

Advance Cues  
in Soccer Penalty Kicks

by

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A Thesis Presented in Partial Fulfillment  
of the Requirements for the Degree  
Master of Science

Approved November 2019 by the  
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December 2019

## ABSTRACT

The study at hand investigated the effects of guidance and type of occlusion on the prediction of shot direction during a soccer penalty kick. Seventy participants took an online survey where they had to guess the direction of a penalty kick from the perspective of a goalkeeper. Half the participants were placed in a group where they had access to tips on what to look for, while the other group had no tips provided. Participants were shown videos in which the penalty shooter had their upper body covered or their lower body covered. Participants had 30 seconds to decide what side the ball was going to, right or left. Results showed that there is no significant between the two groups in terms of judgment accuracy. The group that received no guidance and had the kicker's lower body covered was the group with the highest average score, 50.44%. The findings may help future studies that focus on what material is taught to goalkeepers in a classroom setting and the role of occlusion during free kicks outside the 18-yard box.

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## **Introduction**

Soccer is one of the most watched sports in the world. It brings millions of people together and creates bonds that spread over oceans. In soccer, there are several instances in which a split second can change the game. A penalty kick is one of these moments. According to FIFA, in the 2014 World Cup, penalty kick averaged 70 mph (Gaines, 2014). The ball reaches the goal in less than 400 milliseconds. For a goalkeeper to fully extend to one side, it takes about 500 milliseconds (Insider, 2018). That means that a fast ball near the post is mathematically impossible to reach unless the goalkeeper guesses correctly and starts moving before the ball is kicked. So how does the goalkeeper know what side to move before the ball is kicked? Is it just luck or is there a specific strategy a goalkeeper uses?

## **Overview**

The study at hand is to answer the following question: What is the role that advance cues play on the decision-making of a goalkeeper during a penalty kick, specifically upper vs lower body cues. The first step is to define what a penalty kick is. A penalty kick is given when a player commits a foul (direct free kick) inside his or her 18-yard box. The opponent's goalkeeper must remain on the goal line, facing the kicker, until the ball is kicked. The kicker must score from 12 yards away from goal (Law 14: The Penalty Kick, n.d.). The kicker and the goalkeeper are the only players allowed in the penalty area. The other players must be outside the penalty area. The keeper's decision consists of several factors, one of them being advance cues. Professional goalkeepers initiate their response/decision before the impact of the ball. Advance cues refer to the goalkeeper's ability to make accurate predictions based on the contextual information

available before the player kicks the ball. Advance cues are a significant component when anticipating what will happen. They are visual information that allows players to predict what will happen before the action begins. Advance cues are often essential to a successful performance because the action happens so fast. With this extra information available, athletes still need to make a decision. The following studies help frame the approach for the current study.

An initial analysis was done prior to this study where penalties from the English Premier League from 2014-2018 were examined. Bleacher Report described the English Premier League as the top football league in the world. The league has 1.33 goals per game, 0.06 red cards per game, 26 continental wins, and 31 point differential (Tansey, 2014). From the 360 penalties taken 274 were scored, 19 were missed, and 67 were saved from the keeper. In the 2016-2017 season, goalkeepers guessed the correct side 42 times from the 106 penalties taken. That is only 39% (Maurya, 2017). The statistics show that expert goalkeepers need to improve their penalty kick performance. They must look for reliable information that can help them guide their decision to the correct side. One of the goals of this study is to help develop a goalkeeper training program to improve their penalty kick performance.

## Literature Review

Many studies have focused on penalty kicks in soccer and have specially looked at the rational and thought process of a goalkeeper. For example, Ona, Raya, and Bilbao (2010) investigated the effects of providing advance cues during a penalty kick and measured the kicker's rate of success. The point of the study is the effect of explicitly providing goalkeeper's movement advanced cue to the kicker during a real penalty kick task was assessed. Providing an advance cue significantly improved the player's rate of success relative to players without the advance cue. The cue in this study was the direction the goalkeeper was going to move to. This shows that providing advance movement cues helped the experimental group to increase its decision time significantly, suggesting cognitive adaption to the detection of a cue and making a decision.

