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The Effects of Moderating Variables on the Functions of Observational Learning

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Abstract

This study investigated the effects of gender, competitive level, and sport type on athletes' use of the functions of observational learning (OL): skill, strategy, and performance. Similar studies on OL (as well as imagery) have either compared OL use between athletes in team and individual sports, or independent and interactive sports. However, the author of the current study felt that these classifications were too general and led to the under representation of certain sports. Therefore the current study used more precise classifications of sport type than has been used thus far. This included an Action component made up of independent and interactive levels, and a Structural component consisting of individual and team levels. The Functions of Observational Learning Questionnaire (FOLQ)was administered to 917 male (n = 465) and female (n = 452) athletes participating in a variety of sports at three levels of competition: novice (n = 410), intermediate (n = 339), and proficient (n = 178). Significant differences in OL use were found between independent and interactive sports ($p < .01$), and a significant three way interaction was found between the Action and Structure dimensions of sport type, and the OL Function ($p < .05$). Furthermore, a significant Competitive Level by Function interaction showed differences in the use of the skill function of OL, and a Gender by Function interaction showed a difference in the use of the skill and strategy functions of OL between males and females. Finally, support was found for the results of previous research indicating that the skill function of OL was used significantly more than both the strategy and performance function, while the strategy function was used significantly more than the performance function as well across all sport types and levels of competition.

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Chapter 1: Introduction

Introduction

Visual cues are an efficient means of conveying information, typically more efficient than verbal cues (Bandura, 1986). This is evident when learning a new behaviour or skill, as it is common practice to observe a model such as a parent, teacher, coach, or even a peer, in an effort to obtain the requisite knowledge to reproduce the action. When this occurs, the learner, or observer, is engaged in what is called 'observational learning'(OL). This can take place when learning the most basic of tasks, such as walking, or when learning an exceptionally complex task, such as the movement pattern of an artistic gymnastics routine. OL is recognized as a powerful method of transmitting beliefs, and attitudes, as well as patterns of thought and behaviour (Bandura, 1986). For this reason, literature on OL has crossed several disciplines, including cognitive and behavioural psychology, sport psychology, and motor learning (McCullagh, 1993).

Within the motor learning domain, Cumming, Clarke, Ste-Marie, McCullagh, and Hall (2005) have identified three functions of OL within sport settings; these include (1) skill, (2) strategy, and (3) performance functions. Research that looks at sport type as a variable that moderates the functions of OL has been limited, inconclusive, and clear operational definitions have been lacking. It is possible that more complete operational definitions of this moderating variable will produce more conclusive results and a clearer understanding of its effects on the functions of OL. The current study will investigate sport type as a moderating variable that may influence the functions of OL, in addition to gender and competitive level. It is believed that a better understanding of these moderating variables will inform the development of an applied model of OL within a sport setting.

Chapter 2: Review of Literature

The literature review will begin by defining OL and outlining two theories that most researchers have utilized when explaining its processes and effectiveness. Key experiments highlighting the inconsistencies found in the literature will then be discussed, as well as their importance in directing current research in OL. The development of a conceptual framework for the functions of imagery and OL will then be summarized. Next, the development and appropriateness of the Functions of Observational Learning Questionnaire (FOLQ) will be reviewed in relation to the functions of imagery, and the Sport Imagery Questionnaire (SIQ). This will be followed by a review of the moderating variables that have been examined, and their relationships to the functions of OL and imagery utilized by an athlete. Finally, the review of literature will conclude by explaining the theoretical and applied contributions of the current study to the knowledge of the OL process.

Definitions of Observational Learning and its Theoretical Underpinnings

Observational learning is most commonly defined in the literature as "a process whereby an individual assimilates the information necessary to approximate the actions of others" (Ashford, Bennett, & Davids, 2006, p. 185). The current study will apply the same operational definition of OL as Cumming and her colleagues (Cumming et al., 2005) for the fact that, similar to this research, this definition was specific to motor skills within a sport setting. Cumming et al. (2005) defined OL as "Demonstration, either by having a person watch another team mate execute a skill, by watching a videotape of a skill, or even by watching yourself on videotape is a common means of communicating information about how to perform a skill or game play" (p. 521).

Researchers have predominantly put forth two theories in order to explain the process of OL. The first of these two theories is the symbolic representation theory (Sheffield. 1961). Sheffield (1961), proposed that OL works as a cognitive coding system, allowing an observer to become familiar with the information surrounding the movement pattern and then storing this in a memory representation that would be used for later action. It was theorized that the mental blueprint (Weinberg, & Gould, 2003) created in the central nervous system, with the establishment of a motor program, would be more easily developed and strengthened when observing a model (Sheffield, 1961).

Building on the symbolic representation theory is Bandura's social cognitive theory (Bandura, 1969). Bandura (1986) stated that "most human behaviour is learned by observation through modeling" (p. 47) and that through OL, behavioural responses could be acquired without explicit practice (McCullagh, & Weiss, 2001). Bandura (1986) posited that OL occurs through four subprocesses. These subprocesses include attention, retention, production, and motivation.

The attention phase refers to the amount of information, as well as the type of information that an observer will attend to during OL. This is influenced by both model characteristics and observer characteristics, including task complexity and saliency of the modeled event, as well as the cognitive capacity, arousal level, and expectations of the observer (McCullagh, & Weiss, 2001). Therefore, enhancing various aspects of the modeled action to better coincide with the observer's characteristics will improve the attention phase of OL by increasing the amount of information the observer will attend to. This may include attention directing aids, emphasis of salient features, and verbal cues (McCullagh, & Weiss, 2001).

The second subprocess of OL, retention, refers to the abstraction of relevant information from the modeled event. This information is retained in the observer's memory in a representational form, as was hypothesized by Sheffield's (1961) Symbolic Representation Theory. Bandura (1986) suggested that the relevant information extracted in this phase serves as an internal model for response production. The attention and retention subprocesses comprise the acquisition phase of OL (Bandura, 1986; Berlant, & Weiss, 1997; McCullagh, & Weiss, 2001).

The final subprocesses, reproduction and motivation, comprise the performance phase of OL. Production is characterized by a performer's attempt to reproduce the target behaviour. This attempt is followed by the comparison of one's task performance to the feedback received from the internal representations developed within the retention subprocess. Modifications to subsequent movement production are then made based on the discrepancies between the production outcomes and internal models (McCullagh, & Weiss, 2001).

The fourth and final subprocess put forth by Bandura (1986) is motivation, which recognizes the need for sufficient motivation on the part of the observer to reproduce the modeled behaviour. As such, an observer that has engaged in each of the previous subprocesses will not reproduce the modeled response without adequate motivation to do so, be it intrinsic or extrinsic in nature.

The second theory put forth to explain the effectiveness of OL is the Visual Perception Theory, developed by Scully and Newell (1985). Instead of looking at *how* observational learning works, this theory attempts to explain *what* is being observed during OL. Scully and Newell explain that human movements such as walking and running possess certain characteristics surrounding the movement of the body's joints; i.e. that the movement has relative motion characteristics. Scully and Newell hypothesize that by attending to these joint movements, the skill is distinguishable to observers, and may then be performed.

This theory has been tested primarily through the use of point-light displays and occlusion techniques in order to make these joint movements salient to the observer. Research has shown significant improvements in movement form following point light displays and unedited video demonstrations compared to physical practice alone (Scully & Carnegie, 1998; Al-Abood, Davids, & Bennett, 2001; Horn, Williams, Scott, & Hodges, 2005), suggesting that joint movements provide sufficient information for acquisition. However, Hodges, Williams, Hayes, and Breslin (2008), caution that this information is somewhat limited, as these demonstrations do not allow for an evaluation of the specific features of the model's action that are used to guide reproduction. Instead these authors have found that it is task constraints that direct the movement toward a goal, and end-point displays for single-limb movements that are attended to by learners observing a model. Additionally, these authors have found that when task constraints are not presented, learners minimize their visual search and prioritize the replication of the primary distal effecter. The authors proposed that this is because this point provides the most information for goal attainment.

The current research will be investigating *how* OL is used by athletes, and as such, will review OL literature that has been conducted from a social cognitive perspective. Further, motor learning researchers have focused on determining the effectiveness of OL in motor skill acquisition (McCullagh, & Weiss, 2001). This research has primarily followed Bandura's (1986) social cognitive framework, as opposed to direct perception views, and will be presented in the following section.

Research on the Effectiveness of Observational Learning

Psychomotor research investigating the effectiveness of OL as a method of motor skill acquisition has produced some inconsistent results. LaFollette (1969), for example, examined the value of OL in teaching basic archery skills. Neither videoed feedback or demonstrations given to participants of the experimental group along with physical practice were able to significantly improve participant accuracy on a 20-meter target task when compared to a group taking part in physical practice alone. Horn (2002) also failed to provide support for the effectiveness of OL, as significant differences in soccer chip-shot accuracy were not found between OL, videoed feedback and physical practice groups. Similarly, other researchers have failed to support OL benefits within several other motor skill domains, including badminton (Bradley, 1975), softball (Wiese, 1989), racquetball (Gray, 1990), tennis (Armstrong, 1971), and volleyball (Ashford, 1999; Weeks, & Anderson, 2000). These results replicated the previous findings of Williams (1989) who did not report significant improvements in throwing action movement patterns between experimental and control groups. Despite these negative results, many experiments have supported OL's effectiveness in motor skill acquisition.

