Running Head: OBSERVATIONAL LEARNING AND VIEWING ANGLE

The Effects of Viewing Angle on the Acquisition, Retention and Recognition of a Complex Dance Sequence

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Abstract

The benefits of observing a model when acquiring a new motor skill are well known, however, there is little research on the influence of viewing angle of the model. The purpose of the present experiment was to assess whether a looking-glass (face on) or subjective (facing away) viewing angle would result in different acquisition and retention levels when learning a complex Zumba dance sequence. Greater cognitive effort was expected during the looking-glass condition, consequently resulting in slower acquisition but greater physical performance scores and error recognition/identification. Thirty females were evenly divided into the looking-glass or subjective group and began with the pre-test phase to assess degrees of motivation, self-efficacy, and physical performance. Participants were then lead through six acquisition dances, within which they performed the to-be-learned sequence 18 times. An assessment of cognitive effort followed, then post-test performances and error recognition/identification scores were obtained to conclude the study. While both the looking-glass and subjective conditions demonstrated equal rates of acquisition ($p>.05$), the looking-glass group performed significantly fewer errors during the post-test ($p<.05$) and were significantly better at identifying errors when a video of the dance sequence was shown from the same viewing angle as the acquisition phase ($p<.05$). No differences were reported between the two conditions with respect to cognitive effort ($p>.05$). Based on the results of this study, the looking-glass viewing angle appears to result in better learning of a dance sequence, but cannot be explained by cognitive effort.

Keywords: looking-glass, subjective, cognitive effort, error recognition, error identification

General Introduction

It is no mystery that individuals are constantly being influenced by the behaviours of others. In the well-established social cognitive theory of observational learning (OL), Bandura (1977) speculates that through the observation of such actions, individuals are given the opportunity to identify behavioural patterns that lend to motor skill acquisition and retention. He further argues that these new skills are learned through cognitive processes that allow for the transference of information from the behaviour and the environment, into symbolic representations that are later used to guide actions (Bandura, 1986).

Since the establishment of this theory, evidence has repeatedly supported Bandura's (1977; 1986) hypotheses by demonstrating the positive effects of OL. In fact, its influence on motor skill acquisition occurs through the observation of both skilled (George, Feltz, and Chase, 1992) and unskilled (Gould & Weiss, 1981) models, as well as varied uses of self-as-a-model techniques (Clark & Ste-Marie, 2007; Dowrick & Raeburn, 1995; Onate, Guskiewic, Marshall, Giuliani, & Garrett, 2005). Performance effects are exhibited through improved performance on recall and recognition tests. Furthermore, observation benefits extend to a number of different motor skills including serial, continuous and discrete tasks (Ashford, Bennett & Davids. 2006).

Evidently, there is no question that OL is an effective means of learning new skills. However, there are important features that must be addressed in order to capitalize on its potential. Consequently, Ste-Marie, Law, Rymal, O, Hall, & McCullagh (submitted) have generated a framework for the effective use of observation in motor skill acquisition. To maximize the effects of OL, certain characteristics pertaining to *who* is modeling the behaviour, *what* is being modeled, *where* it is being modeled, *when* the modeling is being provided, and *how* the models are being presented must all be taken into consideration (Ste-Marie, et al.). Specific to *how*, speed, frequency, and viewing angle, can each impact the learning process if not implemented effectively (Gills & Williams, 2008; Weinberg & Gould, 2010). Despite this awareness, there still exists very little research on what viewing angle is best to promote learning when observing a model.

The importance of model viewing angle was initially addressed by Fleishman & Gagné (1954), and subsequent studies have provided results both for, and against, a subjective view (observing from the rear of the model) leading to more efficient acquisition than objective (observing the model face on) and looking-glass views (observing the model face on as though looking in a mirror; i.e. abduction of the model's left leg results in abduction of the observer's right leg) (Roshal, 1961; Inomata, Koyama & Seno, 1983; as cited in Ishikura & Inomata, 1995). Ishikura and Inomata (1995) hypothesized that the looking-glass and objective views would result in deeper cognitive involvement during the learning process, and would consequently lead to slower acquisition, but greater retention of a skill. This premise makes sense as motor learning researchers have argued that increased levels of cognitive effort enhance skill learning (e.g., Lee, Swinnen, & Serrien, 1994). To date, the negligible amount of literature on OL and viewing angle provides no clear support for this hypothesis. Furthermore, the ecological validity of the experiments completed to date has been weak and Ste-Marie et al., (submitted) have highlighted the need for more ecologically valid observation research.

It is evident that a gap in the literature revolves around which viewing angle is most appropriate for both acquisition and retention of a novel motor skill. The scarcity of research, in addition to the weaknesses in the research to date, makes it very difficult to establish consistent and ecologically valid results. Consequently, continued research on the viewing angle of a model is needed. Thus, the purpose of the proposed research will be to examine which of two viewing angles is better; the subjective or looking glass view. This will be examined within a research design that maximizes ecological validity while still accounting for experimenter control. Moreover, the design will include a measure of cognitive effort associated with the two viewing angles, thus enabling a more accurate examination as to the contributions of varied cognitive levels as an explanatory mechanism; a unique contribution to the literature to date.

The proposed research will further our understanding of the potential importance of viewing angle and has theoretical and practical implications. First, it will provide practitioners with more effective methods of teaching that assist learners in acquiring motor skills. Second, we will gain an understanding of the contributions of cognitive effort in relation to viewing angle and its importance in OL for the acquisition and retention of motor skills.

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Chapter I: Literature Review

Literature Review

From birth, the act of observation begins immediately. We are constantly taking in visual stimuli from people and our environment to be processed, transformed into internal models, and used to plan a variety of actions (Goodale, 2011). This process of observing and imitating models, also known as observational learning, is what is responsible for the acquisition of most human forms of behaviour (Bandura, 1977, 1986). Whether it is family, friends, coaches, or teachers who model the movement patterns, the every day process of observation allows for more efficient acquisition of motor skills (De Maeght & Prinz, 2004). While seemingly simplistic, this form of behaviour development is highly dependent on the interaction between the observer's cognitive processes, the environment, and the behaviour to be learned. With this understanding, Bandura (1986) proposed the social cognitive theory stipulating, that not only do individuals learn through observing others, but also that cognition is an equally important determinant in skill acquisition.

While learning a new skill through observation, Bandura (1986) posits that a multi-stage process occurs whereby one transitions through attention, retention, production, and motivation processes. During the initial attention phase, the observer must select a reduced number of stimuli from a larger set of possible stimuli. Therefore, how quickly and to what extent one learns a new skill is largely influenced by his/her degree of attentiveness. This, in turn, is affected by a number of different factors such as: the properties of the modeled activities, observer determinants, and other attentional means (Bandura, 1986). For example, a more complex/serial skill, such as a dance sequence, incorporates a number of different elements and reduces the saliency of the pertinent aspects in the demonstration. When considering different task complexities, it has been shown that serial tasks benefit the most from observational learning when compared to both continuous and discrete tasks (Ashford, et al., 2006). Using slower-than-real-time, repeated demonstrations (Petrosini et al., 2003) and/or segmenting the complex task into smaller parts, has also proven to facilitate the acquisition of complex skills (Petrosini et al., 2003). These strategies exemplify how the modeling experience can be enhanced to help direct the observer's attention towards pertinent information.

Retention is considered the second fundamental cognitive process of observational learning. In this phase, the selected information extracted is transformed into symbolic representations. Once this takes place, the information is stored and called upon as a guide when needed for future action (Bandura, 1986). Bandura emphasizes the importance of the imaginal and verbal construction representations in this phase. During imagery, individuals take the extracted features and "form composite, enduring images of the behaviour patterns" (Bandura, pg 56). This system functions in line with verbal construction, whereby individuals transform the important features into verbal codes (Bandura). Despite the distinction of these systems, they often function in conjunction with each other (Paivio, 1975). In order to retain these symbolic and verbal codes for recall in the future, cognitive rehearsal must be employed (Bandura, 1986). Various studies examining such strategies have provided support for the use of cognitive rehearsal strategies to enhance observational learning benefits (e.g., Bandura & Jeffery, 1973; McCullagh et al., 1990; Meaney, 1994; Weiss, Ebbeck & Rose, 1992).

The production of a newly acquired motor skill represents a transition into the next phase of observational learning, behavior reproduction. This requires "organizing responses spatially and temporally in accordance with the conception of the activity" (Bandura, 1986, pg 63). This is chiefly obtained through a process known as conception-matching, whereby the observer cognitively integrates the different elements of the behaviour, then initiates a response, monitors the response through sensory feedback, and corrects any actions that do not match the internal representation (Bandura). Intrinsically, this feedback consists of visual, auditory and kinesthetic sources, and is often supplemented with an extrinsic source that provides knowledge of results (KR) (Bandura).

When acquiring a new skill, factors such as the observer's physical ability to perform an action may interfere with reproduction of the behaviour. As a result, one's performance may not accurately reflect the degree of observational learning that took place. For this reason, alternative measurements have been established. Verbal production that requires explaining what was learned (Bandura, Jeffery, & Bachicha, 1974), comprehension tests whereby the observer identifies or demonstrates their understanding of the underlying rule (Brown, 1976; Rosenthal & Zimmerman, 1978), maximizing enactment tests that provide incentives along with negligible restrictions to ensure maximum performance of the action (Bandura, Grusec, & Menlove, 1966), and recognition tests that require identifying a specific model prototype or the correct pattern of the skill (Caroll & Bandura, 1985; McCullah and Weiss, 2001) have all been used. These measures also tap into information learned by providing an understanding of the cognitive representation of the motor skill. Knowing this, in addition to the physical performance recall test, recognition tests will also be used. While these additional measurements can better our understanding of what learning took place, the observer's motivation to perform the action must also be taken into account.

The motivational process of Bandura's (1986) social cognitive theory addresses how observers are influenced by different incentives and their own set of personal expectations with respect to skill performance. Evidently, motivation to perform an observed task greatly aids the learning process. Alternatively, a lack of motivation may hinder its acquisition. Without a desire to learn a behaviour, minimal benefits may be displayed and under-represent the advantages of observational learning. Therefore, these types of observer characteristics are important considerations when attempting to understand what guides the processes of observational learning. For this reason, a motivation questionnaire was administered prior to commencing the study to monitor for possible variations between groups, and control for the effect that this may have on learning the Zumba sequence.

