. Due to missing data, 49 visual imagery

participants and 75 non-visual imagery participants were included in the MANCOVA analyses.

Of 127 participants, 77.2% identified as Caucasian (non-Hispanic), 9.5% as Asian, 7.9%

as Hispanic, and 4.8% as Black or African American. Two participants did not report their race.

The age range of participants was as follows: 18-19 (57.9%), 20-21 (36.5%), and over 21 (5.6%).

Two participants did not report their age. Most of the participants identified as freshmen

(48.4%), followed by sophomores (34.9%), juniors (13.5%), and seniors (3.2%). Two

participants did not report their academic level. There were 117 males and 10 females.

Procedure. This investigation took place within the confines of Army ROTC

marksmanship training using the EST 2000 simulator. I randomly assigned participants into

either visual imagery or non-visual imagery groups and low or high challenge conditions using

class rosters and Excel 2007 (see Appendix A for a schematic of group assignments). I created

experimental conditions in order to make causal interpretations about the effectiveness of the

visual imagery intervention on flow perceptions and marksmanship performance. Experimental

conditions allow for the eventual comparison of a different visual imagery paradigm from the

one implemented in this investigation. Causal interpretation can be made about the efficacy of each paradigm (but only one in this study) in the context of Army ROTC marksmanship training.

After cadets were randomly assigned into experimental groups, I sent an email to those participants assigned to the visual imagery group and informed them they had been selected to participate in the investigation and that I would be meeting in person with them to gain their consent and explain the study in greater detail. I sent out a reminder email explaining the study and asking participants to bring a signed consent form two days before I met with participants in-person.

In the emails, I informed participants that they had been selected to partake in a research study involving the use of visual imagery and that the study required that they access an Internet link which them to a web page containing an audio recording and that they would have to listen to daily. I asked participants to engage in the visual imagery exercise 14 times over the course of 14 days. I asked participants to practice the (same) visual imagery exercise once per day for 14 days and make-up any missed days the following day. I instructed participants to engage in the visual imagery exercise at their leisure, but also asked that they do so in a quiet and comfortable place.

How often each participant logged into the website and accessed the visual imagery exercise was recorded automatically by the website. A web log was created that included the number of times that a cadet accessed the site, as well as which of the 14 audio sessions that they accessed. The audio sessions were in folders labeled "Assignments", numbered 1-14; each assignment had a date corresponding to when they should have been accessed by the participants. When one of the "Assignments" was accessed and completed, the cadets received

an email notification stating that they had successfully completed that visual imagery session. This design was intended to help keep the cadets on track and allow me to see who accessed the visual imagery sessions each day so that I could send additional reminders if necessary. The log tracking "Assignment" completion was sent to me via email each day.

Because one of the main goals of this investigation was to determine the efficacy of the visual imagery intervention, any cadet who did not complete at least six visual imagery audio sessions was removed from the analysis. I chose a cut-off of six because I felt six attempts was a reasonable number to demonstrate an effect beyond chance. Fourteen days were allotted for this intervention, beginning Saturday, April 1st, ending Saturday, April 14th. It seemed reasonable that cadets would not attempt all of the sessions, because of homework, social activities, and other ROTC curriculum demands. If a cadet completed at least six attempts it meant that more than one full business week (Monday-Friday) was spent practicing the intervention.

The visual imagery script and use of audio sessions used in this investigation was informed by the Nicholls et al. (2005) study, which used motivational components (MG-M images) to improve self-confidence. There are some differences in the script I created and the one used in the Nicholls et al. investigation. The script I created incorporated CS imagery in addition to MG-M imagery, which required participants to create images that focused on performance (i.e., hitting the bulls-eye). Slight variations in instructions specific to how to construct images also existed, and were informed through prior research (Cox, 2007; Reese, 2005). The script used in this study is located in Appendix B.

Using audio as a means to facilitate the visual imagery exercise was informed by the methodology used by Nicholls et al. (2005). The difference in this intervention is that

participants assigned to the visual imagery group were not given an audiocassette, but rather they were prompted to follow a web link that took them to a website containing an audio recording. This method was simpler, less resource intensive, and more easily executed by participants than the method employed by Nicholls et al. because the participants did not need not worry about losing or misplacing the audio, nor did I need to make individual audio copies.

The link to the audio presentation was provided in an email I sent to participants on the first day the training was scheduled to start. Directions were provided in that email and also posted on the "Welcome" page of the website. Emailing the link lessened the burden of keeping track of the web address and also reminded participants of the need to begin practicing. Subsequent reminder emails were sent by each cadet's instructor. The cadets' instructors sent out two reminder emails out the first week, one on Tuesday and again on Thursday. Another reminder email was sent out the following week on a Monday, also by the cadets' instructors.

At the end of 14 days of visual imagery training, participants were scheduled to engage in EST 2000 simulation training for evaluation purposes. EST simulation training is conducted with a M16-A2 rifle converted for simulation training (e.g., laser mounts and air compression to simulate actual firing). Participants fired at a theater-style screen with targets placed in five lanes, allowing five marksmen to engage simultaneously. Participants engaged in EST simulation training in their challenge group assignments (low or high) in small clusters of 10-30 participants each session.

A date was scheduled for all cadets to shoot on a Sunday exactly 15 days after the visual imagery intervention began. However, due to unforeseen circumstances, only about half of the participants were able to shoot on that date. I subsequently requested a date to have the

remaining cadets shoot, with the best option being the following Wednesday (three days later) at 5:30am-6:30am during what is normally the cadets' physical training. I gave visual imagery cadets preference at this time. Because of time constraints, there was still a need to get a reasonable amount of control group participants after this session date. Because it was at the end of the semester, it was prudent to take up only one more session of the cadets' physical training, so I randomized the remaining control group cadets using Excel 2007 with the intention to obtain the remaining half. I then requested another EST 2000 training session exactly one week from the last session, again during what is normally cadets' physical training. Most of the cadets I requested to be available at that training session were present, thus ending the data collection process.

Participants engaged in a "grouping" exercise with their rifle, with a maximum number of attempts set at 18 shots per cadet. Grouping is a process in which the shooter engages a fixed target at 50 meters, fires single shot bursts, and makes adjustments based on computer feedback from the simulator. In order to meet the standard for "grouping," the cadet must place five of six shots around a four centimeter hole, regardless of where on the target they aim. "Zeroing" their rifle is subsequent to this process and involves hitting five of six shots within the center of the target. A human instructor provided verbal feedback based on computer recommendations. Feedback focused on body adjustment and rifle adjustment. According to a personal conversation with an Army ROTC marksmanship instructor, a skillful shooter should "group" in fewer shots than a less skilled shooter.

To assess the cadets' performance, the number of attempts to group their rifle was tallied, with a maximum of 18 shots allowed. This maximum cutoff is a built-in design of the system. If a shooter fails to group in less than 18 shots, the system resets and the shooter is often retrained

with subsequent PMI instruction. For the present study, no retraining took place, regardless of performance. After shooting, participants immediately met with me to complete the FSS-2. As the participants obtained their survey, they told me their performance score, which I wrote on their survey for them.