Nelson (1958) demonstrated the usefulness of OL in skill acquisition when participants improved the accuracy of their golf shots following the observation of a videoed demonstration using a golf chip-shot task. Since then Hall and Erffmeyer (1983) and Al-Abood, Bennett, Hernandez, Ashford, and Davids, (2002), as well as Herbert and Landin (1994), have recorded improvements in basketball free throw shooting accuracy, and tennis return volley accuracy, respectively, following OL interventions. OL has also been shown to successfully aid in fearful children's adaptation to water, as measured by the prone float skill (Weiss, McCullagh, Smith, & Berlant, 1998). In this study, fearful children that were exposed to an OL intervention were significantly less fearful of the water, and were able to perform the prone float task more proficiently than their matched peers within the control group (Weiss et al, 1998). Additionally, Roach and Burwitz (1986) recorded significant improvements in participants' movement form when performing a cricket off-drive shot following an OL intervention. Similar improvements in movement form have been recorded using the tennis forehand drive (Paulat, 1969), underarm dart throwing (Al-Abood, Davids, & Bennett, 2001) and gymnastic sequences (Magill, & Schoenfelder-Zohdi, 1996).

From the discussion of this evidence, it is clear that equivocal findings within the OL literature exist. In fact, two studies exemplify this, as both positive and null effects were found within the same experiment. First, Armstrong (1971) showed OL to significantly improve participant's forehand racquetball shot accuracy, but not backhand accuracy. Similarly, Gray (1990) recorded significant improvements in tennis backhand drive, but not forehand tennis drive.

Thus, research has both supported and refuted the effectiveness of motor skill acquisition through the use of OL (Scully & Newell, 1985). Recently, it has been suggested that these discrepancies may be a result of differences in performance measurements within OL experiments (Ashford et al. 2006). That is, a number of experimenters measured performance benefits through movement outcome (end results), while others employed the measurement of movement dynamics (process; i.e., the temporal and spatial coordination of limb movement). Ashford et al.'s (2006) meta-analytic review determined that these different measurement variables yielded these contrasting findings. Several studies are able to provide support for this notion. For example, McCullagh (1987) provided participants with a videoed demonstration of a Bachman ladder-climbing task, which required participants to balance a ladder while they proceeded to climb. Meanwhile the control group was given verbal instructions without a demonstration. Results showed that participants within the OL group exhibited better movement outcome scores in comparison to participants receiving verbal instructions alone. McCullagh also noted a trend in the data, similar to the findings of Feltz (1982). That is, movement outcome scores between OL groups and control groups were shown to be equal in later stages of learning. The control group, however, continued to display significantly less accuracy in movement performance (movement dynamics) compared to participants within the OL group. This prompted McCullagh to suggest that OL can impact learning past movement outcome, and that research should reflect this by measuring both the movement dynamics and movement performance contributions of OL.

Subsequent research has investigated the effectiveness of OL on movement dynamics in addition to movement performance using the Bachman ladder-climbing task (Lirgg, & Feltz, 1991). Results showed movement dynamics accuracy to be significantly greater within the experimental groups following a demonstration when compared to that of participants within the control group. However, no significant differences in movement outcome were found between groups receiving an OL intervention, and the control group.

Little and McCullagh (1987) provided support for this notion when an OL intervention was carried out on groups separated by the nature of the feedback they received. After viewing their performance on video, participants were either given knowledge of results concerning their movement outcome, or knowledge of results concerning their movement performance (movement dynamics). The task to be learned in this study was the tennis forehand stroke. Results showed no significant improvement in tennis forehand shot accuracy within the group receiving knowledge of results concerning the movement outcome. However, additional analysis showed a significant increase in movement performance accuracy. Most recently, Horn (2002) has demonstrated the distinction between movement dynamics and movement outcome that is necessary within OL studies, using a soccer chip-shot task. Consistent with the findings previously discussed, significant improvements in the accuracy of movement dynamics were exhibited by participants receiving an OL intervention, while the same group did not record significant improvements in movement outcome, as measured by chip-shot accuracy. These studies provide strong support for OL being an effective method of bringing about motor skill acquisition, and suggest that it can benefit movement dynamics. Indeed, Ashford et al.'s meta-analysis was able to provide strong evidence in support of this.

In that meta-analysis, the authors first showed that an overemphasis to measure the effectiveness of OL based on movement outcomes (end results) rather movement dynamics (process) existed within the literature. Only 33 studies measured performance in terms of movement dynamics, while the remaining 72 studies measured performance in terms of movement outcome (achievement of the movement goal). These studies were separated and analyzed in order to determine the treatment effects for studies measuring movement outcomes versus those measuring movement dynamics. Results revealed a significant advantage for OL groups compared with groups exposed to physical practice alone on measures of movement dynamics. The findings were similar when comparing OL groups to physical practice alone groups on movement outcome measures; however, the difference was extremely modest in comparison to the differences on movement dynamics measures. This finding prompted Ashford et al. to conclude that the magnitude of treatment effects surrounding OL is dependent upon the aspects of performance being measured. OL is more effective in producing a greater approximation of movement coordination, rather than total movement outcome. Furthermore, this study put forth strong evidence that OL, when combined with physical practice, is significantly more effective in bringing about motor skill acquisition than is physical practice alone. The meta-analysis does well to firmly establish the distinction between movement dynamics and movement results within OL research, as well as the positive role each plays in producing treatment effects of OL.

Interestingly, the studies included in this meta-analysis were largely focused on physical performance benefits of a skill only, and it has been shown that OL can be used for other functions (Cumming et al., 2005). The focus of this research concerns the various functions of OL that athlete's use, and thus the next sections will expand upon Cumming et al.'s work. Due to imagery's similarity to OL, Cumming et al. used the SIQ as a starting point to investigate the possible functions of OL. As such, the development of the SIQ is first presented, followed by that of the FOLQ.

The Cognitive and Motivational Functions of Imagery

The SIQ built upon the functions of imagery framework previously established by Paivio (1985). Paivio examined the functions of imagery in order to determine how mental imagery techniques were effective in developing and enhancing motor skills. The resulting framework described two functions of imagery, a cognitive function and a motivational function, as well as suggesting that each operated at either a general level or specific level. According to Paivio, a cognitive specific image was an image that focused on the components and dynamics of a specific skill, such as the golf swing. A cognitive general image, however, involved imagining the completion of an entire performance or strategy. An example of cognitive general imagery would be a gymnast imagining his/her entire floor routine. Motivational specific imagery involved imagining goal-oriented responses, including how to achieve outcome goals, such as winning the Stanley Cup or Olympic medals. And finally, motivational general images were those aimed at regulating arousal, which included both elevating and lowering arousal levels, such as a football player getting excited prior to a competition.

The development of the SIQ (Hall et al., 1998) presented an extension to the theoretical application of Pavio's (1985) framework. Specifically, Hall et al. found that in addition to the functions of imagery outlined by Paivio, athletes were using imagery in order to cue attentional focus and maintain concentration. As a result, the imagery framework was modified to include two types of motivational general imagery. The function related to the regulation of arousal was maintained and identified as motivation general-arousal imagery. The second function concerned the attention focusing imagery function, and was titled motivation general-mastery imagery (Hall et al). This framework has since successfully been applied to other areas of sport psychology and psychomotor learning including self-talk (Gammage, Hardy, & Hall, 2001; Hardy, Gammage, & Hall, 2001) and goal setting (Munroe, Hall, & Weinberg, 2004).

Cumming et al. (2005) argued that OL and imagery were very similar learning strategies, and thus, the functions of OL would likely be the same as those for imagery. This similarity can be seen in Marteniuk's (1976) definition of mental practice that included performance resulting from imagining a skill or watching another performer. As such, Cumming et al. applied the SIQ framework to OL.

The Development of the Functions of Observational Learning Questionnaire

To test whether the five functions of imagery would exist within OL, Cumming et al. (2005) modified each of the 30 items on the SIQ in order to reflect an athlete's use of OL as opposed to imagery. For example, the SIQ item measuring motivational specific imagery which read: I use imagery to understand what it is like to win a championship, was modified to read: I use OL to understand what it is like to win a championship. This first version of the FOLQ had an item distribution that included seven cognitive specific items; six cognitive general items; five motivational specific items; six motivational general-arousal items; and six motivational general-mastery items. Results of the first round of a principle component analysis identified five factors and separated items reflecting cognitive and motivational functions of OL onto two different factors. However, eight items reflecting motivational functions of OL were loaded on multiple factors and were dropped from further principle component analyses. In addition, skewness, kurtosis and communality values resulted in other items being deleted from the questionnaire. This resulted in a second iteration of the questionnaire that consisted of 20 items that was further tested using principal component analysis.

Three factors emerged from the second principle component analysis, and 17 items remained after various exclusion criteria were administered. These 17 items loaded cleanly onto three factors (Cumming et al. 2005). These factors represented a motivational function that the authors described as performance state, as well as two cognitive functions related to skill and strategy. A final principle component analysis was conducted and the items again loaded on these same three factors. Cumming et al. reported that the eigen values of all three factors, as well as the communalities and factor loadings of each of the 17 items met their respective criterion. Internal consistency was established as Cronbach alpha coefficients for each of the three scales ranged from 0.84 to 0.90, thus meeting the criterion coefficient of 0.70. In comparing these results to the functions of imagery framework, (Hall et al., 1998) it is clear that OL holds similar, though fewer functions.