While subsequent studies have demonstrated the positive relationship that exists between modeling and motor skill proficiency (McCullagh, Weiss & Ross, 1989), another key aspect in Bandura's theory is the role of self-efficacy. This facet also influences the cognitive processes that underlie observational learning. Efficacy expectations reflect one's degree of confidence in successfully performing the required action (Bandura, 1977). Personal expectations of efficacy not only take on multiple dimensions, such as: magnitude, generality, and strength, but are also based on four fundamental sources of information: verbal persuasion, physiological states, performance accomplishments (personal mastery), and vicarious experience (Bandura, 1977). Although a principle assumption of the social cognitive theory is that a number of psychological procedures serve as means of creating and strengthening expectations of personal efficacy, it is suggested that vicarious experience (i.e. watching a model) is one of the stronger sources (Bandura, 1977). This act of watching a model perform the desired behaviour is akin to the aforementioned process of observational learning. Therefore, Bandura (1977, 1986) posits that observational learning increases self-efficacy and enhances the learning process of novel skills.

Given the multiple factors that affect one's level of self-efficacy, Bandura (1977, as cited in Bandura et al., 1986) tested the influences of personal mastery and vicarious experience on the relationship between self-efficacy and performance using tasks of varying complexities. Results indicated that regardless of which psychological procedure was used or skill complexity, when subjects' efficacy expectations increased, so did their level of performance. With such a significant relationship between observers' confidence and performance outcomes, it is important to measure this self-belief in order to control for its potential influence; thus a self-efficacy measure was included in the experimental design.

It must be noted that the mere observation of a behaviour does not automatically produce learning benefits. A number of additional factors need to be considered for its effectiveness. Recently, Ste-Marie, et al. (2012) proposed a 5W (who, what, where, when, why) and 1H (how) framework for practitioners to consider in the implementation of observation interventions. In the next sections, I present a brief overview of this framework and how it influences the proposed experimental design.

Without taking into consideration the *how* characteristics of observational practice into a design, one risks not achieving maximum potential through observational learning. Viewing angle, speed and frequency are all examples of modeling characteristics that can be manipulated in order to further enhance the learning experience (Ste-Marie et al., 2012). One consideration with respect to *how* models should be implemented relates to what angle the model is being viewed. The importance of this manipulation was first recognized by Fleishman & Gagné (1954) for its instructional purposes and its influence on modeling effects. Since then, the limited research that has been conducted on this topic has provided contrasting results.

When assessing viewing angle, three different perspectives have been examined. The objective view represents when the model and the observer are face-to-face, with the learner situated in front of the model. The subjective view differs in that the learner is placed behind the model. The third angle examined is the looking-glass view (Ishikura &

Inomata, 1995). This placement again situates the observer in front of the model; however, the observer directly mimics the model's behaviours as though looking into a mirror. For example, a right hand movement by the model results in a left hand movement by the observer.

Roshal (1961) initially examined viewing perspectives in the context of a knot-tying task. The data suggested that having learned from the subjective view resulted in more efficient skill acquisition. However, this benefit disappeared when subjects were required to perform a recall test, with no difference in performance across the groups. Ishikura & Inomata (1995) also examined the influence of the aforementioned viewing angles on the acquisition and retention of a sequenced skill. Simultaneously, they advanced a cognitive processing account known as reversal processing. They stipulated that in the subjective condition, less cognitive processing is required because no reversal of information is necessary, whereas in the other two viewing angles, cognitive reversal of the visual information is initially required before it can be encoded and processed. This reversal processing was proposed to result in more complex cognitive processing, which they argued would reduce the efficiency of acquisition, but enhance skill retention.

This cognitive processing hypothesis for viewing angle is in line with other research that has shown that increased cognitive effort can lead to poorer acquisition, but enhanced retention. For example, Shea & Morgan (1979) first applied what they termed contextual interference into different practice conditions. Findings showed that higher levels of contextual interference (assumedly increasing the cognitive effort of the learning situation) resulted in a poorer acquisition performance, but better retention of the task. As evidenced by the previous findings, incorporating retention and transfer tests in motor learning experiments is critical to understanding the benefits of observational learning in their entirety. Without supplementing with these measures, results based solely on acquisition data increase the risk of drawing false conclusions and devaluing the effectiveness of the task (Schmidt & Bjork, 1992).

It was this approach that provided Ishikura and Inomata (1995) the insight needed to further the understanding of their reversal process hypothesis. However, their data only partially supported their hypothesis. While the easier processing condition (subjective view) did generate faster acquisition, no retention differences were found. Similarly, when Sambrook (1998) returned to the knot-tying task used by Roshal (1961), there were no retention benefits and not even the rate of acquisition varied between viewing angles. Therefore, there is still much uncertainty about the influence of viewing angle on the acquisition and retention of motor skills.

In addition to the ambiguity surrounding viewing angle, there have also been a number of limitations and weaknesses within the research to date. Despite all the evidence on how to effectively implement observation into interventions, studies with respect to viewing angle have neglected to incorporate instructional features into their designs. The aforementioned study by Ishikura and Inomata (1995) occurred in a laboratory-based setting, whereby observers were presented videos of a model from three different angles. No verbal cues or pre-demonstration advice was provided throughout the experiment. Given the complexity of the learned skill, providing verbal cues or advice would have directed observers' attention to the pertinent elements. Therefore, supplementing with these instructional features may have demonstrated different results with respect to the degree of learning displayed during acquisition, and/or retention. Furthermore, motivation to perform the task and degree of self-efficacy were not considered when assessing the effects of the different viewing angles.

Some of the most crucial assessments in observational learning are physical performance measures. However, a number of factors may affect an observer's ability to physically perform a learned skill. Unfortunately, this limitation has not been addressed in studies on viewing angle, seeing how measures that extend beyond physical performance have been lacking with respect to learning assessments. Consequently, the inability to perform the skill may have masked the effects of learning from a specific viewing angle. One final weakness concerns the filled retention interval. Ishikura and Inomata (1995) assigned retention intervals of one day, seven days, and five months following acquisition without controlling for participants' behaviours during that time. Without having monitored the amount of practice employed by the participants, it is important to remain critical as to the accuracy of these results. Therefore, when assessing the effects of viewing angle on recognition, appropriate measures need to be taken to ensure similar retention interval activity. Furthermore, none of the research to date has measured cognitive effort; thus, making it difficult to argue that the faster acquisition pattern was due to easier processing of the angle in which the model was viewed.

Due to the current lack of literature, in combination with the conflicting results and weaknesses in experimental design, any suggestion that implies enhanced learning from a specific viewing angle remains inconclusive. This presents a gap in the observational learning literature that needs to be addressed. So, although we know observational learning can be effective for motor skill acquisition, it is important to ensure that these psychological skills are effectively implemented (e.g. Gill & Williams, 2008; Weinberg & Gould, 2010) to maximize results. For this reason, the proposed study will examine the effect of viewing angle (looking-glass and subjective views) on the acquisition, retention, and recognition of a complex, Zumba dance sequence, while following the 5W and 1H method proposed by Ste-Marie et al. (2012). The other factors associated with the how characteristic and the 5 W's of Ste-Marie et al.'s observation framework will be addressed next for the purpose of further clarifying the experimental design.

In addition to viewing angle, research has manipulated the speed of the demonstration across different skill complexities. Results demonstrate that its influence may be dependent on the movement characteristics (Ste-Marie, et al., 2012). During acquisition, complex skills tend to benefit from slow motion video modeling (Scully & Carnegie, 1998; Williams, 1989), whereby this reduction in speed tends to impede the process for simpler tasks (Al-Abood, Davids, Bennett, Ashford, & Martinez-Marin, 2001). Currently, it is suggested that the benefit/hindrance of slow motion relates to the degree of spatial and/or temporal patterns that need to be processed (Ste-Marie, et al.). However, additional research is required to establish a more consistent pattern of results, and to validate why speed manipulation is only effective in certain circumstances. The proposed dance sequence for this study is a complex skill that requires high spatial and temporal demands. Based on the current literature in regards to the benefits of slow-motion, the first two demonstrations of the dance sequence will be performed slower than real time, while the remaining two demonstrations will be at the same speed as the actual performance. This method lends itself to increased ecological validity, given that Zumba dance instructor videos follow the same modeling approach when teaching new routines (Zumba Fitness Exhilarate: The Ultimate Experience DVD Set). This provides observers with the opportunity to not only direct their attention to pertinent elements of the dance, but also to allow for multiple viewings of the sequence.

How frequently observers are exposed to a model is another manipulation that can influence the effectiveness of observational learning. The guidance hypothesis proposed by

Salmoni, Schmidt, and Walter (1984) suggests that knowledge of results (KR) on every trial interferes with the learning process by establishing a dependency on the model. As a result, observers are not able to reproduce the behaviour once the KR is removed because deeper processing of the skill has not occurred. However, research with observational practice has not shown the same results. A study conducted by Sidaway & Hand (1993) controlled for all levels of viewing frequency and assessed the retention and transfer performance of a golf ball-hitting task. Data indicated that presenting a model on 100% of the trials resulted in significantly better performance during the retention tests. Furthermore, Wrisberg & Pein (2002) assessed viewing frequency by incorporating a self-controlled model view group. This group selectively chose when they wished to view the correct model performance. As expected, both the 100% group and the self-controlled group performed significantly better than the control group during the acquisition phase. However, performance did not differ between these groups during the retention phase. Therefore, while 100% viewing frequency may not represent the most efficient approach to motor learning, it does not appear to hinder the learning process by establishing dependency on the model. Consequently, this study aims to remain ecologically valid by staying true to a typical Zumba class and having the model demonstrate the dance sequence throughout all acquisition trials.

What is being observed and what instructional features are appropriate are important considerations for effective observational learning of motor skills. When comparing, live, video, animated or virtual models, no significant differences in degree of learning were found (Feltz, Landers, & Raeder, 1979; Kampiotis & Theradorakou, 2006; Kernodle, McKethan, & Rabinowits, 2008). Therefore, the use of a live instructor to conduct the

Zumba class for this study should be an effective and ecologically valid means of displaying the to-be-learned dance sequence.

In addition to what is being viewed during observational learning, what instructional features are used to supplement the model must also be taken into consideration. One of the most widely implemented instructional features is supplementing the modeled information with verbal cues (Rosen et al., 2010). Given the excessive amount of information presented to observers, these cues assist in either increasing the saliency of the most pertinent elements of the behaviour, triggering key movement patterns (Landin, 1994), or increasing observers' levels of motivation (Rosen et al.). Studies on adults show that whether these cues are provided before (Al-Abood, Bennett, Hernandez, Ashford, & Davids, 2002; Kampiotis & Theorodorakou, 2006), or concurrently throughout modeling (Meaney, 1994; Janelle et al., 2003), learning increases as a result (Lumsdaine, 1961).