To create gradations in challenge during grouping sessions, two simulated challenge conditions were created: low and high. The low challenge condition was "normal": daylight on the screen, lights are off above the shooters (these were typically standard conditions for marksmanship training). For the high challenge condition, participants were asked to group under the same conditions as the low challenge group, but were required to shoot with their vision obscured by camouflage netting. The netting used was manufactured by Hunter's Specialties, model number 05435. The idea with the netting was to simulate shooting through brush, a plausible scenario that can be easily be simulated, at least to some extent, with the netting.

One piece of camouflage netting (54`` x 12`) was strung from one end of the firing line to the other and draped over the rifles to obscure the cadets' vision. Approximately 6 inches of space between the cadets' eyes and the netting was allotted. This is a change from the Rakes and Jones (2012) investigation which placed individual nets over cadets' heads. Individualized netting likely created unique differences, in that cadets had to make idiosyncratic adjustments in order to ensure visibility. By draping camouflage netting in front of their faces, conditions were more homogenous and, I speculated, slightly less challenging.

Measures

      Flow Perceptions. Flow perceptions were measured using the Flow State Scale-2 (FSS-2), a 36-item self-report instrument that measures the degree to which flow dimensions characterize a just completed experience or event (Jackson & Eklund, 2002, 2004). The instrument was designed using the nine dimensions of flow first conceptualized by Csikszentmihalyi (1990), along with other self-report scales designed to measure flow, and qualitative descriptions of flow from elite athletes (Jackson & Eklund, 2004). The FSS-2 is comprised of items on a 5-point Likert-style scale that requires the participants to choose how much they agree or disagree with a statement. Lower item scores represent less agreement with statements proposed, while higher scores represent greater agreement. Low scores indicate an individual did not likely have a flow-like experience. Conversely, high scores indicate the participant achieved a flow-like state. A value greater than 3 can be considered indicative of achieving the flow state (Jackson & Eklund, 2004).

      Taken cumulatively, the nine dimensions constitute the psychological state of affect that is flow. The global assessment was chosen for its parsimonious explanation of flow potency and its ability to glean the extent to which cadets were engaged and able to achieve optimal experiences while undergoing EST simulation training. Each of the nine subscales has four items. Because a global assessment of flow is desired, the time subscale was removed from the composite, as recommended by Jackson and Eklund (2004). Thus, cadets' scores on the FSS-2 ranged from 32 to 160.

      Marksmanship Performance. Marksmanship performance was measured using the number of shots that it takes a cadet to "group" and only group their rifle. To "group", a cadet

must place five of six shots within the same 4cm hole anywhere on the target. The cadets were allotted 18 shots to "group". The number of shot attempts was tallied in the following range: range of shots as follows: 1 = 6 shots to "group," 2 = 9 shots, 3 = 12 shots, 4 = 15 shots, 5 = 18 shots, and 6 = greater than 18 shots. These scores were the only ones that cadets received. It was not possible for a cadet to have a score different than 6, 9, 12, 15, 18, or greater than 18. For performance, the lower their score on this scale, the better their performance.

Prior Experience. The following item was created to measure prior experience: How many times have you used the EST 2000 simulator not counting today (1 = *none*, 2 = *once*, 3 = *twice*, 4 = *three*, 5 = *four or more*)?"

Demographic and Visual Imagery Information. I collected basic demographic information related to gender, age, race, and class standing. I queried cadets who participated in the visual imagery intervention about how many times they engaged in the visual imagery exercise and whether or not they believed the intervention to be effective. This survey item, not the website log, was used to determine if a cadet practiced the visual imagery intervention at least six times. The complete survey with all of the measures and items is presented in Appendix C.

Data Analysis

I conducted a two-way multivariate analysis of covariance (MANCOVA) with visual imagery (yes vs. no) and challenge level (low vs. high) as the two factors to answer research questions 1, 2, 3, 4, 6, and 7. Gender and prior experience served as covariates in all of the analyses. I performed multivariate *F*-tests using Pillai's trace as the criterion first on a related set

of dependent variables (i.e., flow and performance). That is, I conducted multivariate F-tests to determine whether the independent variables influenced the dependent variables.

If a multivariate F-test was significant, univariate ANCOVAs were performed as follow-up tests to the MANCOVAs. ANCOVA analyses addressed research questions 1, 2, 3, 4, 6, and 7 in greater detail than the multivariate F statistic alone could provide because the ANCOVAs locate more precisely how the independent variable(s) affected which dependent variable(s). There were two independent variables (visual imagery and challenge condition) and two covariates (gender and prior experience) in the univariate model, as well as the interaction of challenge and visual imagery. Because this resulted in five tests, the .05 alpha level was adjusted to .01 using the Bonferroni correction (α / P = 0.05 / 5 = 0.01) for the Tests of Between-Subjects Effects to control for Type I errors. Because there were only two levels to the challenge and visual imagery conditions, no post hoc analyses were necessary. Missing data were excluded pairwise for flow perceptions and marksmanship performance.

For Research Question 5: "Is prior experience or challenge level more highly correlated with flow perceptions?", I conducted two analyses. Prior EST 2000 experience was scored in a range between one and five and challenge level membership was scored as a dichotomous variable (low or high). I correlated prior experience and challenge level with the composite flow score. To determine whether these two correlation coefficients were the same, I calculated the estimated standard error of the difference between independent transformed correlation coefficients (Hinkle, Wiersma, & Jurs, 1998, p. 292). I transformed r to a z using Fisher's r to z transformation and then used the following formula to calculate the estimated standard error:

$$\text{estimated standard error} = \sqrt{(1 / [n_1 - 3]) + (1 / [n_2 - 3])}$$

The second analysis was generated in the MANCOVA model. If an effect was present when conducting the MANCOVA, a subsequent ANCOVA determined the extent of the effect of the covariate "prior experience," which consisted of one item scored on a scale from one to five, with five representing more extensive experience.

Missing data were handled with pairwaise deletion in the MANCOVA and subsequent ANCOVA analyses. Of 127 cases, 126 were included for assessing flow, 127 for assessing performance, and 125 for assessing prior EST 2000 experience. None of the data collected for this investigation were manually deleted prior to statistical analyses. That is, all of cases were included in each of the statistical procedures implemented in this investigation.