In comparison with the SIQ, all six items of the FOLQ reflecting a motivational specific function of OL were eliminated by principle component analysis, suggesting that athletes do not use OL to understand how to achieve outcome goals (Cumming et al., 2005). Furthermore, three items reflecting the motivational general-arousal function, and three items reflecting the motivational general-mastery function were also eliminated through principle component analysis. The remaining motivation items reflecting each of these functions loaded onto a single factor. Cumming et al. labeled this function 'performance state' as it involved using OL to enhance performance through the regulation of arousal levels, and mental states. In sum, the resulting framework put forth by Cumming et al. classified three functions of OL: a skill function, used for skill acquisition; a strategy function, used for strategy development and execution; and a performance state function, used to regulate arousal levels and mental states.

The final stage of the development of the FOLQ included validity and reliability checks of the questionnaire, as well as examining the influence of factors such as gender, competitive level and sport type (Cumming et al., 2005). The validity of the three-factor structure of the FOLQ was measured using the chi-square likelihood ratio statistic in conjunction with fit indices (the standardized root mean square residual, the Tucker Lewis Index, Comparative Fit Index, and Root Mean Square Error of Approximation). The values of each indices indicated a good fit, and all 17 items of the FOLQ loaded onto the same three factors as they had in the initial principle component analysis, therefore confirming the skill, strategy, and performance state functions of OL.

Cumming et al. (2005) also showed acceptable internal consistency, as Cronbach alpha coefficients ranged from 0.84 to 0.88. Bivariate correlations showed that the subscales of the FOLQ were moderately related to the corresponding scales of the SIQ (r values ranged from 0.29 to 0.54), indicating that the scales are related, but represent divergent constructs. Hierarchal regression procedures followed by beta weight analyses assessed the concurrent validity of each scale. The scale of the FOLQ reflecting the skill function of OL showed a positive relationship to the scale reflecting the cognitive specific function of imagery on the SIQ (β=0.41). Similar relationships were demonstrated between the strategy function of OL and the cognitive general function of imagery (β=0.59), as well as between the performance function of OL and the motivational general-mastery function of imagery (β=0.41; Cumming et al., 2005).

Additionally, intraclass correlation coefficients of each of the OL scales were calculated as a measurement of test-retest reliability, and were found to be adequate, ranging from 0.79 to 0.88 (Cumming et al.). These results demonstrated the validity and reliability of the FOLQ and provided clear support for the three functions of OL. Thus, the FOLQ can be used as a measure to identify how athletes use OL. As we have seen in the studies that were previously discussed most of the literature to date has focused on the skill function of OL, but the FOLQ indicates that there are also strategy and performance functions that also need to be researched in the future.

Moderating Variables of the Functions of Observational Learning and Imagery

With three possible functions of OL to utilize, targeting the correct function may be the most influential factor in determining OL's effectiveness to improve athletic performance. As such, identifying the variables that moderate an athlete's use of OL is vital to its success. To consider the possible moderating variables of the functions of OL, both the imagery and OL literature will be utilized. Hall et al. (1998) discovered that the type of imagery an athlete used was influenced by situational and personal factors, including sport context, and an athlete's imagery ability. Taking this into account, Cumming et al. (2005) investigated the impact that certain moderating variables would have on the type of OL and imagery an athlete would engage in addition to developing and validating the FOLQ. These variables included an athlete's gender, level of competition, and type of sport. Other researchers have examined the effects of type of skill (discrete, serial, and continuous), skill level, and gender (see Ashford et al., 2006 for a review). The next section will give an overview of these specific variables that will be studied in this research.

Gender. Cumming et al. (2005) reported no gender differences for any of the functions of OL, thus indicating that one's gender did not influence the function of OL utilized by the athlete. These results supported those found by Hall et al. (1998) using the SIQ, which suggested that gender did not influence the function of imagery an athlete would employ. Other research has produced similar results, with no significant differences in the effectiveness of imagery or OL between males and females (Barr, & Hall, 1992; Munroe, Hall, Simms, & Weinberg, 1998; Salmon, Hall, & Haslam, 1994).

The only aspect of imagery use in which males and females have been shown to differ is exercise imagery, in which females have been shown to use greater amounts of appearance imagery (imagery regarding one's body image), while males invoke greater amounts of technique imagery (technique used to guide one's form and method; Gammage, Hall, & Rodgers, 2000). Recently, however, male athletes have been shown to employ the performance function of OL significantly more often then female athletes (Wesch, Law, & Hall, 2007). Given that the FOLQ is relatively new measure and that varied findings have been found with regard to gender, it will be included as a variable of study in this research.

Level of Competition and Skill. Cumming et al. (2005) found no significant differences in the type of OL or imagery used between athletes at high and low levels of competition. They did recognize, however, the need for further research into the effects that level of competition has on the use of OL. They also suggested that, despite their current findings, athletes might be using the same functions of OL, but for different purposes. In this, they provide the example of a novice level athlete who may use the strategy function of OL in order to learn a new strategy, while a proficient athlete may use the strategy function in order to further develop their knowledge and skill of a strategy they have already learned.

Barr and Hall, (1992) and Hall et al. (1998) also found that athletes at all skill levels employed similar amounts of both cognitive and motivational imagery. Other research, however, has reported that athletes at a proficient skill level use significantly more amounts of motivational imagery than cognitive imagery in comparison to athletes of lower skill levels (Salmon et al., 1994; MacIntyre & Moran, 1996; Perry & Morris, 1995). Although it appears that more research into this area of imagery is necessary, all studies have reported a significant difference in the amount of imagery used by proficient athletes than by non-proficient athletes. These studies have found that as the skill level increases, so to does the amount of imagery use (Barr & Hall, 1992; Hall et al., 1998, Salmon et al., 1994). Results of a recent study concerning OL mirrored these results, as varsity athletes reported using all three functions of OL more frequently than recreational athletes (Wesch, et al., 2007) Evidently, the possible moderating influences of skill level on the uses of OL is still unclear. Thus, skill level will be included as a variable of this study.

There were three skill levels used in this research; 1) novice, consisting of athletes participating at either a recreational or club level, 2) intermediate, consisting of athlete competing at a varsity or provincial level, and 3) proficient, consisting of athletes competing at a national or international level.

Sport Type. The concept of sport type extends from research into the type of activity performed by the athlete. Cumming et al. (2005) found the skill and performance functions of OL to be used more by athletes competing in independent sports in comparison to those in interactive sports. The authors caution that conclusions should not be drawn from these results, however, due to small effect sizes. These results are partially supported by Wesch et al. (2007) as individual sport athletes reported using significantly greater amounts of the skill function of observational learning than did team athletes.

Imagery research has produced similar results. Hall et al. (1998), for example, administered the SIQ to participants of hockey, and track and field competitions. The hockey players were shown to use greater amounts of motivational specific and motivational general-mastery imagery, prompting the authors to suggest that individual and team sport athletes use the cognitive and motivational functions of imagery differently (Hall et al.). A more comprehensive study on this topic conducted by Munroe et al. (1998) included participants within the sports of badminton, basketball, field hockey, fencing, ice hockey, rugby, soccer, volleyball, and wrestling. Again, these sports were defined as either individual or team sports. Results of this study, however, did not support the findings of Hall et al., as no significant differences in imagery use between individual and team athletes were found.

A limitation with each of these studies was that the classification of sport type was unclear. Specifically, the distinction of team versus individual sports (Hall et al., 1998; Munroe at al., 1998), as well as independent versus interactive sports (Cumming et al., 2005), were not operationally defined. Moreover, research concerning OL and sport type has grouped interactive and team sport athletes (e.g., Cumming et al. 2005). Thus, in this research each category is operationally defined and distinct. Specifically, at a the structural dimension, there are individual sports in which the athlete is competing by themselves, and team sports, in which actions are carried out as a unit. At the action dimension, there are independent sports, in which the athlete(s) actions are carried out in absence of an opponent, and interactive sports, in which actions are performed in direct competition to an opponent. These dimensions create a 2x2 matrix in which the individual or team structure of the sport combine with the independent or interactive actions of the sport to make four separate sport types: individual-independent, individual-interactive, team-independent, and team-interactive (see figure 1).

Further, it is possible that differences exist in the functions of observational learning athletes will employ between individual sports in which interaction takes place between an athlete and their opponent (e.g. wrestling) versus individual sports where an athlete's performance is independent of their opponent's (e.g. golf). For example the wrestler may use OL to understand an opponent's strategies, and develop their own strategies in order to counter those of their opponents', thus incorporating the strategy function of OL into his training. Conversely, the golfer, not interacting with his opponent is able to focus solely on their own performance and the successful execution of each skill, therefore employing the skill function of OL. It is argued that a more comprehensive examination of sport type that includes all combinations of interactive/independent and individual/team classifications will provide a more complete picture of the relationship between the use of OL and sport type. Thus, the final moderating variable to be studied is sport type.

Figure 1: 2x2 Sport Type Matrix

		Structure	
Action		Individual	Team
	Independent	Athlete performs independent of either teammates, or opponents. Performance does not impact upon their opponent's, nor does their opponent's performance impact upon their own. E.g. golf, swimming,	A combination of two or more persons must work together in order to achieve a common goal. The team's performance is carried out independently of an opponent. E.g. synchronized swimming,
	Interactive	Athlete's performance is executed while interacting with an opponent, but independent of any teammates. E.g. wrestling, fencing	A combination of two or more persons must work together in order to achieve a common goal, and interact with their opponents in competition. E.g. hockey, soccer

Hypotheses

A number of hypotheses were made regarding each of the moderating variables examined herein. Each will be discussed separately.