A second instructional feature is providing advice on what is most essential to learning the skill prior to observing a model (Rosen et al., 2010). Common methods include learning points or behaviour summaries in an attempt to coach the observers on what they will be learning (Decker & Nathan, 1985; Jentsch et al., 2001; Mann & Decker, 1984; Stoffey & Reilly, 1977; Taylor et al., 2005). Similar to the verbal cues, this advice helps the observer identify and attend to the most important features of the behaviour. Consequently, the proposed experimental design will have the Zumba instructor providing an initial summary of the dance sequence, followed by four demonstrations supplemented with verbal cues.

Another component to consider with observational learning research is the setting in which it is delivered (*Where* component) To date, over 90 per cent of intervention research has taken place in training sessions (Ste-Marie, et al., 2012), with over 80 per cent of those taking place in laboratory settings (e.g., Hodges, Hayes, Breslin, & Williams, 2005; Labiadh, Ramanantsoa, & Golomer, 2010). While this approach allows for greater control over confounding variables, it does compromise the ecological validity of the design. Observational learning studies that use a more ecologically valid setting are recommended. Specific to the proposed experiment, both acquisition and retention will occur in a simulated exercise setting, whereby conditions are controlled to avoid other observational learning opportunities.

Why individuals engage in observational learning is another essential element addressed within Ste-Marie et al.'s (2012) framework. This attends to the underlying intentions concerning why one wishes to engages in observational learning. Of the research that has been conducted, three primary functions have been identified: skill, strategy, and performance (Cumming et al., 2005). Amongst these three, a clear pattern evolved demonstrating that the skill function was utilized most frequently, followed by strategy, then performance (e.g. Hall et al., 2009). This indicates that the vast majority of observers utilized observational learning for the acquisition of a motor skill. In accordance with this trend, this research will also be focusing on the skill function of observational learning as the individual subjects attempt to learn and perform the dance sequence.

Given that observational learning is structured around viewing a model, *who* is demonstrating the behaviour represents another essential feature to consider. Self as a model or others as models represent the two broad categories of model types. When determining who is the most effective model for observation, an important feature is the demonstrator's skill level. This entails selecting an individual who either properly executes the behaviour (skilled), executes the behaviour with errors (unskilled), or transitions from unskilled to skilled throughout the demonstration (learning) (McCullagh, Ste-Marie, & Law, in press). It has been shown that despite the diversity that exists between models, use of a skilled demonstrator results in typically more effective skill acquisition when compared to those who are unskilled (George, Feltz, & Chase, 1992). Given the notable benefits of using a skilled model, a skilled Zumba instructor will be providing the demonstrations and leading the dances in the experimental sessions.

The final "W" within Ste-Marie et al.'s (2012) framework focuses on *when* a model is provided. This could occur before, during, and/or after practice, yet the majority of studies to date have implemented a combination of modeling before and throughout the practice trials. Unfortunately, research in this area is severely lacking, with only two studies to date that are ecologically valid. Furthermore, only one of these two interventions used adults as participants. This study was conducted by Weeks & Anderson (1990) and they examined the effects of model placement before, during and after practice by assessing form and outcome of a volleyball serve. Although groups who received pre-practice demonstrations by the model displayed enhanced acquisition through improved form, no significant differences between groups on either form or outcome measures were found in retention. This suggests that presenting a model before practice is more efficient for acquisition, yet the inclusion of a model at any time would enhance retention of the skill. Given the necessity for research on this topic, no optimal method has been established. That being said, the combination of presenting a model before and during practice trials has been the most widely used method and appears to be effective at enhancing motor learning (Ste-Marie et al., 2012). In the proposed research, the Zumba instructor will provide demonstrations both before and during acquisition, similar to previous research.

In light of the previously mentioned gaps in literature pertaining to viewing angle, this current study will attempt to implement all essential features by following the 5 Ws, 1H framework of observational learning. It will examine the effects of both objective and subjective viewing angles, by measuring the acquisition, recognition, and retention of a complex dance sequence composed of six individual parts. Half of the participants will have the model facing them (looking-glass view) when they learn the dance sequence, whereas the other half will observe her from the subjective view. The location will be within a small group exercise class, with the use of a live, skilled model. Demonstration of the skill will be presented both before and during the acquisition phase, and will be supplemented with verbal cues during the pre-test videos. Based on the previously mentioned literature, the hypotheses are three-fold. First, it is predicted that more efficient (faster) acquisition of the dance sequence will occur in the subjective condition. Second, it is hypothesized that the increased cognitive processing required in the looking-glass condition will result in greater retention of the skill. Finally, similar to retention, it is predicted that observers in the looking-glass condition will display more accurate recognition of the dance sequence.

Chapter II: Experimental Procedures

Experimental Procedures

Participants

A convenience sample of 30 females between the ages of 18 and 30 was recruited from the undergraduate and graduate student population of the University of Ottawa, as well as a Women's only GoodLife Fitness Club. All participants were screened to ensure they were novice learners and had no dance background or previous experience with Zumba. Informed consent was obtained from each participant prior to commencing data collection. In addition, approval was obtained from the ethics review board at the University of Ottawa to make certain that the research complied with all ethical standards (see Appendix A).

Materials

For the recognition tests, eight videos were created using a Sony video Handycam (model number DCR-HC65/HC85). These videos were presented on a Toshiba Satellite laptop computer with a 15-inch screen and displayed the same skilled model from pre-test performing the dance sequence either perfectly, or with errors. Four of these videos were from the subjective viewing angle, while the remaining four were from the looking-glass viewing angle. Two videos from each of the conditions were performed perfectly, and two contained four errors. A score sheet was used to record the decisions made by the participants (see Appendix B)

During the pre-test, acquisition and post-test phases, a Sony video Handycam (model number DCR-HC65/HC85) was used to videotape the dance sequences performed by the participants for later scoring of the dependent variables.

In order to assess cognitive effort, a skilled yoga instructor was filmed using a Sony video Handycam (model number DCR-HC65/HC85) while performing a complex yoga sequence. This sequence was videotaped multiple times from six different viewing angles: looking-glass, subjective, lateral left, lateral right, bottom up, and 45 degrees. With each of these angles, six separate videos were created that rotated through all possible serial positions.

Measures

Motivation. A one-item motivation scale was created to account for possible variations between groups. This consisted of the following, "On a scale of 0 to 10, how motivated are you to learn the Zumba dance sequence by participating in this Zumba class?" A score of 0 represented no motivation to learn the Zumba dance sequence, and 10 represented extremely motivated.

Self-Efficacy. A multi-item self-efficacy scale was used to assess the participants' perceived competencies in completing the dance sequence without error (see Appendix C). It was created in accordance with Bandura's (2006) guidelines and incorporated increasingly longer and more complex dance segments of the to-be-learned sequence. For each statement, participants rated their perceived self-efficacy on a scale of 0 to 100; 0 indicating a complete lack of confidence in correctly performing the dance segment, 100 indicating an extremely strong degree of confidence in correctly performing the dance segment. Self-efficacy scores were determined by averaging the ratings of eight statements, whereby the last statement reflected one's confidence in her ability to perform the entire dance sequence without error. This score was obtained prior to acquisition and was used as a measure for preliminary analysis to determine whether any variation existed between the two conditions, thus possibly requiring it as a covariate for later analyses.

Perceived Cognitive Effort Video/Scale. Prior to data collection, a Sony video Handycam (model number DCR-HC65/HC85) was used to video an individual performing a yoga sequence. This sequence was videotaped from six different viewing angles: looking-glass, subjective, lateral left, lateral right, 45 degrees and from the ground up. Of specific interest to this research was whether the looking-glass and subjective views obtained different cognitive effort scores; however, other viewing angles were added to determine if the measure was sensitive to varied levels of cognitive effort. Given that the same yoga sequence was being seen repeatedly during the test, we deemed it important to make six separate videos that had the different viewing angles rotated through all of the possible serial positions. This was to avoid possible learning effects of the yoga sequence that may differentially affect the ease ratings associated with the effort related to learning a task when viewed from that angle. Perceived degree of difficulty was rated on a scale of 1 to 7; with 1 indicating it would be very easy to learn from that viewing angle and 7 indicating it would be very difficult to learn from that viewing angle (see Appendix D).

Physical Performance: Two dependent measures were used to assess the observers' physical performance during the pre-test and post-tests: (1) a sequence measure to indicate the number of components performed in the correct order, and (2) a quality measure to measure how accurately the individual dance components were performed. While both measures were used for the pre-test and post-test analyses, only the quality measure was used for acquisition because the skilled model was always available and thus sequence was not a relevant learning indicator. For the sequence measure, the raters provided a value with respect to how many of the movements were completed in proper order. One point was awarded for any two components performed in the correct order. Therefore, because the dance sequence contained a total of eight movements, the raters scored each participant on a range from 0, indicating there were no components in order, to 7, indicating all steps were executed in the correct order.

To measure quality, each component of the to-be-learned dance sequence had key criteria identified for that specific movement (e.g. direction, tempo, position, number and laterality for specified arms and legs, as well as direction of the body). After reviewing the sequence, two of the components (arm wave and body roll) were eliminated due to the fact that every participant immediately performed them perfectly. Therefore, they were not pertinent indicators for learning effects. An error score was allotted whenever any of the aforementioned key criteria were performed incorrectly. While each of the movements varied in the quantity of potential errors, a total score across the six dance components was 42 (Refer to Appendices E and F). Therefore, a minimum score of 0 was obtained for a perfectly executed performance and a maximum score of 42 was obtained if the entire sequence was done incorrectly.

The scoring method for the dance performances was first checked using inter-rater reliability. To establish inter-rater reliability, three independent intraclass correlations (ICC) were run on the quality measure of physical performance during the pre-test and acquisition phases. These analyses reflected the different elements of the movements such as 1) arm components 2) leg components and 3) overall score. Initially, a synchronization component was also incorporated in the scoring process that attempted to capture coordination of the movement between the arms and legs, and to allow for a more sensitive measure with respect to performance of the sequence. However, poor levels of inter-rater reliability were obtained, and thus, this single component was eliminated from the dance sequence criteria as it did not provide any valuable information when scoring the movements. Strong correlations were observed for all three of the remaining factors of arms ($r = .937$), legs ($r = .943$), and overall score ($r = .954$). Similarly a high correlation of $r = .824$ was also obtained for the sequence measure at pre-test. Having established that the scoring method was reliable, the skilled Zumba instructor then scored all 30 participants using the same scoring methods. One important note is that all videos were taken from the same viewing angle in order to remain consistent throughout the scoring process. As a result, the scorers could not be blind to the condition in which the participant was involved because movements performed by the looking-glass participants were in the opposite direction to those in the subjective condition; and this feature was observable when the videos were used for scoring.