Chapter 4: Results

Descriptive statistics revealed that mean flow ratings (on a scale of 1 to 5) were above a value of 3.0 for all participants and the average was 3.98 regardless of visual imagery treatment or challenge conditions. This finding suggests EST 2000 simulation training is conducive to achieving the flow state. The average performance score, regardless of visual imagery treatment or challenge conditions, was 4.21. Nearly half of the cadets failed to group (48.8%) in 18 shot attempts. The average prior EST experience of cadets was 3.12 (where it was scored as 1= never used the EST before, 2 = used it once, 3 = used it twice, 4= used it three times, 5 = used it four or more times). That is, most cadets had engaged in EST training at least twice prior to their participation in this investigation. The reliability estimate for flow items was found to be acceptable, $\alpha = .95$. See Table 1 for descriptive statistics on flow, performance, and prior experience. MANCOVA analyses revealed Bartlett's Test of Sphericity to be statistically significant (approximate $\chi^2 = 155.41$, $p < .001$), indicating sufficient correlation between the dependent variables to proceed with the analysis. Box's M Test was also statistically significant, $M = 26.00$, $F = 2.81$, $p < 0.003$, indicating that the dependent variable covariance matrices were not equal across the levels of the independent variables (visual imagery, challenge, gender, and prior experience); therefore, I used Pillai's Trace instead of Wilks' lambda.

MANCOVA statistical analyses take into account correlations between variables by using Bartlett's Test of Sphericity. That is, there should be some, but not a high level of, correlation between the dependent variables to justify continuing the analyses. A small to moderate amount of correlation indicates that the variables are similar, but different enough that clear interpretations can be made about the effects of independent variables. A strong correlation

Table 1

Descriptive Statistics for Flow, Performance, and Prior Experience

Variable	*n*	*M* (SD)	Min.	Max
Flow	126	3.98 (0.63)	1.0	5.0
Performance	127	4.21 (2.08)	1	6
Prior experience	125	3.12 (1.54)	1	5

Note: Performance was calculated as a range from 1-6, where 1 = 6 shots fired in order to meet the criteria for "grouping", 2 = 9, 3 = 12, 4 = 15, 5 = 18 shots, with a score of 6 indicating the cadet did not group in 18 shots (the maximum number of attempts). Prior experience was calculated as a range from 1-5, where it was scored as 1= never used the EST before, 2 = used it once, 3 = used it twice, 4= used it three times, 5 = used it four or more times.

between dependent variables would indicate that insufficient differences between the dependent variables exist.

Table 2 below contains Pearson correlation coefficients between the two dependent variables, as well as the covariates used in the MANCOVA model. Pearson correlation coefficients between the two dependent variables (flow and performance) were found to be acceptable (i.e., significantly correlated, but at low to moderate levels), $r = -.44$, $p < .001$. The covariate gender had significant correlations with flow ($r = .33$, $p < .001$) and performance ($r = -.23$, $p < .01$). The covariate prior experience also had significant correlations with flow ($r = .26$, $p < .01$) and performance ($r = -.31$, $p < .001$). Challenge

Table 2

Intercorrelations Among variables (Pearson coefficients)

Variables	*n*	Flow	Performance	Gender	Prior EST experience
1. Flow	126	1.0			
2. Performance	127	-.44***	1.0		
3. Gender	127	.33***	-.23**	1.0	
4. Prior EST experience	125	.26**	-.31**	.04	1.0

Note: For gender, males were coded with a higher number than women. A higher number on the performance scale indicates poorer performance (i.e., 1 is better than 5).

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

To determine whether prior experience was more highly correlated with flow perceptions than challenge level, the estimated standard error of the difference between independent transformed correlation coefficients were calculated (Hinkle, Wiersma, & Jurs, 1998, p. 292). Results indicated that prior experience was more highly correlated with flow than level of challenge ($z = 1.93$, $p < .05$).

Multivariate omnibus tests indicate whether or not independent variables are associated with differences between the vectors (sets of means). Partial eta squared (η^2) is used as a means to explain the amount of variance a particular variable contributes among the set variables in the model. For this model, multivariate omnibus tests revealed the covariates, prior EST experience and gender, to be significant (Pillai's Trace = .08, $F = 5.28$, $p < 0.006$, partial $\eta^2 = 0.08$; Pillai's

Trace $=.14$, $F = 9.74$, $p < 0.001$, partial $\eta^2 = 0.14$, respectively). These findings indicate that both gender and prior EST experience were good covariates in the multivariate model. See Table 3 below for all multivariate omnibus tests. A significant main effect for one of the independent variables (challenge condition, but not visual imagery) was also found on the variates (Pillai's Trace $= .09$, $F = 5.61$, $p < 0.005$, partial $\eta^2 = 0.09$; Pillai's Trace $= .05$, $F = 3.02$, $p < 0.058$, partial $\eta^2 = 0.05$, respectively). No significant interaction effects between challenge condition and visual imagery participation were discovered.

Significant main effects in the multivariate model require follow-up univariate analyses to determine exactly where statistical differences exist between variables in the multivariate model. Prior to interpreting univariate ANCOVAs, I calculated the Levene's Test of Equality of Error Variances, which tests for homogeneity of variance violations for each dependent measure. The Levene's Tests revealed significant results for both flow ($F[3,124] = 3.81$, $p < .01$) and performance ($F[3,124] = 9.21$, $p < .001$). In other words, the homogeneity variances among the four groups (gender, prior EST experience, visual imagery, and challenge) on each dependent variable were warranted.

Beginning with the covariates, the univariate ANCOVA for gender was statistically significant (flow $= F[1, 124] = 18.35$, $p < 0.001$, partial $\eta^2 = .14$; performance $= F[1, 124] = 6.85$, $p < 0.01$, partial $\eta^2 = .06$). See Table 4 for all ANCOVA analyses. The mean flow rating for males ($n = 116$) was 4.04 versus 3.27 for females ($n = 10$), revealing that men experienced flow at a deeper level than women. See Table 5 below for mean and standard deviations of flow and performance based on gender. The mean performance score for males ($n = 117$) was 4.06

Table 3

Multivariate Omnibus Tests

Variables	Pillai's Trace	F	p	η^2
Challenge	.09	5.61	.005	.09
Visual imagery	.05	3.02	.058	.05
Prior experience	.08	5.28	.006	.08
Gender	.14	9.74	.001	.14

Table 4

Univariate ANCOVAs

Variable	Flow				Performance			
	F	df	p	η^2	F	df	p	η^2
Visual imagery	5.61	1 (124)	0.017	0.05	1.82	1 (124)	0.18	0.02
Challenge	0.32	1 (124)	0.58	0.003	8.24	1 (124)	**0.01**	0.07
Prior EST experience	6.53	1 (124)	**0.01**	0.05	7.95	1 (124)	**0.01**	0.06
Gender	18.35	1 (124)	**0.001**	0.14	6.85	1 (124)	**0.01**	0.06

Note: Statistically significant p values are highlighted in bold.

Table 5

Means and Standard Deviations for Performance and Flow based on Gender

Variables	Males		Females	
	n	M (SD)	n	M (SD)
Flow	116	4.04 (.06)	10	3.27 (.47)
Performance	117	4.06 (2.1)	10	5.8 (.063)

Note: A value greater than 3 is indicative of achieving the flow state

A higher number on the performance scale indicates poorer performance
 (i.e., 1 is better than 5).

versus 5.80 for females (n =10), indicating that men outperformed women in the EST 2000

simulation training sessions.