Williams and David's (1998) study investigated the relationship between visual search strategy, selective attention, and expertise in soccer. Participants recruited consisted of 12 experienced and 12 less experienced male soccer players. They were asked to anticipate pass destination as quickly and accurately as possible. Although there were no differences in search strategy in 3v3 situations, in 1v1 situations, experienced players had a higher search rate, involving more fixations of shooter duration, and fixated longer on the hip region (Williams & Davids, 1998). The article indicated the hip region to be an area of importance in anticipating an opponent's movement. It also mentions the advantage of using eye movements with more direct measures.

Johnston and Morrison (2010) looked at the application of naturalistic decision-making technique to explore cues in rugby players. The purpose of this study was to see the types of meaning of cues and how it varied between the skill level of the player. It



was also anticipated that experts would practice greater cue discrimination than novices. Participants consisted of three players from a semi-professional club and seven players from a professional club. Participants were put into four categories. Category one is representing the highest level of ability and Category 4 the lowest. Also, participants were part of a cognitive task analysis. They were asked sixteen questions framed around a specific event that was recalled from memory by the individual. Following the cognitive task analysis, the participants were shown a picture stimulus depicting a scene from a professional rugby league game (Johnston & Morrison, 2016). They were asked to describe what they would do if they were part of the scene. Findings demonstrated differences in the number of cues used across player categories, with the highest category player reporting a reliance on fewer cues than the other players. Cues in rugby helped players make predictions of their opponent in the field.

Savelsbergh, Williams, Van Der Kamp, and Ward (2002) conducted a study in the Netherlands, where they investigated the effects of visual search, anticipation, and expertise in goalkeepers. Fourteen players participated where seven had played ten plus years in a semi-professional league and the other seven players less frequently, for fun. Participants were placed in two groups, the expert, and novice group, based on their experience. Experts and novices were then asked to move a joystick in response to penalty kicks presented on film. Visual search behavior was assessed using an eye movement registration system. Expert goalkeepers were more accurate in predicting the direction of the penalty kick than novice goalkeepers (Savelsbergh, 2002). A critical piece of information from this study is that the novice group fixated more on the trunk, arms, and hips (upper body), whereas the expert group paid attention to the kick and non-

kicking leg (lower body) and ball. The findings in this study are interesting in that participants separated cues into the categories.

Morris and Colenso's (1996) work looked at the anticipation of goalkeepers when facing right and left-footed penalty kicks, similar findings to the previous study were found. Participants were shown a film with ten right-left footed penalty kicks and ten left-footed penalty kicks (McMorris & Colenso, 1996). A 2-way ANOVA indicated that anticipation of right footed-kicks was significantly better than left-footed kicks. Where this study connects with the previous one is that *post hoc* interviews were conducted and revealed that participants used the angle of approach of the ball, foot position at contact, and hip position at the time of contact as their main cues (lower body). From these previous studies, we see how there is a reliance among these two types of cues, upper and lower.

Causser, Smeeton, and Williams (2017) looked at the effects of having penalties both spatially and temporally occluded on the ability for skilled and less skilled goalkeepers to predict their direction. Twenty-four goalkeepers were asked to look at a video on a projector, and they had to dive to the side the goalkeepers believed to ball was traveling to. Participants were required to verbalize the side they were diving to. The clips the participants saw were either showing the full body of the kicker or only the hip section. The videos were also stopped at -240 ms before the kick or at 80ms before the kick. Findings showed how skilled goalkeepers used to hip region to accurately predict the direction of the penalty kick. Later temporal occlusions times were also associated with increased performance in the correction response and direction of the analyses (Causser, Smeeton, & William, 2017).