For pre-test and post-test measures, the average score of three trials for the sequence and quality measures were the dependent variables. For acquisition, the score from the final sequence performed in each of the six trial blocks (Zumba dance) was used as the dependent measure.

Error Recognition/Identification: Eight videos of the dance sequence were recorded to measure error recognition and identification. Four videos were presented from the subjective view, while the remaining four were presented from the looking-glass view. This created a congruency manipulation whereby half of the videos were judged from the same viewing angle (congruent) as that in which the dance sequence had been learned, and the other half were judged from the opposing viewing angle (incongruent). Within these eight videos, half of them were performed with no errors and half had performances with four errors executed in the dance sequence. The identical errors were balanced across the congruent and incongruent conditions. Two scoring measures were obtained to help establish the degree of error recognition and error identification among participants. The former reflected whether the participant correctly recognized the dance sequence as being done with or without error (error recognition). This first dependent measure was based on an all-or-none criteria, whereby participants got the point if they indicated errors during an incorrectly performed sequence, or when they did not identify errors during the perfectly executed video. An overall percentage was determined with respect to the number of sequences correctly identified. A total of eight sequences were presented, thus the possible range of score attained was 0% (none correct) to 100% (8/8 correct).

Scores for the latter dependent measure of error identification ranged from 0% (missed all errors) to 100% (16/16 errors correctly identified). For an error to be judged as correct, the participant had to correctly specify the error in the dance sequence. For example, during the Merengue 6 Step, one was supposed to travel from left to right. For one of the videos, the model simply did the footing in one spot and did not change her direction. In order to receive the point in this circumstance, participants would have had to identify that the direction of the feet/legs were incorrect.

Procedure

Data collection generally occurred in small groups of three participants (range 1-4 participants). Each group was quasi-randomly assigned to one of the two conditions, with the experimenter ensuring that there were equal numbers in the two viewing angle groups.

Motivation. Upon arriving, participants completed the motivation questionnaire by circling a number from 0 to 10 on the scale that best represented their level of motivation to learn the dance sequence. Once that questionnaire was completed, four previously recorded trials of the dance sequence were presented to the group on the laptop in accordance with the viewing angle as per their group assignment. The first two trials were at a reduced speed, third in real time, and fourth in real time with the model's own dance expression provided. During these demonstrations, verbal cues were provided by the instructor in the video that drew participants' attention to the important elements of each movement. Participants were instructed not to move/practice during these four demonstration trials.

Pre-test. To establish the participants' initial degrees of perceived confidence in performing the dance movements, a self-efficacy questionnaire was administered following the model demonstrations, but prior to them performing the dance sequence. Following this, each participant individually performed the to-be-learned dance sequence three times. These trials were videotaped. During the time that each participant was executing the sequence, the Zumba instructor involved the other members in other cognitively engaging activities so as to avoid any mental rehearsal or further observation of the dance sequence. These activities involved participation in either a game of tic tac toe or hangman.

Acquisition. To begin the acquisition phase, one of two skilled Zumba instructors led the participants through one warm up song that did not include any element of the to-be-learned dance sequence. After this, the participants were taken through six different dances, all of which were similar dance styles (i.e. salsa, merengue, etc.). While these dances were performed, participants observed the instructor from the same viewing angle as the specified condition. The to-be-learned dance sequence was incorporated into each of these six dances and reoccurred three times throughout each song. This yielded 18 practice trials of the dance sequence. Participants were videotaped throughout the entire process and the last dance sequence of each song was analyzed and used to score acquisition performance (six acquisition trial blocks).

Filled Retention Interval: Perceived Cognitive Effort. A filled-retention interval of approximately 30 minutes followed the acquisition phase. Participants were first taken through two cool down songs that did not incorporate the dance sequence, but rather a series of slow movements that transitioned through a compilation of stretches. These songs served two purposes: (1) to bring down the participants' heart rates, and (2) to avoid any mental rehearsal prior to the retention test. Once cooled down, the participants completed the cognitive effort measure. This involved viewing a yoga sequence on video performed by a skilled model that was displayed from multiple viewing angles. The participants were randomly assigned to watch one of six cognitive effort videos. During that time, a questionnaire was administered that asked the participants to indicate their perceived degree of ease/difficulty to learn the yoga sequence from the specific viewing angle provided. The end of the retention interval involved completing the self-efficacy questionnaire a second time. This time participants considered how they would perform the learned dance sequence during the post-test when answering the given questions. The main purpose of this questionnaire was to keep the participants from mentally rehearsing the dance during the retention interval. No analyses were completed on this measure.

Post-Test. The post-test was administered the same way as the pre-test; i.e., one at a time participants were asked to perform the dance sequence to the best of their abilities. Throughout this time, the remaining participants were located in a different area of the room, facing away from the individual executing the sequence, and were engaged in a mental task to avoid mental rehearsal. When the go signal was given, the sequence was performed three times and these trials were videotaped.

Error Recognition/Identification Test. Immediately following the post-test, the participants were individually shown eight video performances of the dance sequence performed by the instructor. While viewing, participants verbally identified when an error was detected in the dance sequence and explained the error in the movement. They were told that the video could be paused at any point throughout, but that they were only allowed one viewing and would not be given the opportunity to rewind the video. The experimenter recorded the responses of the participants. If no errors were mentioned throughout the viewing, the participant was asked if she thought the dance sequence was performed correctly.

Experimental Design

While the importance of pre and post-test analyses has been established within motor learning literature, these phases carried a different purpose with respect to examining the effect of viewing angle in this study. The pre-test variables of motivation, self-efficacy, and physical performance (sequence and quality) were utilized to establish equality between the two groups prior to acquisition. This was to ensure that any results obtained were strictly due to the manipulation of viewing angle. Further, the post-test analyses on the physical performance measures were to determine which viewing angle resulted in a greater learning of the dance sequence. Therefore, while acquisition was assessed to demonstrate that learning took place, the degree of learning from pre-test to post-test was not the direct focus of the study. Instead, the effect of viewing angle on learning was of upmost importance and was examined through the differences in scores obtained during the post-test.

Chapter III: Results

Results

Preliminary Analysis

Using the PASW Statistics 18 program, analyses were carried out to determine whether any covariates were needed in future analyses. Independent t-tests were conducted on the pre-test scores obtained for the motivation and self-efficacy measures, as well as on the two physical performance scores of sequence and quality. For all preliminary analyses, the Bonferroni correction was used to account for the four comparisons, and thus statistical significance was set at $p < 0.0125$. These analyses showed that participants in the two observation conditions were not significantly different from one another with respect to motivation ($p > .0125$) and self-efficacy ($p > .0125$). Similarly, the values for the quality measure ($p > .0125$) and sequence measure ($p > .0125$) were not significantly different. Therefore, no covariates were required.

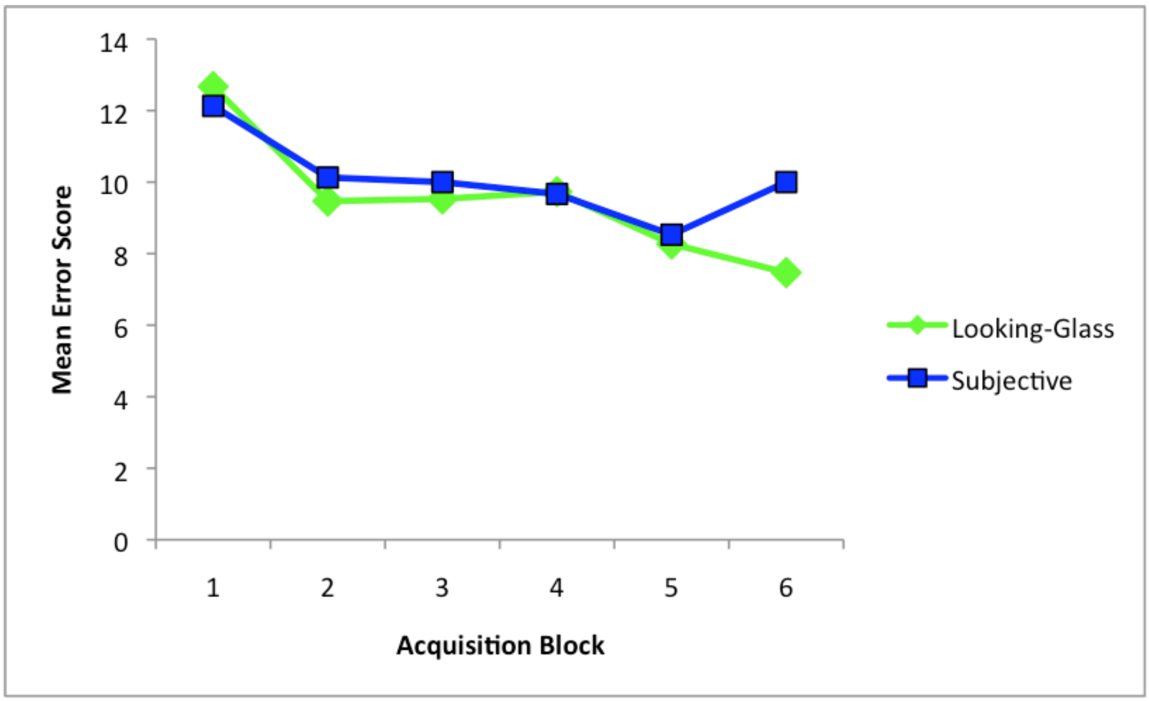
A final preliminary analysis was conducted to ensure that the two Zumba instructors used to present the dance sequence did not generate different learning outcomes during acquisition. To do this, a 2 Model (Zumba instructors) x 6 Block (acquisition blocks 1-6) analysis of variance (ANOVA) with repeated measures on the last factor was used. This analysis demonstrated no differences between models ($p > .0125$). Consequently, the factor of Model was not used in any further analyses.