The univariate ANCOVA for prior experience was also statistically significant (flow =

F[1, 124] = .53, $p < 0.01$, partial $\eta^2 = .05$; performance = F[1, 124] = 7.95, $p < 0.01$, partial $\eta^2 =$

.06) (see Table 4). Cadets with four or more training sessions on the EST simulator had a mean

flow rating of 4.22 versus 3.88 reported by those who had never had a training session (see Table

6). These findings suggest that, in general, the more a cadet engages in EST 2000 simulation

training, the more likely they are to achieve flow at a deeper level. Likewise, performance

improved as the number of training sessions increased, with a mean of 2.97 for those cadets with

four or more sessions versus a mean of 4.96 for those with no training experience. The results

shown in Table 6 reveal that better EST performance is a function of practice.

Concerning the main analyses, the univariate ANCOVA for visual imagery was not

significant for the dependent variables flow (F[1, 124] = 5.61, $p < 0.017$, partial $\eta^2 = .05$) or

performance (F[1, 124] = 1.82, $p > 0.18$, partial $\eta^2 = .02$) (see Table 4). Compared to the cadets

who did not receive the visual imagery training, cadets who received the visual imagery training

did not experience flow at significantly deeper levels while engaged in EST training.

Additionally, visual imagery training did not lead to significantly better *overall* performance (see

Table 7).

Table 6

Means and Standard Deviations for Performance and
Flow based on EST 2000 Prior Experience

Prior EST 2000	Flow		Performance	
Experience	*n*	*M* (SD)	*n*	*M* (SD)
Never used the EST	24	3.88 (.68)	24	4.96 (1.65)
Used the EST once	29	3.75 (.67)	30	4.2 (2.12)
Used the EST twice	16	3.95 (.43)	16	5.41 (1.2)
Used the EST three times	17	4.05 (.57)	16	4.53 (1.87)
Used the EST four or more times	38	4.22 (.58)	38	2.97 (2.15)

Note: A value greater than 3 is indicative of achieving the flow state
A higher number on the performance scale indicates poorer performance
(i.e., 1 is better than 5).

Table 7

Means and Standard Deviations for Flow and Performance
based on Visual Imagery

	Visual imagery		Non-visual imagery	
	n	*M (SD)*	*n*	*M (SD)*
Flow	49	4.14 (.5)	76	3.87 (0.68)
Performance	49	3.88 (2.16)	77	4.4 (2.01)

Note: A value greater than 3 is indicative of achieving the flow state
A higher number on the performance scale indicates poorer performance
(i.e., 1 is better than 5).

Conversely, the univariate ANCOVA for challenge was significant for the dependent variable performance ($F(1, 124) = 8.24$, $p < 0.01$, partial $\eta^2 =. 07$), but not for flow ($F(1, 124) = .32$, $p > 0.58$, partial $\eta^2 =. 003$) (see Table 4). Overall, cadets in the low challenge condition ($n = 65$; $M = 3.60$) outperformed than those cadets in the high challenge condition ($n = 62$; $M = 4.82$). Additionally, visual imagery cadets outperformed non-visual imagery cadets in the high challenge condition, $M = 4.15$; $M = 5.34$, respectively, as well as the low challenge condition $M = 3.57$; $M = 3.62$, respectively (see Table 8).

Table 8

Means and Standard Deviations for Flow and Performance based on Visual Imagery and

Challenge Condition

	Visual imagery		No visual imagery	
	Low challenge	High challenge	Low challenge	High challenge
	M (SD)	*M* (SD)	*M* (SD)	*M* (SD)
Flow	4.16 (.51)	4.12 (.50)	3.86 (.71)	3.88 (.65)
Performance	3.57 (2.17)	4.15 (2.16)	3.61 (2.19)	5.34 (1.26)

Note: A value greater than 3 is indicative of achieving the flow state
A higher number on the performance scale indicates poorer performance
 (i.e., 1 is better than 5).

Chapter 5: Discussion and Conclusion

This investigation had two main goals: (a) to determine the efficacy of the Hall et al. (1998) visual imagery paradigm, in terms of its impact on EST 2000 marksmanship performance and flow experiences amongst Army ROTC cadets, and (b) to determine which is the better facilitator of flow: a balance of challenge and skills or prior EST experience. An additional, but distal goal, of this investigation was to provide either substantiation or refutation of part of Csikszentmihalyi's (1990) original holistic flow model. To achieve these ends, seven research questions were generated:

1. Do cadets who participate in a visual imagery intervention have statistically higher flow perceptions than those who do not participate in the visual imagery intervention?

2. Do cadets who participate in a visual imagery intervention have statistically higher marksmanship performance than those who do not participate in the visual imagery intervention?

3. Are more challenging conditions associated with significantly higher flow perceptions than less challenging conditions?

4. Are more challenging conditions associated with significantly lower marksmanship performance than less challenging conditions?

5. Is prior experience or challenge level more highly correlated with flow perceptions?

6. Do visual imagery and challenge conditions interact to affect cadets' flow perceptions?

7. Do visual imagery and challenge conditions interact to affect cadets' marksmanship performance?

Visual Imagery

To address Research Questions 1 and 2, I implemented a visual imagery intervention over the course of 14 days amongst a population of Army ROTC cadets. The goal of the visual imagery intervention was to determine whether mental skills practice involving visual imagery training would improve cadets' performance and improve their flow experiences while engaged in EST 2000 simulation training. Using experimental conditions, I compared cadets that received visual imagery training to cadets that did not receive visual imagery training, both groups having been assessed in two separate gradations of challenge.

First, the visual imagery intervention did not enhance flow with statistical certainty at the .01 level of significance, although it was marginally significant on flow perceptions ($p = .017$). The cadets who underwent visual imagery training reported an increase in flow rating over those who did not ($M = 4.14$ vs. 3.87), suggesting that the use of visual imagery shows promise for having a positive effect on cadets' flow experiences. The statistical insignificance of this effect, I speculate, is due to the novelty of this type of intervention amongst this particular population and activity. Because this is uncharted territory, there is a need for similar investigations to sort out the best method for improving flow and performance. I believe that modifications in the imagery intervention, which I discuss below, could prove to be highly efficacious in enhancing flow and performance based on the promising results of this investigation.