Hunter, Murphy, Angilletta Jr, and Wilson (2018) study focused on the effects of speed and technique of the kick on predicting the direction of penalty kick. More than seven hundred participants were part of an online survey where they matched penalty shots from the point of view of a goalkeeper. Participants watched 60 videos penalty kicks at different occlusion times (-0.4s to 0.0s) before the ball was kicked and needed to predict the direction of the kick. The kickers in the video were asked to kick in four different way, left and side-foot; right and side-foot; left and instep; right and instep (Hunter, Murphy, Angilletta Jr, & Wilson, 2018). Results showed that side-foot kicks were easier to predict when they were fast. Instep kicks were harder to predict slow or fast. It was also found the accuracy increased on videos were the occlusion time was closer to ball contact.

Dicks, Button, and Davids (2010) investigated the behaviors of goalkeepers in three situ conditions and two video simulation conditions. The three situ conditions were categorized into verbal, simplified body movement, and interceptive response followed by verbal and joystick movement response video simulations. Goalkeepers were asked to verbally judge the direction of the penalty kick without making any movements for the video simulation verbal and the in-situ verbal condition. In the video conditions, goalkeepers were asked to move to actually try to save the penalty kick. Findings showed that goalkeepers focus more on the penalty kick taker's movement compared to the ball location (Dicks, Button, & Davids, 2010). In the situ interception, goalkeepers spend the same amount of time looking at the penalty kicks movements and the ball location. The article mentioned that depending on the limitations of the experimental task, the gaze and movement behaviors function differently. From the findings, what is useful for the

current study is how goalkeepers spend more time fixating on information from the kicker.

Smeeton and Williams (2012) looked at how human movement that has deception about the outcome is thought to be different from non-deceptive movement. Skilled and less skilled soccer players were asked to look at temporally occluded deceptive, non-deceptive, and non-deceptive exaggerated penalty kicks (Smeeton & Williams, 2012). Participants looked at the penalty kick videos and were asked to judge the direction of the penalty kick and write down what their level of confidence was. Participants were overconfident when guessing the deceptive kicks compared to the non-deceptive kicks.

Memmert, Hüttermann, Hagemann, Loffing, and Strauss (2013) developed a five-step process for goalkeepers to anticipate the direction of a kick in a penalty situation. The first step is to look at the orientation of the non-kicking foot. The second step is to look at the orientation or turning of the torso of the kicker. The third step is to look at the position of the support/non-kicking leg in relation to the ball. The last step is to look at oblique run-up of the kicker. Collectively the movement features observed can be used by goalkeepers to anticipate the kick (Memmert, Hüttermann, Hagemann, Loffing, & Strauss, 2013). Looking at the technique, cues from the hip up and down are used to determine the direction of the kick. From this information, there is a combination of upper and lower body cues used to establish a successful performance during a penalty kick as a goalkeeper.

From this research, two concepts have been presented. The first is that advance cues are critical when it comes to making a decision. The CTA from Johnston and Morrison (2016) study we saw that higher skilled players do use anticipation skills when

judging a play. From the last two studies, it is noted that advances cues are broken down in two areas, upper and lower body. Upper body consisting of, trunk, arms, head and lower of legs and feet. Lower body was shown effective in Savelsbergh, Williams, Van Der Kamp, & Ward (2002) and McMorris and Colenso (1996), it is hypothesized that lower body cues will be more effective in deciding the kick of a penalty than upper body cues. For the structure of this study, a combination of Hunter et al. (2018) and Causer, Smeeton, and Williams (2017) will be used. The survey approached similar to Hunter's work and the procedure of producing the test film from Causer, Smeeton, and Williams (2017).

The goal of the present study was to extend previous work by combining two manipulations that have been used in the past: spatial occlusion and instructions about which part of the body to look at. Specifically, participants viewed videos of a shooter in which either the top or low half of the body was occluded. Participants were randomly placed in one of four groups, guidance group with occluded lower body, guidance group with occluded upper body, no guidance provided group with occluded lower body and no guidance group with occluded upper body. It was predicted that the group with guidance provided and upper body occluded was going to have the highest correct direction guesses among the groups. Based on the previous studies, the legs and lower hip areas were areas to focus on.