Acquisition

For acquisition, a two factor (Viewing Angle x Block) ANOVA with repeated measures on the last factor was conducted. This was to assess the effect of viewing angle on the quality variable for physical performance. While both conditions showed significant improvement by demonstrating fewer errors across their performances during the six trial blocks ($F(5,28) = 7.62$, $p < .01$, $n_p^2 = .21$), there was no significant main effect of Group ($p >$

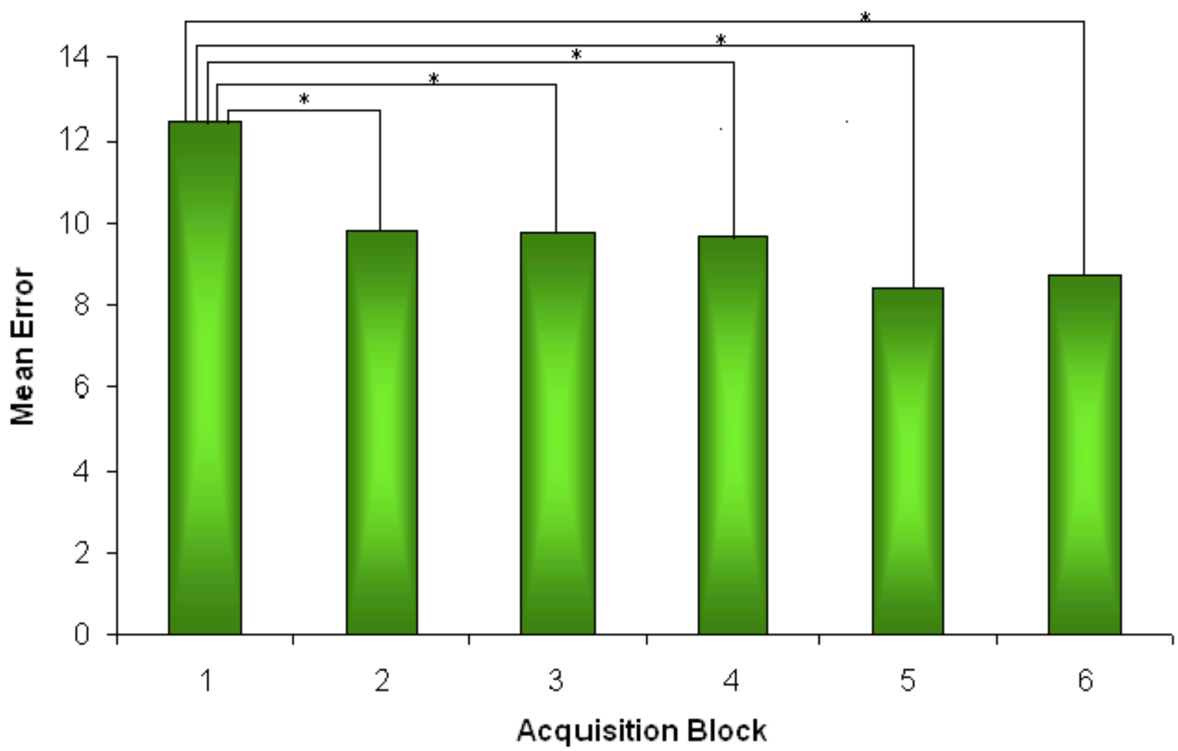
.05), or interaction ($p > .05$) (Refer to Figure 3.1). Bonferonni pairwise comparisons showed that the participants were significantly better in blocks 2-6 as compared to block 1 (Refer to Figure 3.2), with no other differences obtained.

Figure 3.1: Looking-Glass vs. Subjective Physical Performance Acquisition



Note: A lower score indicates better performance.

Figure 3.2: Physical Performance Acquisition for the Quality Measure

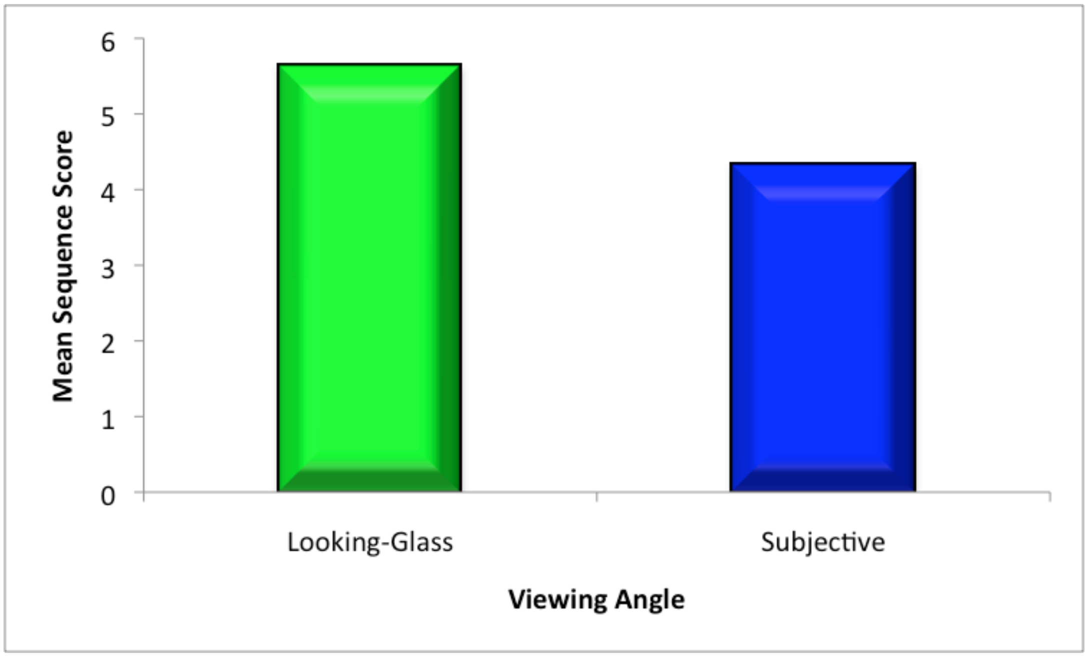


Note: A lower score indicates a better performance

Post-Test/Error Recognition

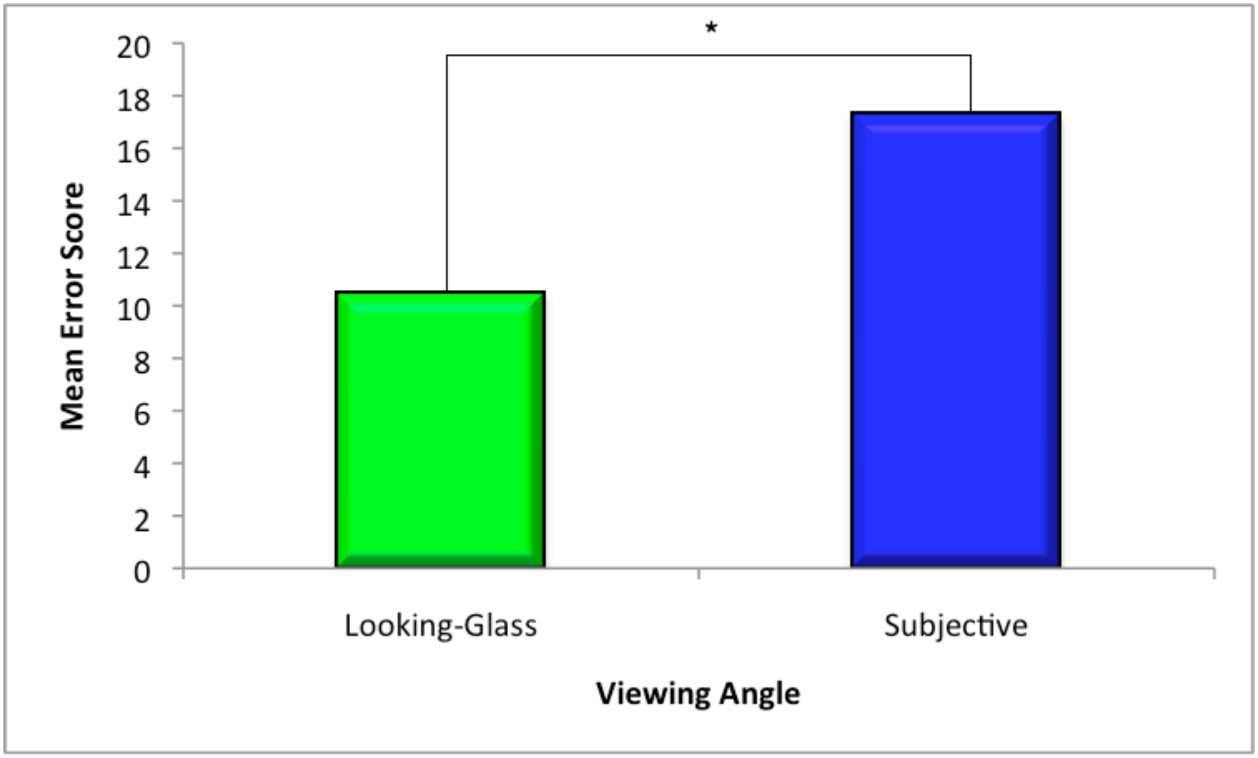
To evaluate the effect of viewing angle on the degree of learning that occurred following the acquisition phase, two independent t-tests were conducted on the two physical performance measures of sequence and quality. Bonferroni correction was used to adjust for the multiple comparisons made within the two groups, thus significance was set at $p < .025$. When analyzing the sequence measure, the looking-glass group (M= 5.64, SD = 1.24) had higher scores than the subjective group (M= 4.33, SD = 2.35) with respect to performing more of the movements in the correct sequence, yet these values did not reach significance, as there was no main effect for group ($p > .025$) (Refer to Figure 3.3). When assessing the quality measure of physical performance, the looking-glass group (M = 10.44, SD= 2.64) executed significantly fewer errors than the subjective group (M= 17.27, SD= 6.84; $t(1, 28) = 3.61$, $p < .025$, $d = 1.4$) (Refer to Figure 3.4).

Figure 3.3: Looking-Glass vs. Subjective Post-Test Physical Performance (Sequence)



Note: A higher score indicates better performance.