Hypothesis I. Both Cummings et al. (2005) and Wesch et al. (2007) have found the skill function of OL to be employed significantly more than the strategy function of OL, which in turn, was employed significantly more than the performance function. It was hypothesized that these results would be replicated within this study.

Hypothesis II. While Wesch et al. (2007) suggested that males use the performance function of OL significantly more than females; Cumming et al (2005) reported no significant differences in OL use between genders. Additionally, due to the recognized similarity between the constructs of OL and imagery, the consistent finding of an absence of gender differences in imagery use (Martin et al., 1999) led to the hypothesis that no significant differences in the use of OL would be found between males and females.

Hypothesis III. It was hypothesized that proficient level athletes (i.e., national and international level) would use the performance function of OL more frequently than novice level athletes. Conversely, novice level athletes were expected to use the skill function of OL more frequently than proficient athletes. This is expected because novice level athletes have less knowledge concerning the skill, or group of skills, being learned. Thus, they would use OL more to gain the critical information surrounding movement coordination and goal attainment. Additionally, within the imagery literature, novice performers have been shown to use the cognitive function of imagery (conceptually related to the skill function of observational learning) most often, whereas proficient performers use the motivational functions of imagery (related to the performance function of OL) most.

Hypothesis IV. With respect to sport type, predicting the amount that each OL function is used differs depending on the function of interest. To begin, no differences in the use of the performance function of OL were expected across the different sport types. The skill function of OL, however, was expected to differ depending upon the Action dimension of sport type. Specifically independent athletes were predicted to use this function significantly more often than interactive sport athletes. This difference is expected due to the focus on specific skills and routines in independent sports. In fact, this result was found by Cumming et al. (2005). Conversely, it is hypothesized that the focus on strategies, reactions, and contingencies that characterize interactive sports will cause a significant difference in the use of the strategy function of OL. That is, interactive sports were expected to employ a greater amount of the strategy function of OL compared to independent athletes. Both of these hypotheses would be supported by an Action by Function interaction.

Hypothesis V.

The final hypothesis was that there would be a three-way interaction between the Structure and Action dimensions of sport type and the OL function, and that this would be driven by the difference in team versus individual sports, but only for the independent dimension of Action. In particular, it is hypothesized that because a team structure demands a certain level of coordination among teammates, this induces a greater need for strategy than individual sports, and thus, a greater amount of the strategy function of OL would be used by team athletes compared to individual athletes. Differences between team and individual athletes, however, will not emerge at the strategy level for interactive sports. For these sports, it is argued that the more salient component of interacting with an opponent will result in similar strategy function use.

Contributions

Developing a clearer understanding of three possible moderating variables on the functions of OL is the focus of the current study. This understanding will further the knowledge surrounding athletes use of the various functions of OL in a sport setting.

Additionally this information will contribute to the development of an applied model of OL within sport settings. Providing an applied framework gives direction to future research. Moreover, through the development of an applied model of OL in sport, coaches, teachers, and researchers will be better able to predict the type of imagery their athletes will benefit from and adjust their OL techniques accordingly, in order to bring about a desired outcome.

Chapter 3: Methodology

Participants

The sample consisted of 930 participants aged between 17 and 25 years. Of this 930, the data of 717 participants was obtained from questionnaires they had completed for the third study in Cumming et al's (2005) series of studies. An examination of the sport type representation of this data set showed that the individual-interactive and team-independent categories were low in number. Consequently, for the purpose of this master's thesis, 213 participants (male n = 95; female n = 118) were recruited from the University of Ottawa as well as local sport associations within the city of Ottawa. These additional athletes were involved in sport at the novice (n = 66), intermediate (n = 41), and proficient (n = 106) levels and represented the individual-interactive (n = 115) and team-independent (n = 98) categories. Thus, the total sample consisted of the following characteristics; a) Gender: males (n = 470), females (n = 460), b) competitive level: novice (n = 389), intermediate (n = 356), proficient (n = 185), and sport type: individual-independent (n = 223), individual-interactive (n = 115), team-interactive (n = 481), team-independent (n = 98).

Materials

The Functions of Observational Learning Questionnaire (FOLQ). The FOLQ was developed by Cumming, et al. (2005) and contains 17 items aimed at identifying the functions (skill, strategy, or performance) of OL an athlete uses when taking part in OL. Participants respond to each item using a seven-point Likert rating scale (1 = rarely, 7 = often). All three scales of the FOLQ were shown to possess acceptable internal consistency (alpha coefficients ranging from 0.84 to 0.88), test-retest reliability with intraclass correlation coefficients of 0.88, 0.80, and 0.79 for the skill, strategy, and performance scales respectively, and concurrent validity to the corresponding scales of the Sport Imagery Questionnaire (Hall et al., 1998). Skill: R^2cha = 0.17, $\beta = 0.41$, $p < 0.001$; Strategy: R^2cha = 0.02, $\beta = -0.25$, $p < 0.001$; Performance: R^2cha = 0.30, $\beta = 0.41$, $p < 0.001$.

Procedure

The principal researcher recruited participants by first approaching sport organizations and gaining permission to approach coaches of athletes in those two categories of sport that were targeted (individual-interactive and team-independent). Coaches were then contacted and asked permission to approach their athletes. Athletes who wished to take part in the study were required to read and sign a letter of informed consent and return it to the researcher. Participants then completed the FOLQ and returned it directly to the researcher. Questionnaires were administered before or after scheduled practices and the questionnaire took approximately 15 minutes to complete during which time the researcher was available to answer questions from the participants concerning the study.

Chapter 4: Results

Preliminary Analyses

From the original sample of 930 participants three cases were removed due to missing data thus decreasing the sample size to 927. Analysis of z-scores on each of the three dependent variables revealed that there were three univariate outliers within the 927 participants. An additional seven cases were found to have a Mahalanobis Distance greater than the critical value with three dependent variables (16.27), indicating that they were multivariate outliers. Each outlier was subsequently removed to provide a final sample size 917.

Cronbach's alphas were conducted on each of the subscales of the FOLQ in order to demonstrate the internal consistency of the data, and to provide support for the internal consistency for the subscales of the FOLQ. The criterion level was set at an alpha coefficient of 0.70 as recommended by Nunnally (1978) and Nunnally and Berstein (1994). The skill, strategy and performance scales demonstrated acceptable internal reliabilities: 0.90, 0.83, and 0.88, respectively.

Prior to conducting further analyses the normality of the skill, strategy and performance subscales of the FOLQ were tested and shown to violate the assumption of normality (see table 1). However, as identified by Tabachnick and Fidell (2001) with a large sample size, like that used in this study; it is not likely that the skewness and kurtosis will deviate enough from normality to significantly affect the statistical analysis.

Table 1: Descriptive Statistics of the Functions of OL

Source	N	Mean (SD)	Skewness (SD)	Kurtosis (SD)
Skill	917	5.41(1.2)	-.86 (.08)	.48 (16)
Strategy	917	4.63 (1.3)	-.48 (.08)	-.15 (.16)
Performance	917	3.34(1.4)	.13 (.08)	-.84 (.16)

It was decided that the analysis would be carried out using three separate mixed model ANOVAs; one for each moderating variable. This statistical procedure was selected in favour of grouping all factors together in a 2 (Gender) x 3 (Competitive Level) x (2 Action) x 2 (Structure) x 3 (Function) with repeated measures on the last factor, mixed model ANOVA. This decision was made as very low numbers were obtained in specific cells of the design, with the most drastic example being male participants (n=15) in team-independent sports (refer to frequency distributions table 2).

Table 2: Frequencies of Males and Females Within Each Sport Type at Each Level of Competition

	Male (n = 465)				Female (n = 452)			
	Nov.	Int.	Prof.	Total	Nov.	Int.	Prof.	Total
Individual-Independent	46	25	31	102	50	42	29	121
Team-Independent	4	11	0	15	13	10	60	83
Individual-Interactive	33	17	30	80	15	4	16	35
Team-Interactive	160	99	9	268	79	131	3	213
Total	243	152	70	465	157	187	108	452

Gender Analysis

A two way (Gender x Function) mixed model analysis of variance (ANOVA) with repeated measures on the last factor was conducted in order to determine whether there were significant differences in the use of observational learning between males and females. Mauchly's test of sphericity indicated that the assumption of homogeneity of variance was not satisfied ($p <.05$), as such, Greenhouse-Geisser scores were analyzed in order to decrease the likelihood of performing a type I error.

Results of the ANOVA showed a significant main effect for Function F (1.8, 1.7) = 1.058, $p <.01$, partial $\eta^2 = .53$. Post hoc analyses using Pairwise comparisons showed significant mean differences between the skill and strategy functions of OL ($p < .01$), the skill and performance functions of OL ($p < .01$) and the strategy and performance functions of OL ($p < .01$) (see table 3 for grand means and standard deviations). Tests of between subjects effects showed no main effect for Gender [F (1. 915) < 1.0]. As well, a significant interaction between Gender and Function [F (1.8, 1.7) = 12.3, $p <.01$, partial $\eta^2 = 0.01$]. Independent t-tests for each function showed that a) females reported using the skill function of OL significantly more than males [t (914) = 2.8, $p < .01$], b) that males used the strategy function of OL significantly more often than females [t (914) = 2.7, $p < .01$], and c) that no significant differences in the use of the performance function of OL resulted between males and females [t (914) = .96, $p >$ .05]; thus explaining the Gender by Function interaction.