## **Methods**

### **Participants**

A total of 70 participants were part of this study. A survey was used to serve a convenient sample online. The link to the survey was emailed to ASU Sports Clubs,

Grand Canyon University Division 1 Soccer Mens' Team, Polytechnic Group, SDFC' patrons, and Youth Arizona Sports Clubs. Participants were not required to have previous experience with soccer to participate in this study. On the other hand, they needed to be 18 years or older to participate.

## **Materials**

### **Video Production**

Two soccer players from the Arizona State University Men's Soccer Club were recruited to take penalty kicks and be recorded. Video were recorded using Sony - Handycam AX53 4K Flash Memory Premium Camcorder. The players were asked to use the same technique they would use in a game to execute the penalty kicks. Players were also asked to kick six penalties to each of the four corners of a goal. A regular 7.32 m by 2.44 m goal will be used for the shoot. The camera was placed in the middle of the goalpost to record from the perspective of a goalkeeper. The location of the filming was at the Polytechnic Campus' soccer fields. Videos were edited to stop before ball contact. This was done to prevent ball trajectory from influencing the decision of the participants. Half of the videos were occluded from the waist up and half included from the waist down. The video software Adobe Premiere Pro was be used to edit the videos powered by a Dell XPS desktop. A total of twenty-one videos were used from each kicker. Shots missed were not taken into consideration.

### **Survey Structure**

The survey was created and distributed using Qualtrics. The edited videos uploaded to YouTube using a 1920 x 1080 60 fps format and were listed as unlisted. An

unlisted YouTube video can be viewed by people who have the video link. It will not appear in public places, such as search results, your channel, or subscriber feeds (McCabe, 2018). Videos played once and the options, right or left, appeared at the bottom, along with a timer. Video and options share a page. The first two pages had information about the study and the instructions. It was followed by two practice videos, and then the testing stage began.

## **Procedure**

### **Survey Instructions**

Participants watched forty videos of players taking penalty kicks from the perspective of the goalkeeper. Participants had to guess the direction of the kick (right or left) after the video ends. Instructions were provided at the start of the survey and had two practice videos before the testing videos began.

Participants were randomly placed in one of four groups, guidance group with occluded lower body, guidance group with occluded upper body, no guidance provided group with occluded lower body and no guidance group with occluded upper body. The guidance provided group received 5 tips before the testing phase. The tips provided information on what other studies have found successful when it comes to predicting the direction of a soccer kick (Figure 5). The no guidance group will not have a message section and will go straight into the testing section. This was done using Qualtrics, Randomizer tool.

## Results

A two-way ANOVA, 2 Group (guidance, no guidance) x 2 (lower body occluded, upper body occluded) was conducted that examined the effects of providing guidance and types of occlusion on direction prediction of a soccer penalty kick. The alpha level for significance was set at 0.05. A correct response was measured as such if participants guessed the correct side the ball was traveling to, right or left.

The 2 way ANOVA performed on these data revealed no significant main effect of guidance ( $p=.21$ ) and no significant effect of type of occlusion ( $p=.79$ ). In addition, there was no statistically significant interaction between the effects of providing guidance and types of occlusion, ( $p = .44$ ).

Figure 1 shows that the group of Guidance/LowerOccluded had an average score of 47.32% and group Guidance/UpperOccluded had an average score of 48.33%. It was predicted that the group with the upper body occluded was going to perform better than the group with the lower body occluded. That was only true for group who received guidance. The NoGuidance/LowerOccluded group had an average score of 51.47% and



NoGuidance/UpperOccluded had an average score of 49.35%.