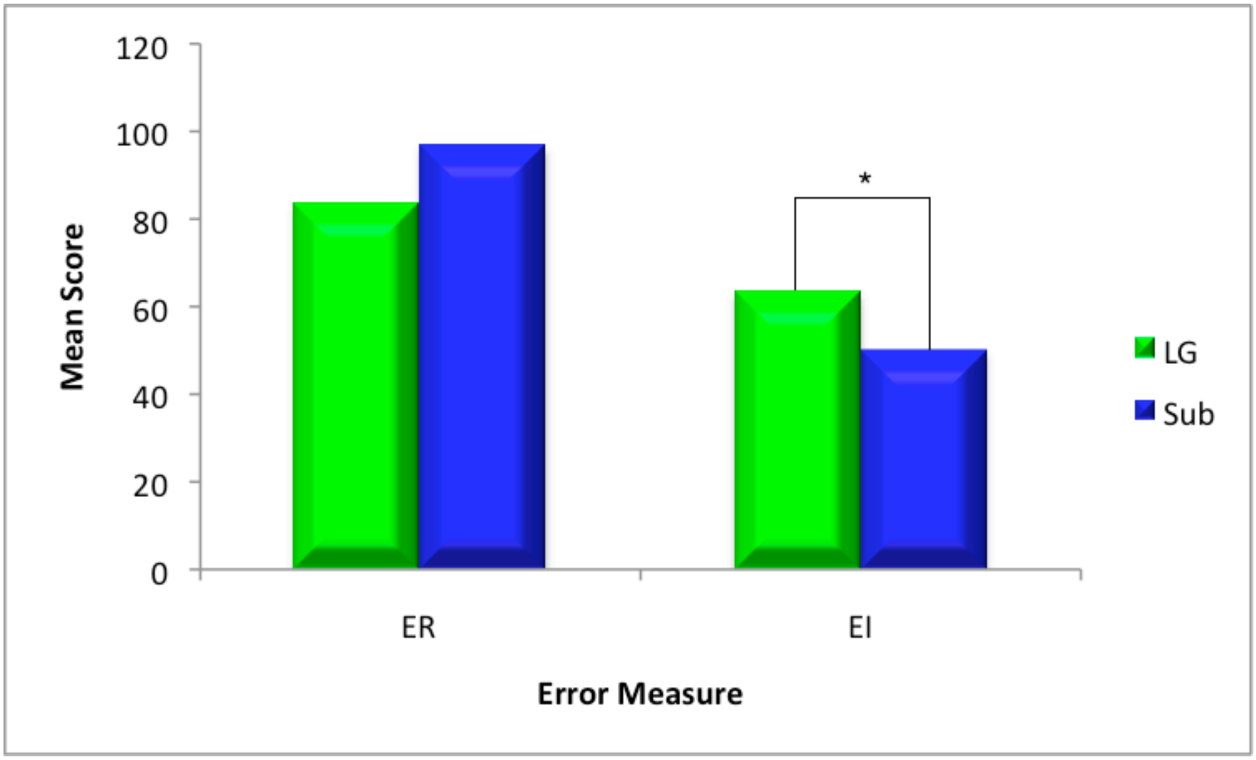
Figure 3.4: Looking-Glass vs. Subjective Post-Test Physical Performance (Quality)



Note: A higher score indicates poorer performance.

In addition to the physical performance measures, error recognition and error identification measures were also assessed to evaluate the participants' degree of learning. To complete this statistical analysis, a three factor multivariate analysis of variance (MANOVA) with repeated measures on the last two factors was used. This followed a 2 Group (Looking-glass vs. Subjective) x 2 Congruency (Congruency vs. Incongruency) x 2 Measure (Recognition vs. Identification) analysis. A significant main effect occurred for the decision made with error recognition (M=92.50, SD=2.23) being more accurate than error identification (M=54.17, SD=3.01). More importantly, a significant three-way interaction occurred between all factors ($F(1,28) = 6.56$, $p < .05$ $n_p^2 = .19$). Tukey's HSD post hoc was then used to identify the source of this interaction. It was determined that the looking-glass group was significantly better than the subjective group when identifying errors, but only within the congruent condition of error identification; no other means were different (Refer to Figure 3.5).

Figure 3.5: Error Measures Relative to Viewing Angle

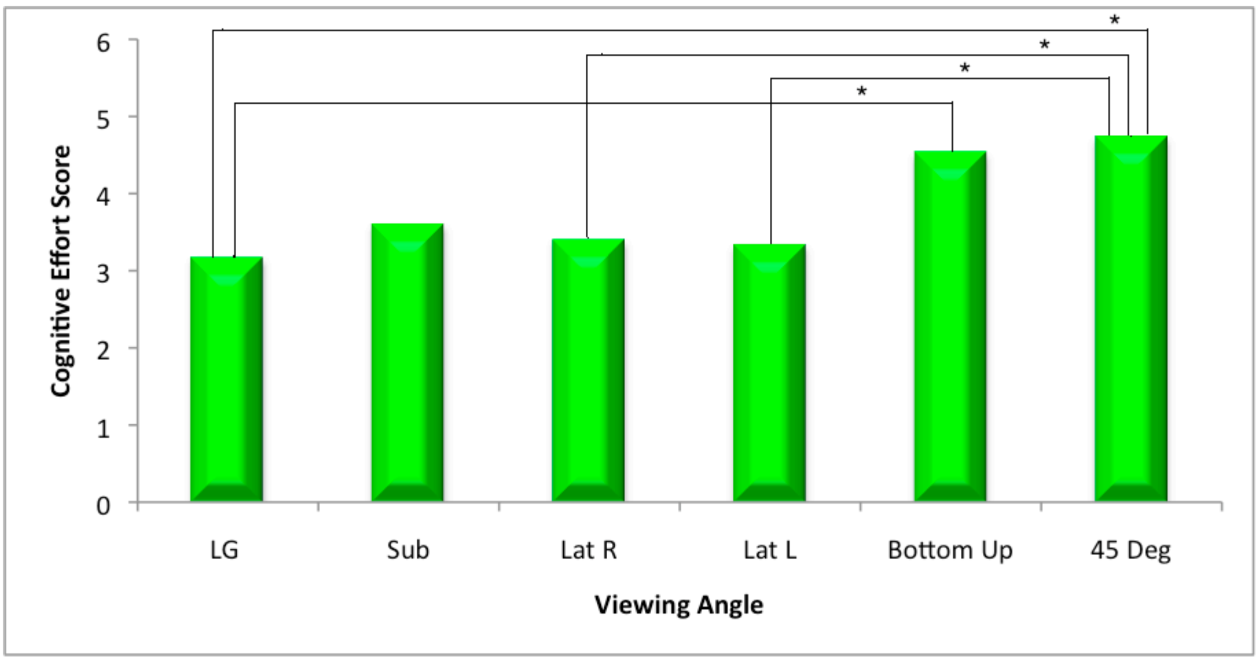


Note: A higher score indicates greater ability to identify and recognize errors (better scores). ER = Error Recognition, EI = Error Identification.

Perceived Cognitive **Effort**

A one way ANOVA with repeated measures was conducted with Viewing Angle Item as the factor. Due to data not meeting with Mauchly's test of sphericity during this analysis, Huynh-Feldt values were used to test for significance and a significant main effect of viewing angle was detected ($F(3.80,110.01) = 6.35$, $p < .01$, $n_p{}^2 = .18$). Bonferonni pairwise comparisons were conducted to determine which Items were significantly different from each other. As can be seen in Figure 3.6, attempting to learn the yoga sequence from a 45 Degree viewing angle was perceived as being significantly more cognitively effortful than the looking-glass, lateral left, and lateral right viewing angles, but not different from the bottom up (*M* = 4.53, *SD* = 1.59) viewing angle, which was different from the looking-glass angle. Of specific interest here, however, was the comparison between the looking-glass and the subjective view, which were shown not to differ in terms of perceived cognitive effort.

Figure 3.6: Perceived Cognitive Effort Scores Relative to Viewing Angle



Note: the cognitive effort scale ranged from 1 to 7, with 1 indicating the least cognitive effort and 7 requiring the most cognitive effort. LG = looking-glass, Lat L = lateral left, Lat R = lateral right, Sub = subjective, Bottom Up = from the ground looking upwards, 45 Deg = 45 degrees

Chapter IV: Discussion

Discussion

While significant research has identified the benefit of viewing a model while learning a new skill, little to date has assessed the effect of viewing angle on the acquisition and retention of a novel motor skill. Of the few studies that have assessed this research question, none have attempted to measure whether variations in cognitive effort associated with the viewing angle could help explain any possible difference in observational learning advantages. Therefore, the purpose of this study was to determine whether a looking-glass or subjective viewing angle would result in greater acquisition and retention of a complex Zumba dance sequence, and whether this could be explained by increased cognitive demands. Based on Ishikura and Inomata's reversal processing hypothesis (1995), it was hypothesized that when viewing a model from the looking-glass condition, the participants would report greater cognitive demands relative to the subjective condition. In turn, it was predicted that this increased demand would result in slower acquisition for the looking-glass condition, yet better learning during the post-test.

Acquisition

Before addressing whether viewing angle had an influence, it is important to note that learning of the task was evidenced during acquisition, with significant improvements in the quality of the dance performance occurring mostly in the first two trial blocks, then gradual improvement demonstrated throughout the remaining four. This suggests that participants were able to adopt the pertinent elements of the sequence quite rapidly and that the following repetitions were dedicated to tailoring the individual movements within the sequence. However, this learning pattern was the same for both the looking-glass and subjective conditions, as there was no main effect for viewing angle. While these findings parallel the acquisition findings of Sambrook's knot tying task (1998), they differ from those of Ishikura and Inomata's sequence study (1995), as well as Roshal's knot tying task (1961) whose subjective conditions demonstrated a faster rate of acquisition than the looking-glass conditions.

Upon further analysis, one suggested reasoning for the differing outcomes reflects the design and scoring methods of the studies. One of the most drastic differences was that each of the former studies was performed in a laboratory-based setting, whereas this current research was conducted in an ecologically valid environment. As a result of this, both the 1995 study by Ishikura and Inomata, as well as Sambrook's 1998 study, allowed for one element of the task to be demonstrated at a time. Each of these steps was then followed by a pause that involved time intervals between 3-14 seconds before demonstrating the second part to the movement. This opportunity was not possible in the current study due to the fact that the participants were required to maintain tempo with the music and keep up with the rest of the dance.

A second consideration with respect to design reflects the additional verbal and visual cueing methods. Sambrook (1998) integrated verbal cues into the demonstrations of the knot-tying task. At each stage of the knot, an explanation was provided to provide additional information on what was important with respect to tying the knot correctly. Alternatively, Ishikura and Inomata (1995) dressed their model in all black, with white markers located on the elbows and the knees. Throughout the demonstration, the model was then placed in front of a white screen. This increased the saliency of these landmarks while participants were viewing the model. Therefore, in both of these situations the design allowed participants to focus their attention on the most pertinent elements of the skill by enhancing the demonstration with verbal or visual cues.