Table 3: Means of Males' and Females' Use of the Functions of OL

Source	Males (N = 465)	Females (N = 452)	Total (N = 917)
Skill	5.32 (1.2)	5.53 (1.1)	5.41 (1.2)
Strategy	4.75 (1.2)	4.52 (1.3)	4.63 (1.3)
Performance	3.39 (1.42)	3.30 (1.4)	3.34 (1.4)
Total	4.94 (1.27)	4.45 (1.2)	4.46 (1.3)

Competition Level Analysis

A two way (Competitive Level x Function) mixed model ANOVA with repeated measures on the last factor was conducted in order to identify significant differences in the use of observational learning at various levels of athletic competition. Mauchly's test of sphericity indicated that the assumption of homogeneity of variance was once again violated ($p < .01$) and thus Greenhousse-Geisser scores are reported in order to decrease the risk of type I error (Tabachnick & Fidell, 2001).

Results revealed a significant main effect within OL Function [F (1.8, 1.7) = 955.7, $p < 0.01$, partial $\eta^2 = .51$]. Pairwise comparisons again showed significant mean differences between the skill and strategy functions of OL, the skill and performance functions of OL, and the strategy and performance functions of OL. Similar to Gender, tests of between subjects effects showed no main effect for the three levels of competition [F (2, 914) = 0.3, $p > 0.05$. A significant interaction between Function and Competition Level [F (3.7, 1.7) = 4.0, $p < 0.01$, partial η^2=.01], however, was found. Univariate tests showed a significant difference in the use of the skill function of OL between the novice and proficient competition levels [F (2, 916) = 4.04, $p < .05$, partial $\eta^2 = .01$], but no significant differences in the strategy [F (2, 916) < 1] and performance functions [F (2, 916) < 1] of OL between these two competition levels. The means of the novice, intermediate and proficient competitive levels' reported use of the skill, strategy and performance functions of OL are displayed in table 4.

Table 4: Means of Competitive Levels' Use of the Functions of OL

Source	Novice (N = 400)	Intermediate (N = 339)	Proficient (N = 178)	Total (N = 917)
Skill	5.32 (1.2)	5.45 (1.1)	5.62 (1.1)	5.42 (1.2)
Strategy	4.66 (1.3)	4.70 (1.2)	4.48 (1.3)	4.63 (1.3)
Performance	3.35 (1.4)	3.36 (1.3)	3.30 (1.6)	3.34 (1.4)
Total	4.44 (1.2)	4.50 (1.2)	4.46 (1.3)	4.49 (1.3)

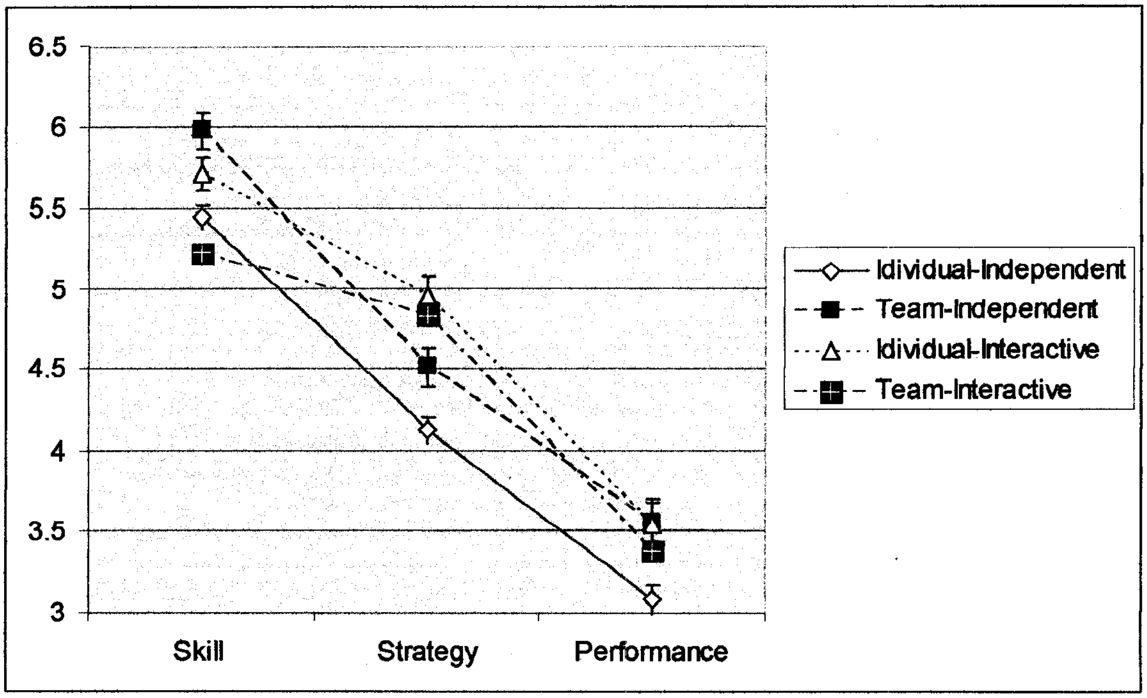
Sport Type Analysis

A 2 (Structure) x2 (Action) x3 (Function) mixed model ANOVA with repeated measures on the last factor was conducted. Once again, Mauchly's test of sphericity revealed that the assumption of homogeneity of variance was violated, prompting the interpretation of Greenhouse-Geisser scores in order to reduce the likelihood of performing a type I error.

This analysis showed a significant main effect for the OL Function [F (1.8, 1.7) = 8.17.6, p<0.01, partial η^2=.47]. Again, Pairwise comparisons showed significant mean differences between the skill and strategy functions of OL, the skill and performance functions of OL, and the strategy and performance functions of OL. Additionally, a significant interaction was found between Action and Function [F (1.8, 1.7) = 28.13, p < 0.01, partial η^2 = .03]. Univariate analyses indicated that independent sport athletes used a significantly greater amount of the skill function of OL compared to interactive sport athletes [F (1, 916) = 12.0, p < .01, partial η^2 = .01], while interactive sport athletes were shown to use the strategy function of OL significantly more often than independent athletes [F (1, 916) = 51.2, p < .01, partial η^2 = .05]. No differences in the in the use of the performance function of OL were found between independent and interactive sports, however [F (1, 916) = < 1].

Furthermore, tests of between subjects effects found a significant Action by Structure interaction [F (1, 913) = 21.3, p>0.01, partial η^2= .02], and a significant three way interaction was found between the Action and Structure dimensions of sport type and OL functions [F (1.8, 1.7)) = 3.45, p < .05, partial η^2 = .002]. Post hoc analyses were conducted using a Games-Howell procedure due to the unequal group sizes (Jaccard, Becker, & Wood, 1984). The three way interaction can be explained in that team-independent athletes reported using the skill and performance functions of OL significantly more often than individual-independent athletes (p < .05), while individual-interactive athletes reported using the strategy function of OL significantly more than both individual-independent athletes (p < .05) and team-independent athletes (p < .05). Additionally, individual-interactive sport athletes reported using the performance OL function significantly more than individual-independent sport athletes (p < .05), while individual-independent sport athletes used more of the performance function of OL than team-interactive sport athletes (p < .05). Also, team-interactive athletes reported using the strategy function of OL significantly more than individual-independent athletes (p<.05). Additionally, team-interactive athletes reported using the skill function of OL significantly more often than both individual interactive (p < .05) and team-independent athletes (p < .05). These interactions are displayed in figure 2.

Figure 2: Use of OL by Sport Type



Chapter 5: Discussion

The primary focus of this research was to examine possible moderating variables for the functions of OL. The specific moderating variables examined included gender, competitive level, and sport type. For sport type, the interest was to compare the dimension of both independent and interactive sports (Action dimension) as well as individual and team sports (Structure dimension). It was identified that previous OL research had failed to use each pairing in their comparisons. A 2 (Structure) x 2 (Action) sport type matrix was developed that allowed each sport type to be operationally defined. Moreover, a specific examination of previously under-represented sport types was now viable. Several hypotheses were made regarding these moderating variables and each of these will be examined separately.

Hypothesis I

The first hypothesis put forward was that the skill function of OL would be employed significantly more often than the strategy function of OL, which in turn, would be employed significantly more often than the performance function. This was indeed demonstrated by the data, as all three mixed model ANOVAs showed significant main effects for Function. Notable was that each of these main effects was accompanied by large effect sizes recorded in each analysis which showed that OL function accounted for 47-53% of the variance; a large effect size according to Cohen, (1998). These results provide further support for those found by Cumming et al. (2005) and Wesch et al. (2007) who also reported these same differences among the three functions of OL. Thus, although OL is used to learn skills, strategies, and coping techniques, the distribution of time spent employing each function is not equal. This finding will be discussed further in the section dedicated to future research.

Hypothesis II

It was predicted in Hypothesis II that no differences in the use of OL would be present between males and females. However, the null hypothesis was rejected as females were shown to use the skill function of OL significantly more often than males. This result is not consistent with the findings of Cumming et al. (2005) and Wesch et al. (2007). It is possible that this gender difference is reflective of a sampling byproduct found within the factor of sport type.

As noted in the results, participants in team-independent sports use the skill function of OL more than other sport types. A look at the specific sports in this team-independent category shows sports such as synchronized swimming and cheerleading; sports in which the athletes are predominantly female. Referring to table 2, we can see that females make up 83 of the 98 participants in the team-independent sport type group (84%); a clear limitation of this study. Hence, the logic is that the skill function of OL was used significantly more often by females by virtue of the fact that they represent the majority of the team-independent sport type and that it is in fact sport type that is driving this interaction.