I have determined four areas of modifications to this investigation that future researchers can make to potentially enhance flow and performance through the use of a visual imagery intervention: (a) the imagery paradigm, (b) the focus of script, (c) individualization of the intervention and (d) the method of delivery. Four examples concerning these areas are outlined

thusly. First, the visual imagery paradigm could be altered by using the Model of Imagery

Ability created by Watt, Morris, & Anderson (2004) rather than the Hall et al. (1998) Model of

Applied Imagery used in this investigation. By altering the visual imagery paradigm,

determinations can be made about the efficacy of one style of imagery intervention over another

(Vealey, 2007). Second, by changing the focus of the script to focus more or less on CS imagery

or MG-M imagery, determinations can be made about which components enhance flow and

improve performance more than another. Third, by individualizing the intervention to focus on

components deemed most important to each participant, individual efficacies can be tapped and

used in a manner best suited to an individual's current skill level (as opposed to a one-size-fits-

all approach). Additionally, the likelihood of participants *actually* practicing the intervention is

increased. Fourth, by altering the method of delivery, determinations can be made about the use

of face-to-face sessions rather than audio sessions accessed online.

Performance

The most dramatic increase in performance occurred in the more challenging conditions

rather than the less challenging conditions. That is, the visual imagery cadets outperformed the

non-visual imagery cadets when the circumstances were most difficult ($M = 4.15$ vs. $M = 5.34$).

This finding suggests that the MG-M components of the visual imagery intervention helped

cadets maintain focus and perform well when faced with difficult circumstances. In particular,

the visual imagery script asked cadets to "Imagine feeling that you have the ability to meet any

challenges you are faced with, such as shooting through heavy brush or hitting the bulls-eye in

the center." It seems logical that this particular component contributed to their mental

preparation and focus, both prior to EST training, and while they were engaged in actual EST

training in the high challenge condition. It seems that this mental preparation, in turn, enhanced

their ability to perform well. This speculation is informed by a FSS-2 item that queried cadets'

assigned to the visual imagery intervention about whether or not it helped them perform better on

the EST simulator. The mean value on the 1 to 5 scale was a 3.39, indicating that, on average, the

cadets believed that the visual imagery intervention helped them perform better.

Challenge and Prior Experience

Research Questions 3, 4, and 5 were addressed by assessing the role of challenge and

skill balance and prior experience in facilitating flow and enhancing marksmanship performance.

Research Questions 3 and 4 addressed the role of challenge in enhancing or diminishing flow

and marksmanship performance. Research Question 5 addressed which variable, prior experience

or challenge level, was more highly associated with flow. To determine the better facilitator of

flow -- a balance of challenge and skills or prior experience -- results showed that challenge did

not have an effect on cadets' flow perceptions. According to flow theory, a balance of challenge

and skills is needed to achieve the flow state (Csikszentmihalyi, 1997; Jackson et al., 2001).

However, in this experiment, as well as a very similar experiment conducted by Rakes and Jones

(2012), the level of challenge had no effect on whether or not participants achieved flow.

There are three potential explanations for why no differences were detected. One, it could

be that both conditions were perceived to be similar in terms of challenge. However, if this were

the case, it would make sense that the cadets would have performed similarly, which did not

occur. Cadets in the low challenge condition outperformed cadets in the high challenge condition

($M = 3.64$ vs. $M = 4.64$). Two, extraneous environmental factors may have contributed to

insignificant flow differences between challenge conditions (e.g., shooting at different times,

having one group shoot on a Sunday, but the other groups shoot on Wednesdays early in the

morning). This seems to be an unlikely cause, however, when taking into account that Rakes and Jones (2012) had nearly identical experimental conditions and also reported no differences between groups with regard to flow ratings and challenge conditions. Three, and the most plausible explanation, is that skill, not challenge, is the better predictor of flow. The findings for prior EST experience help illuminate this plausibility. Results showed that the amount of training that cadets receive on the EST 2000 simulator affects their ability to achieve flow. The depth of flow experienced by cadets was clearly a function of the number of times they had received previous training, with more experience generally leading to a greater depth of flow. Furthermore, prior experience was more highly correlated with flow than level of challenge. In sum, as skill level goes up, so does the potential to experience flow, regardless of challenge condition.

This is not the first empirical investigation to report skills, rather than challenge and skills balance, as a better predictor of flow. For example, Schweinle et al. (2008) concluded that challenge, at least for elementary school math students, is important when accompanied by low skill. Students were happier when their skills were greater than the perceived challenge. If skill level was low, and challenge high, students tended to demonstrate reduced efficacy and personal affect. Therefore, skill level, not challenge, was more important in mathematics classrooms in terms of quality experiences. Likewise, it appears that, in the context of EST 2000 simulation training, greater skill, not a balance of challenge and skill, is more conducive to quality experiences.

This finding brings into question Csikszentmihalyi's (1990) holistic model of flow, the crux of which is a balance of challenge and skill. In the context of EST 2000 simulation training, cadets struggled to perform well with basic exercises, such as grouping and zeroing. The

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challenge of these basic exercises outweighs most cadets' skills, especially those with limited experience on the simulator. Yet, for this population and activity, an increase in challenge did not affect their flow ratings. This is interesting not only because it is counter to the postulates of flow theory, but also counter to SDT, which posits that a perception of competence is necessary for optimal motivation (Deci & Ryan, 2002). The cadets in this experiment, and the one conducted by Rakes and Jones (2012), experienced flow even when performing poorly. That is, they knew they were not performing competently at the task at hand (due to immediate feedback from the simulator), but enjoyed performing the task anyway.

This finding also leads me to wonder about the validity of the scores produced by the FSS-2. Is this inventory really assessing flow experiences? Or is this scale assessing some other, related, psychological factor? If the cadets are happy and highly engaged (i.e., in flow) regardless of their poor performance and inability to meet the challenge of various situations, it would seem that the flow state would be difficult to ascertain, given that flow is a state of optimal motivation that is often associated with superior functioning (Jackson & Csikszentmihalyi, 1999). Future researchers should focus on this aspect of assessing flow experiences and work to establish substantiated explanations for why and how this effect is possible.

One idea would be to simultaneously assess a variety of activities that are similar to EST 2000 training using the FSS-2. These activities should be similar to EST training in terms of being a relevant Army ROTC curriculum activity, but different enough that clear distinctions could be made between them. For example, physical training and drill activities might be compared to a more mundane activity, such as map reading. A comparison of flow ratings can then be made between those activities to determine any significant differences between them.

Such an investigation would help determine if the effects observed in this experiment are more local or global in nature.

Another idea would be to use a similar set of methodologies to those employed by Hodge et al. (2009) in future investigations. That is, assessing simultaneously flow and SDT and individual interest perceptions may help determine if indeed cadets perceive themselves to be competent, autonomous, and related (intrinsically motivated) when engaging in EST marksmanship training. Theoretically, if cadets rate a high degree of self-determination and individual interest, then the probability of being in flow is more readily realized (Csikszentmihalyi, 1997; Deci & Ryan, 2002). By assessing simultaneously self-determination and flow perceptions, the degree to which cadets feel competent can be compared against their flow ratings. If cadets feel highly competent and in flow, then the likelihood that the FSS-2 is measuring what it intends to measure is high. However, if competence (as rated when assessing self-determination) and individual interest is rated low, yet flow is rated highly, then whether or not the FSS-2 is measuring flow becomes questionable.