One final explanation for the differing results pertains to the scoring methods used. In both Roshal's 1961 study and Sambrook's 1998 study, there was no post-test analysis. Instead, each attempt performed by the participant was preceded with a demonstration by the model. Therefore, the results obtained reflect the learning that took place throughout acquisition, but cannot attest to the degree of learning that may have been retained following a delayed period of time. Although Ishikura and Inomata (1995) did take this into consideration and factored in multiple post-tests of 1 day, 7 days, and 5 months, their scoring methods were similar to those of the other two in that they did not focus on the quality of the movement. Roshal (1961) and Sambrook (1998) both adopted a timed technique whereby the participants were to continue tying the knots until they a) successfully completed the task, b) tied the knot to the best of their abilities, or c) 2 minutes had passed. When scored, it was based on an all-or-none criteria of either right or wrong. Ishikura and Inomata (1995) measured how many attempts were required for the participant to perform the sequence three times correctly. Therefore, although the demonstrations were segmented into individual components of a more complex skill, not one of the previous studies attempted to dissect participants' performances to assess the quality of the movements. These contrasting approaches to both methodology and scoring lend some potential explanation as to the variability in results found across research to date.

Physical Measures

Of more importance is the assessment of the degree of learning following acquisition. For this, two physical measures of sequence and quality were analyzed, in addition to error recognition and identification. With respect to the sequence measure, there was a notable trend with the looking-glass condition performing more of the movements in the correct sequence as compared to those who had the model provide the subjective view, yet these differences were not significant. Analysis of the quality measure for physical performance did show significant differences, with the looking-glass condition performing the dance sequence more accurately than the subjective condition. These results differ from all research to date (Roshal 1961; Ishikura & Inomata, 1995; Sambrook, 1998), but supported the hypothesis.

Error Recognition/Identification

In order to gain further insight into learning, error recognition and identification were also assessed. Given Bandura's (1986) view that retention of a skill results from the transference of information from the behaviour and the environment into symbolic representations that are later used to guide actions, one could argue that those who demonstrated greater abilities at recognizing and identifying errors established a better cognitive representation of the skill. Consequently, this representation would have allowed for the application of an error detection and correction mechanism for future skill performance, a process known to be important for motor skill acquisition (Bandura, 1986).

With respect to these measures, the results obtained partially supported the hypotheses, as there was a significant interaction between viewing angle, congruency, and the two error measures. While it was hypothesized that the looking-glass condition would be significantly better at both recognition and identification of errors, post hoc analyses determined that both viewing angles resulted in equal error recognition scores. A look at the descriptive statistics does show that both the looking-glass and subjective conditions scored greater than 90%, suggesting that they could equally determine that the dance sequence was performed with/without errors. Such high percentages suggest that ceiling effects may have undermined potential differences at this level of decision making.

It was only at the deeper level of analysis, in error identification, that differences emerged between conditions. Results for error identification showed that the looking-glass condition was significantly better than the subjective condition, but only when identifying the errors from the same viewing angle to which they were assigned; i.e., they were better at error identification in the congruent condition. This finding further supports that the looking-glass condition was able to create a stronger cognitive representation of the skill, which ultimately lead to a superior degree of learning.

Cognitive Effort

Having shown better learning on the part of the looking-glass group, one needs to then consider why that group has learning advantages. It has been proposed by others that when greater cognitive demand is required during acquisition of a new task, that increased learning takes place (e.g., Lee, et al., 1994). It is upon this basic premise that Ishikura and Inomata's (1995) reversal processing hypothesis lies when accounting for possible benefits related to acquiring a skill from the looking-glass view. More specifically, a looking-glass viewing angle was argued to provide an increased cognitive demand due to the necessity of flipping the movement before producing it. Results from the cognitive effort measure, however, do not support this explanation as no significant difference was found between the two viewing angles. Thus, the learning advantages shown through superior physical performance and error identification may be due to some alternative influence.

Alternate Explanations

One possible interpretation of these results concerns the availability of viewing the relevant cues pertinent to the dance sequence. As mentioned, there were a number of points allocated to the direction, position, tempo, and laterality of the arms during each component of the sequence. While both conditions were presented with the same sequence, the looking-glass viewing angle may have provided a vantage point that provided greater access to the relevant cues. For example, with the model facing the group, participants may have had a clearer view of the arm actions involved in the dance steps as compared to those in the subjective condition. Therefore, a follow up analysis was conducted that assessed the quality measure of physical performance for the arms separate from the legs within each condition. Scores for both the arms and legs demonstrated greater errors within the subjective condition (*M* arms = 8.78, *SD* = 3.02; *M* legs = 8.47, *SD* = 4.13) when compared to the looking-glass condition (*M* arms= 4.85, *SD* = 1.82; *M* legs = 5.56, *SD* = 2.32). Furthermore, a trend was observed whereby the quality of the arms was more sensitive to the different viewing angles. This was evidenced by increasingly more errors performed by the arms (*M* = 8.77, *SD* = 3.02) compared to the legs (*M* = 8.47, *SD* = 4.13) within the subjective condition. This being said, none of these values reached significance. A similar analysis was conducted on the error identification scores to further assess this alternative hypothesis. Once again, no significant findings were obtained to support this explanation. Therefore, further research is required to determine whether a specific vantage point that provides more relevant cues is a factor with respect to learning a new motor skill.

A second point to consider is that the looking-glass condition was also exposed to the model's facial expressions. Research has shown that when gestures were combined with facial expressions, individuals learned a task significantly better than when the facial expressions were not provided (Baylor & Kim, 2009). This being the case, the participants in the looking-glass condition may have gained an advantage by being able to see the face of the model. Future research could try to isolate the contributions of seeing the model's face during demonstrations and the pertinence of relevant cues.

Beyond these possible interpretations, there also needs to be consideration of the potential weakness of the cognitive effort measure. Although the measure used did show a range of scores for the different viewing angles, it had not been validated or tested for reliability. It may have been better to have used a validated cognitive effort questionnaire such as the NASA Task Load Index (NASA-TLX). This is a multi-dimensional rating procedure that establishes an overall workload score based on an average weighting of six subscales: mental, physical, temporal, performance, effort, and frustration (Hart & Staveland, 1988). Furthermore, Hart and Staveland (1988) proposed that between subject analyses for the NASA-TLX increases experimental validity and reduces experimental error. The benefit to this measure is that it allows the participants the opportunity to report on a situation they are actually experiencing. Therefore, future designs could have participants complete the NASA-TLX during the acquisition phase and to do so while reflecting on their assigned viewing angle only. Once these scores are established, a between subject analysis between the two viewing angles could allow for greater understanding as to whether there were differences in cognitive effort between the two conditions.

Aside from the external factors that could have affected the results, there were other factors to consider that could have potentially influenced the cognitive effort measure. Based on the design of this study, one's *perceived* degree of cognitive effort was assessed. There exists the possibility that the looking-glass view was perceived as low in cognitive effort for two reasons. First, the majority of the sample was from the GoodLife Fitness Center. All classes provided at this facility are from a looking-glass perspective. Therefore, the sheer familiarity of this situation could have been enough to influence their perceived cognitive demands as low. Secondly, the cognitive effort questionnaire was applied following the acquisition phase. After exposure to this viewing angle for this extent of time, participants may have adapted to that angle, thus resulting in low perceptions of cognitive demand.

Limitations/Future Research

After reflecting on the design of the study, one factor that was brought into consideration was that there was no music during the pre-test and post-test. Seeing how participants expressed difficulty replicating the sequence during the post-test due to the fact that it did not parallel the conditions of the acquisition phase, future research might consider integrating music into each of these stages. Another element of the design to consider is the length of time between acquisition and the post-test. Former research has implemented both immediate and long-term post-tests, while this study only incorporated half an hour following acquisition. Although this timeframe has been deemed acceptable based on past research (Landauer & Bjork, 1978; Shea & Morgan, 1979), a greater delay may have identified deeper learning effects relative to one of the viewing angles.

A second limitation that is important to note is that there was no potential for scorers to remain blind to the condition. All performances were videotaped from he same vantage point in order to remain consistent with the scoring process. Therefore, the direction of the movements would identify to which condition the participants belonged. Although there exists the potential for researcher bias within such circumstances, an inter-rater reliability check was conducted during the preliminary analyses. Results found no differences between scorers, thus attenuating this possible bias.

One final limitation of the study was the result of attempting to maintain ecological validity throughout the study. Having used a live model, there were two potential confounds that must be considered. First, there was no guarantee that each performance by the model was exactly the same as the initial demonstration. Although the general sequence was performed correctly, there is a strong possibility that certain elements of each movement differed across the performances. Given that this study focused on the quality of the movement, there is the potential that this could have had an affect on some results obtained. The second limitation to using the live model was that the verbal cues provided could have differed from one performance to the next. In attempt to control for this, the model was directed to refrain from using verbal cues while performing the to-be-learned dance sequence during the acquisition phase. However, the possibility that this was not always implemented thoroughly needs to be taken into consideration when assessing the outcomes of the study. In the future, one could completely eliminate all verbal cueing during acquisition in order to control for this circumstance. Alternatively, if attempting to remain ecologically valid, perhaps a script could be created in advance and used by the model during the demonstrations. This way, there will be increased likelihood that the research is staying true to a real-life setting, while avoiding the potential that differing queues will jeopardize the accuracy of the results.

Chapter V: Conclusion

Conclusion

Summary of Findings

For years, observational learning has repeatedly proven to be beneficial with respect to learning a new motor skill. However, very few studies exist that capitalize on all the important elements of observational learning (who, what, where, when, why, how), while remaining ecologically valid. Specifically relating to the *How* feature of observational learning, the effect of viewing angle has been understudied. As a result, this study was designed around Ste-Marie et al.'s 5W 1H model whereby the purpose was to determine if the looking-glass or subjective viewing angle would result in faster acquisition and greater learning of a complex Zumba dance sequence. Results did not support the first hypothesis, as neither condition demonstrated faster rates of acquisition. Post-test results supported the predictions, with the looking-glass condition exhibiting significantly fewer errors for the quality measure of physical performance and an increased capability to identify more of the incorrect movements. Finally, based on the results of this study, the degree of perceived cognitive effort did not differ between the two viewing angles. Therefore, explaining the looking-glass learning advantages by the reversal hypothesis theory proposed by Ishikura & Inomata (1995) is untenable at this point.