Further support for this argument may be found in the findings of Cumming et al. (2005). The sample of the current study included Cumming et al.'s original sample while adding all the participants that made up the team-independent sport type group. Being that Cumming et al. found no gender differences, it is probable that it is this team-independent sport type that is the more influential factor in bringing about the gender difference reported by the current analysis.

It was also shown that males use the strategy function of OL significantly more often than females. Once again, this difference may be caused by sport type. Results of the sport type analysis indicated an Action by Function interaction, where post hoc analyses indicated that interactive sport athletes used significantly greater amounts of the strategy function of OL compared to independent sport athletes. Once again referring to table 1, we can see that of the 465 male participants in the study 348 competed in interactive sports (75%). Therefore, this Gender by Function interaction may again be a byproduct of a difference in OL use between sport types.

Hypothesis III

In the third hypothesis it was predicted that athletes competing at a novice competitive level would use the skill and strategy functions of OL significantly more often than proficient level athletes, while athletes at a proficient competitive level would use the performance function of OL significantly more often than novice level athletes. This hypothesis was not supported. Instead, proficient level athletes reported using the skill function of OL significantly more often than novice level athletes and both competitive levels used the performance function similarly. The prediction given was based on the imagery literature which has consistently found that proficient level athletes use the motivational functions of imagery (related to the performance function of OL) significantly more often than the cognitive functions of imagery when compared to novice level athletes (Hall et al. 1998; Martin et al. 1999). Cumming et al. (2005), however, did argue that OL was distinct from imagery and this is likely an example that highlights the difference between OL and imagery.

Within OL research though, equivocal results have been reported concerning competitive level and the functions of OL. Cumming et al. (2005) found no significant differences in OL use between competitive levels, whereas Wesch et al. (2007) found that varsity level athletes used all three functions of OL significantly more often than recreational athletes. A noted limitation of the current study, however, is the unequal sample sizes among the different competitive levels. As well, the sample of 178 athletes competing at a proficient level included 98 athletes competing in a team-independent sport type (55%). This is of importance to note because the team-independent sport type reported using the skill function of OL significantly more often then the individual-independent and team-interactive sport types. In addition to team-independent sports being made up of predominantly female athletes, the competitions for such sports occur at the provincial, national, and international levels. Therefore it may be possible that this difference in OL use is caused by sport type rather than competitive level.

Hypothesis IV

Three predictions were made regarding the use of OL between sport types. The first two predictions for sport type were 1) that athletes competing within sports that included an independent component would report using the skill function of OL significantly more often than athletes competing within sports that included an interactive component, and 2) that athletes competing within sports that included an interactive component would use the strategy function of OL significantly more often than athletes competing within sports that included an independent component. Both of these hypotheses were supported, through the Action by Function interaction. Post hoc analyses showed that independent sport athletes did in fact report using the skill function of OL significantly more often than interactive sport athletes. And interactive sport athletes reported using the strategy function significantly more often than independent sport athletes.

Hypothesis V

Important to note is that a three way interaction was also obtained, which supported the final prediction made for sport type; that the use of the strategy function would interact with the structural and action dimensions of sport type. Recall that I argued that this would be revealed by the team-independent athletes using significantly greater amounts of the strategy function of OL compared to individual-independent athletes, whereas the action dimension would not interact with structure for the interactive sports. That is, the team-interactive and individual-interactive sport athletes would use similar amounts of the strategy function of OL.

Indeed, the team-independent sport athletes were shown to use the strategy function of OL significantly more often than individual-independent sport athletes and no significant difference was found between team-interactive and individual-interactive sport athletes. This would suggest that within the interactive action dimension, a team structure does not demand the use of a greater amount of the strategy function of OL compared to interactive sports that are performed individually.

The results also showed that team-interactive sport athletes used the performance function significantly more often than the other three groups. This finding is contrary to that of Cumming et al. (2005) who, while using a sample that consisted only of individual-independent and team-interactive sport athletes, reported that independent sport athletes used the performance function of OL significantly more often than interactive sport athletes. It is not clear why these different results were obtained.

The results in this section may suggest that coaches should think about using OL for strategy improvement when coaching athletes within sports that include either a team, or interactive; and that they should think incorporating OL for skill learning when coaching sports that are independent. Or, these results may suggest that coaches are already using such OL techniques. That is, it may be that athletes are employing these functions of OL by their own choosing, or their coaches are structuring their OL practice to include such functions. This concerns independent versus structured OL practice and highlights the importance of gathering such information in future OL research. Should it be shown that athletes are employing these functions of OL independently then it would be worth while for coaches to structure their OL practices to cater to such functions. If, on the other hand, these differences in OL use are caused by coaches' structured OL practices then research into the effects of each OL function on performance can provide more insight into the implementation of the OL functions. This topic is discussed further in the future research and limitation section of this thesis.

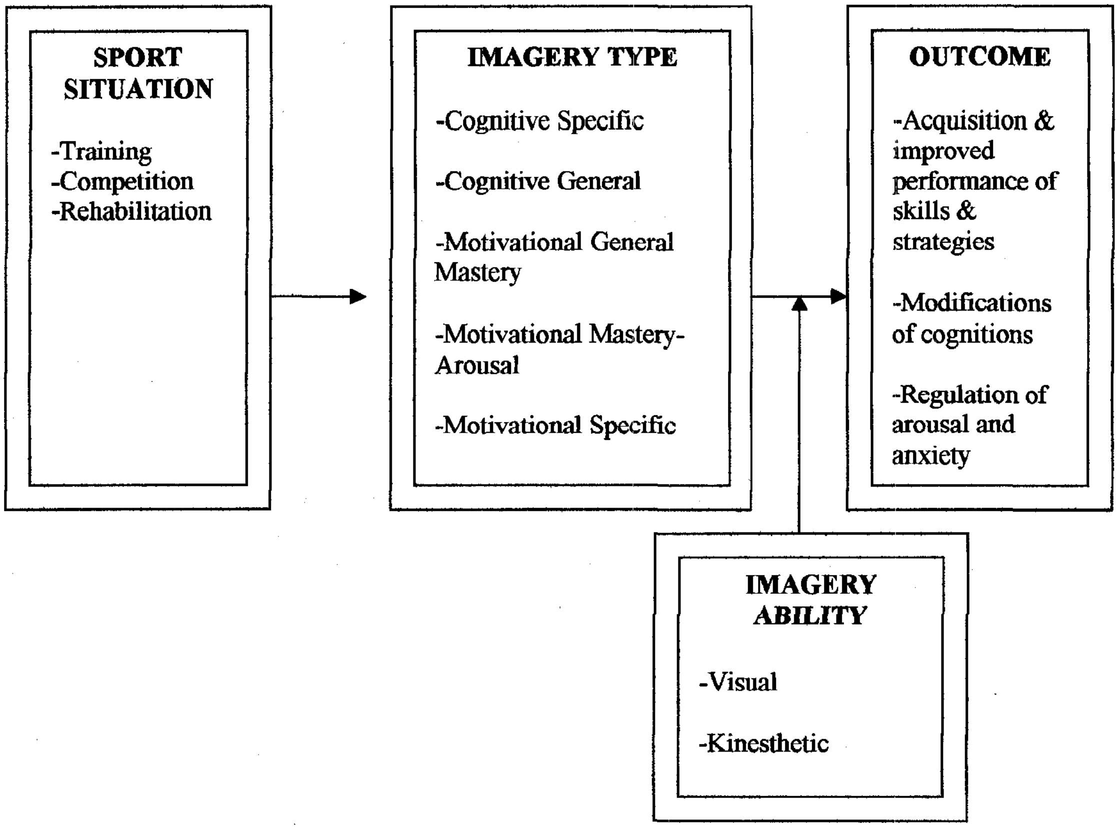
It can be argued, however, that coaches will not implement an intervention if they do not think it would be effective. So, if it can be shown that engaging in the performance or the strategy function of OL positively affects athletes' performance, than logically it would be beneficial for coaches to increase OL practice relating to those functions. Therefore, while the effects of OL relating to the skill function are well documented, research into the effects of the strategy and performance functions of OL use on athletic performance is needed to confidently make recommendations on their implementation.

It can further be argued that while Cumming et al. (2005) describe the functions of OL as separate entities; that all models used in OL contain each of these entities. The selection of which, function is to be employed, or rather attended to, is then moderated by the athletes' gender, competitive level and sport type. A working model of OL use in sport is proposed in the next section.

Applied Model of Observational Learning Use in Sport

As the knowledge surrounding observational learning within sport settings increases, and its processes become clearer, the need for an applied model of observational learning in sport is called for. As part of the discussion of this thesis, ideas concerning the nature of such an applied model are forwarded. Due to the similarities in the functions of imagery and observational learning, Martin et al.'s applied model of mental imagery use in sport is an appropriate starting point in thinking about the development of an applied model of observational learning. Martin, Moritz, and Hall (1999) put forth the Applied Model of Imagery Use in sport (see figure 3) in order to explain how the functions of imagery used by the athletes are associated with cognitive, affective and behavioural reactions.

Figure 3: Applied Model of Imagery Use in Sport



Note: Reprinted, with permission, from K.M. Ginnis, S. Moritz and C. Hall, 1999, "Imagery use in sport: A literature review and applied model," The Sport Psychologist(3): 248.