Gender Effects

Interestingly, gender was discovered to have a significant effect on both flow perceptions and performance. With regard to flow, males experienced flow at deeper levels than females, regardless of visual imagery treatment or challenge condition. In terms of performance, most of the female participants failed to "group", with an average of 5.80 shots, compared to an average of 4.06 for males. I am not sure why males experienced flow at deeper levels than females, however.

At first I thought prior experience might explain the difference, given that cadets with less EST experience reported less intense flow perceptions. To find any differences I ran a descriptive statistics analysis, which showed that females had nearly as much prior EST 2000 experience as males ($M = 2.9$ vs. $M = 3.14$, respectively). Furthermore, Rakes and Jones (2012) also reported that males experienced flow more intensely than females, which suggests that this is a systemic and stable finding with this activity and population.

One explanation for this finding likely stems from the ineligibility of women serving in the US military to engage directly in combat roles (Parrish, 2011). It seems logical that females would be less motivated (i.e., not in flow) than their male counterparts when engaging in an activity that is not useful to their future duties as military personnel. This lack of motivation probably helps to explain why females do not perform as well as males either. Until this policy is changed, motivating females to perform well at this task will take creative initiative on behalf of EST 2000 trainers. However, given the small number of females in this study, this finding may not accurately represent "true" gender effects existent in this type of training, and therefore should be used with caution. Assessing individual interest in future research would help illuminate the extent of these findings and show if females consider marksmanship training more valuable than their male counterparts.

Interaction Effects

Lastly, Research Questions 6 and 7 addressed whether or not interaction effects existed between challenge visual imagery training. No interaction effects were discovered in this investigation. That is, challenge and visual imagery did not interact in such a way that either flow or marksmanship performance were enhanced or diminished significantly. Given that only

challenge had a statistically significant effect on one of the variates (performance), the lack of an interaction effect is not surprising.

Limitations and Future Research

First and foremost, the results of this study are limited by the instruments used to measure the constructs. Although the FSS-2 has demonstrated acceptable statistical properties (e.g., reliability and fit indices), it is limited because flow is a highly subjective experience. No means of measurement currently exists that can fully capture the true essence of flow. All empirical assessments of flow are only partial reflections of the experience (Jackson & Eklund, 2002; Jackson & Marsh, 1996). Further, the measure used to assess students' prior experience is self-reported, which is not as accurate as measuring cadet's marksmanship ability directly prior to the time that they start the visual imagery training.

Second, this investigation has potentially limited generalizability of findings. Given the highly contextual nature of this investigation (Army ROTC marksmanship training), the effects of the imagery intervention, challenge conditions, and role of prior experience on flow and performance are likely specific to this population. That is, the potential for the findings from this investigation are likely most applicable in contexts similar to that of Army ROTC marksmanship training.

Lastly, I would like to point out some noteworthy considerations important to this investigation specifically, but also this line of inquiry more generally. To determine the effectiveness of one visual imagery paradigm versus that of another, several empirical investigations will be necessary. I believe that simultaneous exploration of this issue (assessing two paradigms in the same study) would be difficult. As a result, future researchers will likely

need to assess one paradigm at a time. I form this opinion based on the complex logistical issues present in this investigation (e.g., access, scheduling, and researcher and cadet availability).

In the absence of complex logistical issues, and under ideal circumstances, participants in the present investigation would have been split into two groups, with both groups receiving a different imagery intervention. Comparing the two imagery paradigms in terms of efficacy would be much simpler as a result, as there would be a lack of idiosyncratic differences that a new population (and or context) brings to bear. Therefore, this investigation is limited as a result of not having a simultaneous comparison of visual imagery models. That stated, I believe that the use of experimental conditions in this investigation helped to diminish this limitation.

This investigation, then, is the first of potentially many that will be needed to address whether one visual imagery paradigm is more effective than another in enhancing flow and marksmanship performance. This investigation is merely the first piece of a puzzle that works to establish the truth regarding the efficacy and applicability of one visual imagery model versus that of another (in terms of enhancing flow and improving performance).

Conclusion

The findings of this investigation showed that mental skills training involving the use of visual imagery did not positively enhance cadets' flow experiences or improve their marksmanship performance with statistical certainty. The results, however, might be practically significant. That is, findings revealed that cadets in the high challenge condition who received visual imagery training outperformed non-visual imagery cadets in the same condition by over one point on a six-point rating scale. This finding shows the most promise for visual imagery training amongst this population and activity. With more research, investigators could potentially

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identify methods for keeping soldiers focused and highly motivated in certain activities or situations despite challenging circumstances.

Regarding the holistic model of flow used in this investigation, some of the tenants of the model were not supported. Specifically, level of challenge failed to impact flow experiences. Prior EST experience-and by extension skill level, however, positively impacted flow experiences and performance. The more experienced the cadets were with EST 2000 simulation training, the greater their potential to achieve flow-like states and perform at a higher level than those cadets with less experience. Other significant findings included gender differences in flow, as well as performance, with males achieving flow-like states more intensely and also outperforming their female counterparts. Additionally, results showed that all cadets performed better in the low challenge condition than in the high challenge condition. Cadets who engaged in visual imagery training, notably, outperformed those who did not, especially when faced with greater challenges.

With regard to visual imagery and flow, future researchers should continue to study which visual imagery paradigms better facilitate flow and improve performance during EST marksmanship training. This experiment showed, albeit without statistical certainty, that The Applied Model of Imagery (Hall et al., 1998) is efficacious in terms of improving EST simulator performance and facilitating flow perceptions. However, the potential of that efficacy is yet to be determined. Different approaches with the same model may prove more or less efficacious. The application of a different model altogether, however, works to establish the efficacy of one paradigm over another (Vealey, 2007). Both approaches are integral to improving the performance and motivation of cadets and military personnel who engage in EST training. Such

endeavors have the potential not only to reduce training and operating costs, but also to enhance the performance and motivation of soldiers who serve in combat roles.

Lastly, future researchers should continue to examine the dynamics of challenge and skill to better determine whether balance of the two or higher skill alone is the better facilitator of flow. Examining the viability of Csikszentmihalyi's (1990) holistic model of flow is part of that process. In this experiment, results indicated that cadets were in flow regardless of whether they performed poorly or were participating in a challenging task that went beyond their skill level. That is, cadets knew they were not performing competently, but enjoyed performing the task anyway. This is a surprising finding, in that most individuals do not enjoy participating in tasks in which they are not competent. To better understand this finding, an investigation that compares how a variety of tasks facilitate flow should be endeavored. The tasks should similar in nature to EST simulation training (i.e., fun and engaging), but different enough that clear distinctions can be made among them. Such an investigation would help illuminate if the findings from this investigation are localized or more global in nature.