Alternate Explanations

As an alternative, it could be argued that the saliency of relevant cues that were available during the looking-glass condition, but not during the subjective condition, allowed for superior learning to take place. This aligns with Bandura's social cognitive theory (1986) in that the learner was provided access to information during the attention component of observation and could then retain this information in the form of a stronger cognitive representation of the dance sequence. This stronger cognitive representation then enabled both superior physical performance of the dance and error identification.

Practical Applications

Given the findings of this current research, one of two approaches should be taken in order to capitalize on the benefits of viewing angle within practical settings. In a situation whereby all the relevant cues are not visible from one particular viewing angle, one should establish a situation whereby multiple perspectives are provided. If these conditions cannot be met, then an alternative would be to ensure that verbal cues are provided during situations when the pertinent components are not visible. By following one of these two suggestions, this allows observers to focus their attention on the most relevant aspects of the motor skill, thus allowing for deeper cognitive processing and greater learning.

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Appendix A

Ethics Approval

File Number: h11-11-04

Date (mm/dd/yyyy): 01/26/2012

Université d'Ottawa
Bureau d'éthique et d'intégrité de la recherche

University of Ottawa
Office of Research Ethics and Integrity

Ethics Approval Notice

Health Sciences and Science REB

Principal Investigator / Supervisor / Co-investigator(s) / Student(s)

First Name	Last Name	Affiliation	Role
Diane	Ste-Marie	Health Sciences / Human Kinetics	Supervisor
Jenna	Smith	Health Sciences / Human Kinetics	Student Researcher
Kelly	Vertes	Health Sciences / Human Kinetics	Research Assistant

File Number: H11-11-04

Type of Project: Master's Thesis

Title: The Effects of Viewing Angle on the Acquisition, Retention and Recognition of a Complex Dance Sequence

Approval Date (mm/dd/yyyy)	Expiry Date (mm/dd/yyyy)	Approval Type
01/26/2012	01/25/2013	Ia

(Ia: Approval, Ib: Approval for initial stage only)

Special Conditions / Comments:
N/A

File Number: h11-11-04

Date (mm/dd/yyyy): 01/26/2012

Université d'Ottawa
Bureau d'éthique et d'intégrité de la recherche

University of Ottawa
Office of Research Ethics and Integrity

This is to confirm that the University of Ottawa Research Ethics Board identified above, which operates in accordance with the Tri-Council Policy Statement and other applicable laws and regulations in Ontario, has examined and approved the application for ethical approval for the above named research project as of the Ethics Approval Date indicated for the period above and subject to the conditions listed the section above entitled "Special Conditions / Comments".

During the course of the study the protocol may not be modified without prior written approval from the REB except when necessary to remove subjects from immediate endangerment or when the modification(s) pertain to only administrative or logistical components of the study (e.g. change of telephone number). Investigators must also promptly alert the REB of any changes which increase the risk to participant(s), any changes which considerably affect the conduct of the project, all unanticipated and harmful events that occur, and new information that may negatively affect the conduct of the project and safety of the participant(s). Modifications to the project, information/consent documentation, and/or recruitment documentation, should be submitted to this office for approval using the "Modification to research project" form available at:
http://www.rges.uottawa.ca/ethics/application_dwn.asp

Please submit an annual status report to the Protocol Officer 4 weeks before the above-referenced expiry date to either close the file or request a renewal of ethics approval. This document can be found at:
http://www.rges.uottawa.ca/ethics/application_dwn.asp

If you have any questions, please do not hesitate to contact the Ethics Office

Kim Thompson
Protocol Officer for Ethics in Research
For Daniel Lagarec, Chair of the Sciences and Health Sciences REB

Appendix B

Participant: ____________
Sequence: ______________
Date: ___________________

Recognition Test/Tracking Sheet

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
Merengue March	Salsa Travel	Merengue 6 Step	Body Rolls	Salsa Side Step	Salsa Back Step	Knee Highs	Arm Waves

Video #1

Step 1 Step 2 Step 3 Step 4 Step 5 Step 6 Step 7 Step 8

Video #2

Step 1 Step 2 Step 3 Step 4 Step 5 Step 6 Step 7 Step 8

Video #3

Step 1 Step 2 Step 3 Step 4 Step 5 Step 6 Step 7 Step 8

Video #4

Step 1 Step 2 Step 3 Step 4 Step 5 Step 6 Step 7 Step 8

Video #5

Step 1 Step 2 Step 3 Step 4 Step 5 Step 6 Step 7 Step 8

Video #6

Step 1 Step 2 Step 3 Step 4 Step 5 Step 6 Step 7 Step 8

Video #7

Step 1 Step 2 Step 3 Step 4 Step 5 Step 6 Step 7 Step 8

Video #8

Step 1 Step 2 Step 3 Step 4 Step 5 Step 6 Step 7 Step 8

Appendix C

Perceived Self-Efficacy

Date:____________
Participant:_______
Pre Post

This questionnaire is designed to give us a better understanding of how confident you are in your ability to perform the components of the dance sequence. Please rate below how certain you are that you can complete each segment without error and present all the key features of the movement. All of your answers will be kept confidential and completely anonymous.

Rate your degree of confidence by recording a number from 0 to 100 according to the scale given below:

0 10 20 30 40 50 60 70 80 90 100
Cannot do at all — Moderately can do — Highly certain can do

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
Merengue March	Salsa Travel	Merengue 6 Step	Body Rolls	Salsa Side Step	Salsa Back Step	Knee Highs	Arm Waves

I will accurately perform all the movements and pertinent features of at least:

One step:
0 10 20 30 40 50 60 70 80 90 100
Cannot do at all — Moderately can do — Highly certain can do

Two steps:
0 10 20 30 40 50 60 70 80 90 100
Cannot do at all — Moderately can do — Highly certain can do

Three steps:
0 10 20 30 40 50 60 70 80 90 100
Cannot do at all — Moderately can do — Highly certain can do

Four steps:
0 10 20 30 40 50 60 70 80 90 100
Cannot do at all — Moderately can do — Highly certain can do

Five steps:
0 10 20 30 40 50 60 70 80 90 100
Cannot do at all — Moderately can do — Highly certain can do

Six steps:
0 10 20 30 40 50 60 70 80 90 100
Cannot do at all — Moderately can do — Highly certain can do

Seven steps:
0 10 20 30 40 50 60 70 80 90 100
Cannot do at all — Moderately can do — Highly certain can do

All eight steps:
0 10 20 30 40 50 60 70 80 90 100
Cannot do at all — Moderately can do — Highly certain can do

Appendix D

Perceived Cognitive Effort Scale

Participant: ____________
Sequence #: ____________
Date: __________________

This questionnaire is designed to give us a better understanding of how easy or difficult you find it to learn a yoga sequence from the specified viewing angles. Please rate below your perceived degree of difficulty for each angle. All of your answers will be kept confidential and completely anonymous.

Rate your perceived degree of difficulty by recording a number from 1 to 7 according to the scale provided below:

1	2	3	4	5	6	7
Very easy to learn	Easy to learn	Somewhat easy to learn	Neutral (not easy nor hard)	Somewhat hard to learn	Hard to learn	Very hard to learn

Anterior (Instructor facing you):

1	2	3	4	5	6	7
Very easy to learn	Easy to learn	Somewhat easy to learn	Neutral (not easy nor hard)	Somewhat hard to learn	Hard to learn	Very hard to learn

Lateral: Left Side View

1	2	3	4	5	6	7
Very easy to learn	Easy to learn	Somewhat easy to learn	Neutral (not easy nor hard)	Somewhat hard to learn	Hard to learn	Very hard to learn

Lateral: Right Side View:

1	2	3	4	5	6	7
Very easy to learn	Easy to learn	Somewhat easy to learn	Neutral (not easy nor hard)	Somewhat hard to learn	Hard to learn	Very hard to learn

Posterior (Instructor facing away):

1	2	3	4	5	6	7
Very easy to learn	Easy to learn	Somewhat easy to learn	Neutral (not easy nor hard)	Somewhat hard to learn	Hard to learn	Very hard to learn

Bottom-up view:

1	2	3	4	5	6	7
Very easy to learn	Easy to learn	Somewhat easy to learn	Neutral (not easy nor hard)	Somewhat hard to learn	Hard to learn	Very hard to learn

45 Degree Angle:

1	2	3	4	5	6	7
Very easy to learn	Easy to learn	Somewhat easy to learn	Neutral (not easy nor hard)	Somewhat hard to learn	Hard to learn	Very hard to learn

Appendix E
Physical Performance Pre-test and Post-test:
Rater Scoring Sheet

Participant: ____________
Condition: ____________
Model: ________________

Pretest Post-test

Sequence Measure

In the space provided, indicate whether or not the two identified components were performed in the correct order. At the end, provide the total out of 7 to indicate how many of the dance components were performed in proper order. One point will be awarded for every 2 components placed in the proper sequence.

Step 1 - 2	**Step 2 - 3**	**Step 3 - 4**	**Step 4 - 5**	**Step 5 - 6**	**Step 6-7**	**Step 7 – 8**
Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N

Total: __________

Quality Measure

Check off the space provided if the participant <u>incorrectly</u> executed the key criteria identified for each component within the dance sequence. At the end, indicate the total number of errors out of 42.

Attempt #: **Sequence #:** **Time:** **Total:**

	Arms	**Legs**	**Direction (Body)**
Merengue March	**D # T P**	**D # T L**	
Salsa Travel	**D # T P**	**D # T**	
Merengue 6 step	**D # T P L**	**D # T**	
Salsa Side Steps	**D P**	**D # T**	
Salsa Back Steps	**D T P**	**D # T L**	
Knee Highs	**D P**	**D # T L**	

Appendix F

Physical Performance Acquisition: Rater Scoring Sheet

Participant: ___________
Condition:____________
Model:________________

Quality Measure – Acquisition

Check off the space provided if the participant <u>incorrectly</u> executed the key criteria identified for each component within the dance sequence. At the end, indicate the total number of errors out of 42 below.

Song #: Sequence #: Time: Total:

	Arms	Legs	Direction (Body)
Merengue March	**D**, **#**, **T**, **P**	**D**, **#**, **T**, **L**	
Salsa Travel	**D**, **#**, **T**, **P**	**D**, **#**, **T**	
Merengue 6 step	**D**, **#**, **T**, **P**, **L**	**D**, **#**, **T**	
Salsa Side Steps	**D**, **P**	**D**, **#**, **T**	
Salsa Back Steps	**D**, **T**, **P**	**D**, **#**, **T**, **L**	
Knee Highs	**D**, **P**	**D**, **#**, **T**, **L**	