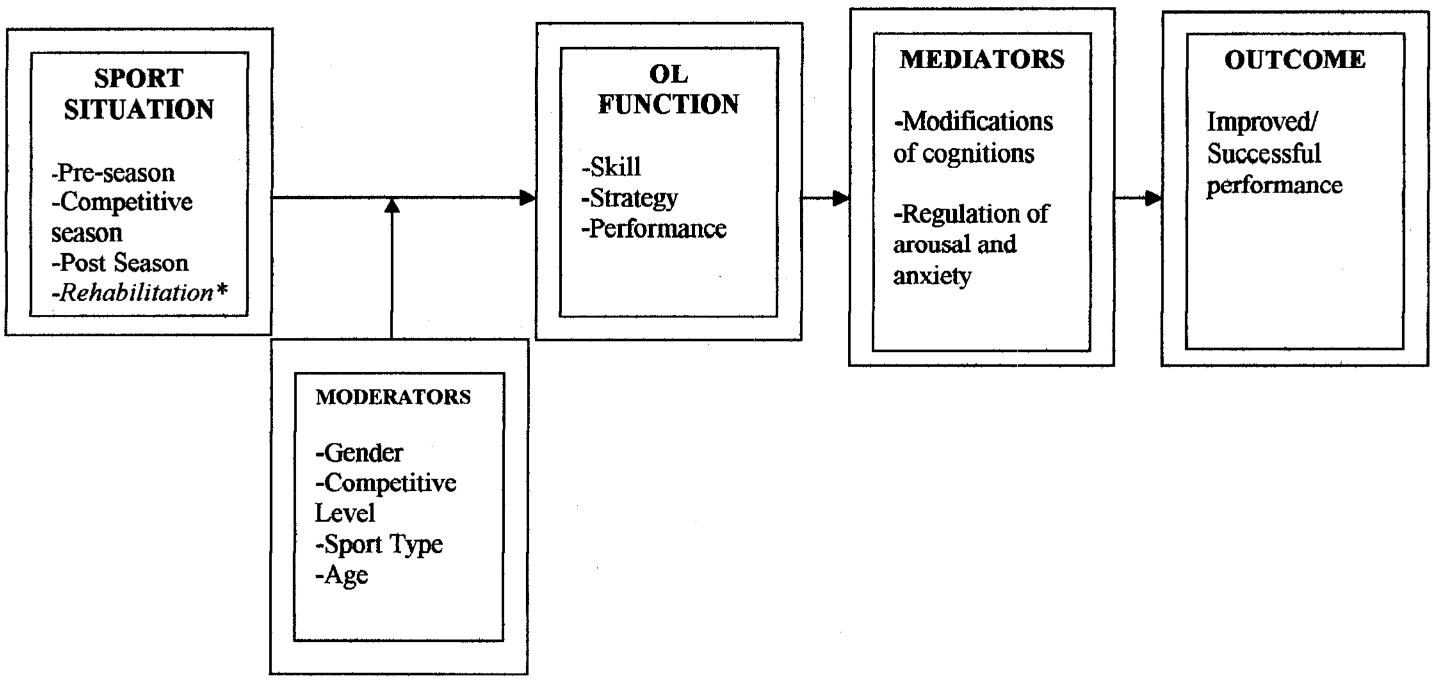
The applied model of OL (see figure 4) would borrow the environments in which an athlete may employ observational learning (Sport Situation), as well as the notion that these sport situations result in the use of the different functions of observational learning (OL Function). Most recently, Law (2007) interviewed athletes concerning the five Ws of OL use; that is the questions of who, what, where, when, and why of OL use. The results from the *where* and *when* components of OL can be used to inform the sport situation component of the Applied Model of Observational Learning Use in Sport. Specifically, Law showed that athletes use OL during the pre-season (i.e. prior to competitive season), competitive season (i.e. between competitions and events), and post-season (i.e. after the competitive season has concluded). This is contrary to imagery in that imagery was shown to be used in training (i.e. prior to, and between competitions and events), competition (i.e. during competitions and events), and rehabilitation (i.e. rehabilitation of a sport injury). The difference in sport situations between imagery and OL is likely due to the use of imagery as an onsite intervention and mental strategy, whereas OL is typically employed during scheduled practice times due to logistics.

Another difference is that, unlike imagery, the use of OL was not identified for rehabilitation purposes by the athletes interviewed by Law (2007). However, it should not be concluded that OL is not, or should not be used for rehabilitation purposes. A literature search for the use of OL with rehabilitation was conducted and showed no research has been done with sport athletes, however, research with other populations has shown observation to be effective for motor learning (see Dowrick, 1999 for a review). So although OL was not identified as a rehabilitation tool by Law it could conceptually aid in sport injury rehabilitation, and as such, is included in this model. That said, research is still needed to not only investigate if OL is used during rehabilitation, but its effectiveness in speeding up and improving the recovery process. For this reason, rehabilitation is presented in italics within the Applied Model of Observational Learning Use in Sport with an asterisk.

In terms of the OL Functions component of the model, Law (2007) corroborated that athletes used the skill, strategy and performance functions. However, two other possible functions of OL were identified as well. The first, Group Norms, suggested that athletes are using observational learning in order to learn the standards of behaviour that are expected of group members. Second, a possible Rule function emerged, wherein the athletes proposed using OL to learn the rules of their sport. Law's research offers insight into possible additions to the functions of OL, and direction to future OL research. However, there were just 12 participants in a semi-structured interview format and although it is not known how many of the 12 cited using OL to learn group norms; just one athlete cited using OL to learn the rules of the sport. As such more research is needed to determine if these functions indeed subsist, or are perhaps subsumed by one of the three existing functions before they are placed in the Applied Model of Observational Learning. These differences in the sport situation and functions components of the Applied OL Model versus the Imagery Model are quite superficial, and next I argue for two more substantial differences.

First, although Martin et al.'s (1999) model describes the impact of sport context on the function of imagery used, and in turn, its effect on cognitive, affective, and behavioural changes on the part of an athlete, it does not include moderating variables that could impact upon the function of imagery an athlete will utilize. The results of this research show that there are moderating variables that influences the functions of observational learning employed by athletes. While these variables were not included in the applied model of mental imagery due to the authors' goal to reduce the amount of imagery related variables to the smallest amount of meaningful factors (Martin et al.), I believe that the model is most useful in an applied setting with such moderating variables included. I, for example, have shown that independent sport athletes use the skill function of OL significantly more often than interactive sport athletes, while interactive sport athletes use greater amounts of the strategy function of OL than independent sport athletes. As well, the action dimension of sport type interacts with the structural dimension as the skill function of OL was used significantly more by team-independent athletes compared to individual-independent athletes. Law and Hall (2007) also found a relationship between skill level, age, and OL use among golfers, as it was shown that the use of all three functions of OL decreased as golfers' age increased.

Figure 4: Applied Model of Observational Learning Use in Sport



The second point that I argue is a change concerning the modifications of cognitions, as well as regulation of arousal and anxiety. These may be inappropriately labeled as outcomes within Martin et al's model. Though these may be short-term outcomes of imagery use, the outcome of any sport model should include a successful performance, and therefore, it could be argued that the modifications of cognitions and the regulation of anxiety and arousal become mediating variables that will influence the final performance outcome. For example, Bandura's (1997) self-efficacy theory states that OL can provide both mastery and vicarious experiences to observers, both of which are robust sources of self-efficacy. Singleton and Feltz (1999) have demonstrated OL's ability to increase both self-efficacy and shooting performance in the sport of hockey. Starkes and Lindley (1994), as well as Christina, Barressi, and Shaffner (1990) have shown that OL has been used successfully to improve decision making accuracy, and speed within sport situations that invoke pressure. Although neither study regarding anxiety and arousal obtained information regarding improved performance, it is theoretically presumable that more accurate and efficient decision making will improve athletic outcomes. As such, the applied model of observational learning displays the modifications of cognitions, and regulation of arousal and anxiety, as mediating variables that influence the performance outcome (see figure 4). Obviously, it was not the goal of this study to research the possible mediating effects of psychological responses on athletic performance following the use of OL, and thus, this should be investigated in future studies.

This model is intended to aid coaches and sport psychology consultants in choosing the content of their demonstrations when using OL. The model begins with sport situation. Again, athletes report using OL during pre-season, competition, and post-season. The moderating variables of an athlete's OL use look at *who* the athlete is, and directly affects *why* they are using OL, which is represented by the functions of OL. As this study has shown, as well as Cumming et al. (2005), Wesch et al. (2007) and Law (2007), and Law and Hall (2007); an athlete's gender, skill level, sport type, and age will influence why they are engaging in OL, and thus whether they use the skill, strategy, or performance functions of OL. Therefore, based on the sport situation and the moderating variables; a coach or sport psychology consultant can better understand which function of OL an athlete is using and structure their demonstrations accordingly. Following the use of OL whether or not the athlete has modified their cognitions, regulated their arousal and anxiety will mediate whether or not there is an improved or successful performance by the athlete, or team, which is the outcome goal.

Limitations & Future Research

While investigating the moderating effects that gender, competitive level, and sport type have on an athlete's use of OL was the primary focus of the study, a secondary objective was to operationally define sport types in a manner that would promote equal representation across each. In developing this 2x2 sport type matrix each sport type is operationally defined and a framework is established that allows for the investigation of both individual and team sports as well as independent and interactive sports. This suggests that future research investigating the role of sport type on athlete's use of OL, imagery, and any number of other constructs within sport psychology should use this 2x2 sport type matrix in order to achieve the most comprehensive results. However, this research is not without its limitations.