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Appendix A

Participant Group Assignment

246 Cadets Total, Assigned Randomly

Visual Imagery	No Visual Imagery
(123 Students)	(123 Students)

EST Low Challenge	EST High Challenge	EST Low Challenge	EST High Challenge
(61 Students)	(62 Students)	(61 Students)	(62 Students)
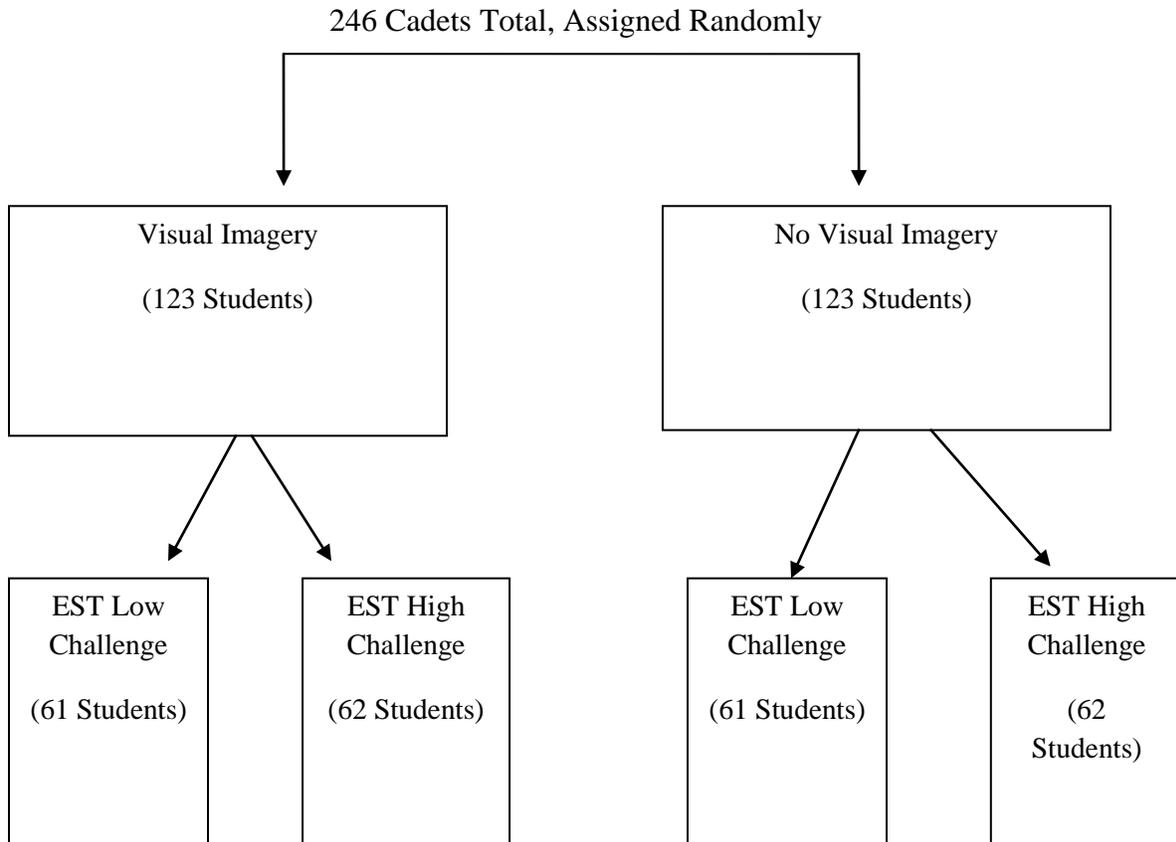
Appendix B

Imagery Script

I constructed the following the visual imagery script, which follows closely the script utilized in the Nicholls et al. (2005) investigation, and is informed through additional literature (Cox, 2007; Reese, 2005):

Get into a comfortable position and close your eyes. Focus on the center of your body and take several slow deep breaths. With each inhalation imagine that you are pulling all the tension from your body into your lungs. With each exhalation, imagine that you are releasing all of the tension and negative thoughts from your body. Continue this breathing, becoming more focused and confident. (30 seconds)

Now that your eyes are closed and you are relaxed, imagine yourself sitting in a theater. You see yourself on the video screen. That's fine, now imagine that you are about to engage in EST simulation training using a M16.

You are about to engage in target practice with your M16 rifle. You are in the prone position, and ready to fire your weapon in single shot bursts. First, acquire the target in the rifle sights at 50 meters. Now, posture your body properly and steady your position. Third, think about your breathing. It should be steady, normal breathing. Look at the gun……. Notice where the trigger guard is…… feel its shape as you grab it. As you partially exhale, relax your arms and body….. Feel the bend in your elbow as your gun muzzle drops into position for the shot. Look ahead to the position to where you are going to hit the target……… take an easy centering breath. When you have exhaled to the point where you feel comfortable remind yourself that you feel mentally tough and confident. ………….. prior to trigger squeeze, take an easy breath and

exhale. Now, sight your target, position your finger over the trigger, and push out your breath, ….3, 2, 1, squeeze the trigger and fire a round. See the bullet strike the target exactly where you have aimed. Release your breath and breathe normal. Imagine the feeling of confidence in your hands and notice how smooth the rifle feels in your hands. Imagine a sense of ease and lightness when squeezing the trigger……. As if firing this shot is almost becoming effortless.

Good, rehearse 20 shots; rehearse every aspect of the 20 shots just as before……. Try 10 shots around the edge of the bull's-eye and then 10 shots in the center …… Imagine that other cadets are present on the firing line, but don't let them rush you……Notice how the focus of your concentration shifts from a broad focus as you are looking around to a very narrow focus, as you prepare to fire another shot. Imagine feeling that you have the ability to meet any challenges you are faced with, such as shooting through heavy brush or hitting the bulls-eye in the center. (Spend 3 minutes on this section)

Good, imagine you are about to fire a shot in the center of the bull's-eye, you are feeling a little tight……. You want this one…….. you start to worry about missing the center……. You can stop your worrying by taking a breath. On the exhale remind yourself that you feel relaxed and confident. Imagine the shot being fired where you want it, feeling the distance and seeing the shot hit where you desire. You are confident and successfully recover by staying focused and in control of your emotions. Fire the bull's eye shot…… (Spend 20 seconds on this section)

Now imagine yourself arriving at the EST range feeling confident in both your mental and physical preparation, feeling good. You are here to perform, not practice. (20 seconds)

You feel the nervous anticipation of the training and remind yourself that it is exhilarating to train with a M16 rifle on the EST simulator. You are motivated to perform. (10 seconds)

You feel confident in your preparation and clearly focused on your zeroing exercise. Your breathing is calm and controlled. Your muscles feel warm and elastic ready to explode with intensity and precision. You are ready. (20 seconds)

Your first shots go well and you remind yourself that you are ready for any unexpected obstacle as you are confident in your refocusing ability and remind yourself that you are mentally tough. You feel optimally energized and ready to go. Enjoy the moment.

Appendix C

FSS-2 Survey

INSTRUCTIONS

Please answer the following questions in relation to your experience in the event or activity you have just completed. These questions relate to the thoughts and feelings you may have just experienced while taking part. There are no right or wrong answers. Think about how you felt during the activity and answer the questions using the rating scale below. For each question bubble in the number that best matches your experience on the scantron you are given.

Please do not provide your name on the survey form or scantron sheet. Your answers will be completely confidential along with the number of attempts you make at zeroing in your rifle on the simulator.

The purpose of this survey is to gather information about how certain types of instruction may lead to improvements in shooting performance and how you feel while shooting.

Your input is critical for determining if training of this type can be improved. With your feedback, we can better determine effective methods for hand-on and simulation training.

Rating Scale

Strongly Disagree Disagree   Neither Agree nor Disagree Agree   Strongly Agree

1   2   3   4   5

Please Fill in Your Answer on the Scantron

During the Event:

1. I was challenged, but I believed my skills would allow me to meet the challenge.
2. I made the correct movements without trying to do so.
3. I knew clearly what I wanted to do.
4. It was really clear to me how my performance was going.
5. My attention was focused entirely on what I was doing.

6. I had a sense of control over what I was doing.

7. I was not concerned with what others may have been thinking of me.

8. I really enjoyed the experience.

9. My abilities matched the high challenge of the situation.

10. Things just seemed to be happening automatically.

11. I had a strong sense of what I wanted to do.

12. I was aware of how well I was performing.

13. It was no effort to keep my mind on what I was doing.

14. I felt like I could control what I was doing.

15. I was not concerned with how others may have been evaluating me.

16. I loved the feeling of the performance and want to capture it again.

17. I felt I was competent enough to meet the high demands of the situation.

18. I performed automatically, without thinking too much.

19. I knew what I wanted to achieve.

20. I had a good idea while I was performing about how well I was doing.

21. I had total concentration.

22. I had a feeling of total control.

23. I was not concerned with how I was presenting myself.

24. The experience left me feeling great.

25. The challenge and my skills were at an equally high level.

26. I did things spontaneously and automatically without having to think.

27. My goals were clearly defined.

28. I could tell by the way I was performing how well I was doing.

29. I was completely focused on the task at hand.

30. I felt in total control of my body.

31. I was not worried about what others may have been thinking of me.

32. I found the experience extremely rewarding.

33. **Did you participate in visual imagery instruction by accessing a website provided by the researcher?**

    1. Yes

2. No

34. If yes, how many times did you complete the visual imagery exercise?

1. 1-2
2. 3-4
3. 5-6
4. 6-7
5. 8-9
6. 10-11
7. 12-13
8. 14-15
9. 15 or more

35. If you participated in visual imagery instruction, please respond to the following: The visual imagery sessions helped me perform better in the EST zeroing exercise?

1. Strongly Disagree
2. Disagree
3. Neither Agree nor Disagree
4. Agree
5. Strongly Agree

36. How many times have you used the EST 2000 simulator NOT counting today (all cadets should answer)?

1. None
2. Once
3. Twice
4. Three
5. Four or more

37. Your Gender: 1. Female 2. Male

38. Your Current Academic Level:

1. Freshman
2. Sophomore
3. Junior
4. Senior

39. Age:

1. 17

2. 18-19
3. 20-21
4. 21 and older

40. Race

1. Asian
2. Black or African American
3. Hispanic
4. Caucasian, non-Hispanic
5. Hawaiian or other Pacific Islander
6. Native American

Appendix D

Plotted Results: Rakes and Jones (2012)

Estimated Marginal Means of Flow

Covariates appearing in the model are evaluated at the following values: Gender = 1.8333
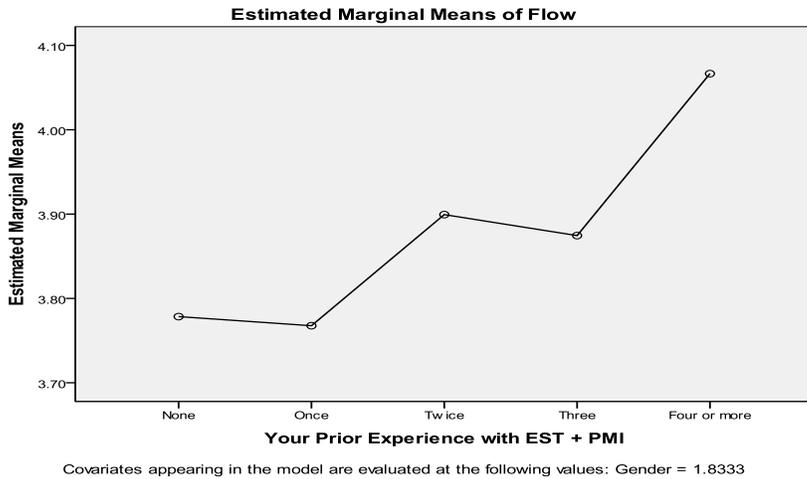
As prior experience increased so did the potential to enter flow. This figure shows clearly that four or more sessions on the EST 2000 simulator led to more potent flow experiences (flow perceptions are shown on the Y-axis where greater flow perceptions are indicated by higher scores).

Estimated Marginal Means of Performance

Covariates appearing in the model are evaluated at the following values: Your Prior Experience with EST + PMI = 3.6800
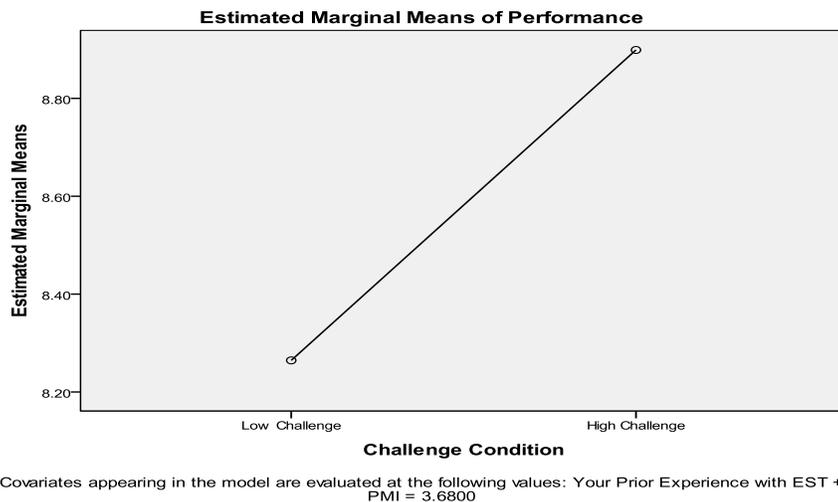
This figure shows that low challenge conditions resulted in better performance. Lower scores indicated better performance because it meant that the cadets needed fewer shots to complete the marksmanship exercise.