Earlier it was noted that the amount of time athletes spent using OL was significantly different between each of the OL functions. Moreover, these significant differences were shown to have large effect sizes. However, the significant differences in OL use that were found between males and females, novice and proficient athletes, and various sport types were shown to have much smaller effect sizes. Cohen (1998) has reported guidelines regarding meaningful effect sizes, describing a large effect size as partial $\eta^2 = .25$, a moderate effect size as partial $\eta^2 = .09$, and a small effect size as partial $\eta^2 = .01$. As reported in the results, effects sizes obtained for the differences in OL use between males and females, novice and proficient athletes, and various sport types, were small to moderate. As such, results should be interpreted with caution as they may be attributable to the study's large sample size. This study is also limited by information that was not gathered; information that now appears could play a critical role in future research into the use of OL.

Again, this study looked at the amount of time athletes spent using the skill, strategy and performance functions of OL, and found that it differed significantly between each function. What was not examined was how much OL engaged in by athletes was independent versus structured by coaches and instructors. This may be influenced by gender, competitive level, and sport type as well as other possible moderating variables, and may differ between OL functions. For example, it may be that the use of the skill and strategy functions of OL occurs predominantly during structured OL sessions, whereas the performance function is largely employed independently by the athlete. If this were the case, increasing the amount of structured OL sessions focusing on the performance function may increase athletes' coping abilities and positively influence athletic performance. Thus, it is possible that information regarding independent versus structured OL practice has the potential to offer great insight into the use of OL in sport settings, and increase the effectiveness of OL in improving performance. As such, it would be a valuable addition to future OL research.

While failing to gather information concerning independent versus structured OL practice limits this study in the scope of its conclusions, perhaps the greatest limitation comes from its sample sizes. This study was unable to conduct a reliable mixed measures ANOVA that included each of the moderating variables due to an essentially non-existent group of male team-independent athletes. As a result, we were unable to investigate possible interactions between moderating variables that might have influenced an athletes use of OL. As was noted in the discussion of hypothesis II; team-independent sports are not heavily populated with male athletes, thus making this a difficult group for which to participants. Though difficult to find, male dance teams are increasing in popularity and future researchers should make a concerted effort to recruit such teams in order to obtain a male team-independent sport group of acceptable size that will allow for an ANOVA that will measure interactions between moderating variables.

Similar to this gender effect, the difference in the use of the strategy function of OL between males and females is suggested to be a byproduct of the Action by Function interaction of the sport type analysis caused by a disproportionate amount of males in interactive ($n = 117$) versus individual sports ($n = 348$). Again, this discrepancy in these numbers will decrease with the recruitment of more male team-independent athletes in future research. The team-independent sport type also produced sampling difficulties relating to competitive level.

Due to ethics constraints the sample of the current study could not include participants less than 17 years of age. During the recruitment period it became evident that there a lack of team-independent sports athletes above the age of 17 that are competing at a competitive level lower than proficient. For this reason future researchers should obtain ethics approval to recruit youth participants in order to gain representation of male team-independent sport athletes.

It should also be noted that this study did not investigate the amount or extent of athletes' experience within a sport, which does not always correlate to athletes' competition level. While it can be assumed that an athlete competing within a proficient or even intermediate level of competition will have a significant amount of experience within a sport; it is possible that a novice level athlete competed at an intermediate or proficient level prior to testing, in which case they too would have a significant amount of experience within their sport. Again this can be taken into account in future research into the functions of OL. Recent research into the use of OL has shed light on new issues that require the attention of OL researchers.

The findings of Law (2007), and Law and Hall (2007) have the potential to greatly impact our understanding of athletes' use of OL. First, they have revealed that athletes are reportedly using OL during the pre-season, competitive season, and post-season. Future studies should confirm this finding and determine how, if at all, the sport situation affects the function of OL athletes will employ in their training. Second, Law and Hall have shown that an athlete's age may moderate their use of OL. Being that the sample of the current study, as well as those by Cumming et al. (2005) included athletes between the ages of 17 and 25, while Wesch et al. (2007) studied university students and varsity athletes, future research should include a sample that consists of a greater range ages in order to further test the findings of Law, and Law and Hall. Finally, the discovery of group norms and rules as potential functions of OL warrants further research. If in fact group norms and rules are confirmed as functions of OL a revised version of the FOLQ in which two additional scales containing items that reflect these new functions will be required.

Conclusions

This study found support for the findings of Cumming et al. (2005) and Wesch et al. (2007) who showed that athletes use greater amounts of the skill function than both the strategy and performance function, while the strategy function is also used significantly more often than the performance function. Future research should account for independent versus structured OL practice in order to determine if these trends change with increased structured OL practice. Although differences in the use of the skill function of OL were noted between males and females, as well as novice and proficient level athletes, it is believed that these differences may in fact be a byproduct of a sport type effect caused by the elevated levels of the skill function of OL employed by team-independent athletes.

OL use was shown to differ at the action dimension of sport type, as independent sport athletes used more of the skill function, but less of the strategy function of OL compared to interactive sport athletes. Furthermore, it was shown that the Action dimension of sport type interacted with the Structural dimension of sport type in that those team-independent athletes reported using a greater amount of the strategy function of OL than the individual-independent athletes. This suggests that both the Action and the Structural aspects of sport type influence athletes' use of OL. As such, it is recommended that the 2x2 sport type matrix introduced in this research be used by future researchers studying the moderating variables of sport type on any sport psychology construct.

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Appendices

Appendix A

Functions of Observational Learning Questionnaire

Please fill in the blank or circle the appropriate answer:

Sport: ______________________________ **Sex**: Male / Female **Age**: _____

Level of Competition: Recreational Club Varsity Provincial National International

General Purpose:

Demonstration, either by having a person watch another teammate execute a skill, by watching a videotape of a skill, or even by watching yourself on videotape is a common means of communicating information about how to perform a skill or game play. These forms of demonstration are commonly referred to as observational learning. Research to date has not identified the possible functions that observational learning may serve. Thus, this questionnaire was designed to assess the extent to which you incorporate observational learning into your sport and the possible functions it may serve.

General Instructions:

Any statement describing observational learning (OL) that you rarely use should be given a **low rating**. In contrast, any statement describing OL that you frequently use should be given a **high rating**. Your ratings will be made on a seven-point scale, where **one** is **rarely or never** engage in that kind of OL and **seven is often** engage in that kind of OL. Statements that fall within these two extremes should be rated accordingly along the rest of the scale. Read each statement below and fill in the blank with the appropriate number from the scale provided to indicate the degree to which the statement applies to you when you are practicing or competing in your sport. Don't be concerned about using the same number repeatedly as long as you feel that number represents your true feelings. Remember that there are no right or wrong answers, so please answer as accurately as possible.

Rarely						Often
1	2	3	4	5	6	7

1) I use OL to change how I perform a skill. ______

2) I use OL to determine how a strategy will work in an event/game. _____

3) I use OL to understand what it takes to be mentally tough. ______

4) I use OL to form alternative plans. ______

5) I use OL to make up new plans/strategies in my head. ______

6) I use OL to know how to respond to the excitement associated with performing. ______

7) I use OL to help me fine tune my skills. ______

8) I use OL to learn how to be focused during a challenging situation. ______

9) I use OL to understand how to perfectly perform a skill. ______

10) I use OL to help me improve my game/event strategies. ______

11) I use OL to learn how to cope with anxiety. ______

12) I use OL to help me learn new skills. ______

13) I use OL to improve my skills. ______

14) I use OL to understand how to get psyched up. ______

15) I use OL to develop game plans and routines. ______

16) I use OL to assist me in staying positive in tough situations (e.g., a player short, sore ankle, etc.) ______

17) I use OL to help me properly perform a physical skill. ______

Please circle the situations in which you make use of observational learning.

a) Watching another athlete or team at my same level on video

b) Watching an expert athlete or team on video

c) Watching myself on video

d) Watching my own team on video

e) Other, please specify: ____.

Please circle the amount of time, per week, during which you make use of observational learning.

a) 0-15 minutes.

b) 15-30 minutes.

c) 30-60 minutes.

d) More than 60 minutes.

Appendix B

Université d'Ottawa University of Ottawa

HEALTH SCIENCES AND SCIENCE RESEARCH ETHICS BOARD

CERTIFICATE OF ETHICAL APPROVAL

This is to certify that the University of Ottawa Health Sciences and Science Research Ethics Board has examined the application for ethical approval of the research project entitled **'The Effects of Moderating Variables on the Functions of Observational Learning' (file # H-05-07-08)** submitted by Diane Ste-Marie and Adam Jared Sunderland of the Faculty of Health Sciences, Department of Human Kinetics. The Board found that this research project met appropriate ethical standards as outlined in the Tri-Council Policy Statement and in the Procedures of the University of Ottawa Research Ethics Boards, and accordingly gave it a Category 1a (approval). This certification is valid one year from the date indicated below.

Date: July 16, 2007

Dorothyann Curran
Protocol Officer for Ethics in Research
For Dr. Daniel Lagarec, Chair of the
Health Sciences and Science REB

Appendix C

May 2, 2008

Adam Sunderland

University of Ottawa

RE: request to use material in master's thesis

Dear Adam Sunderland:

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