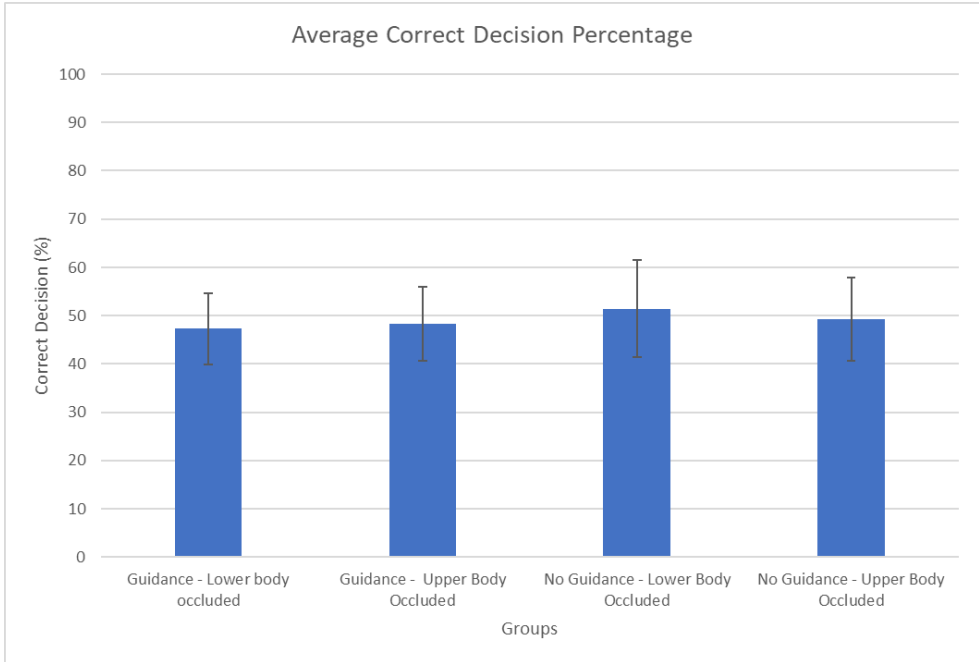


Figure 1 Average Correct Decision Score for 4 Groups

Figure 2 shows the group that received no tips was the group with the highest score with 50.44%.

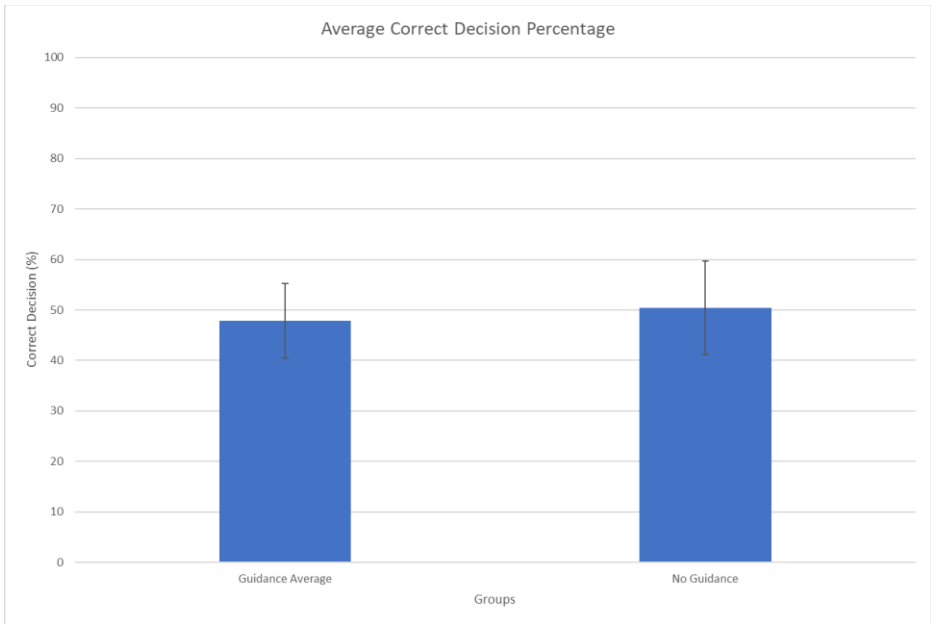


Figure 2 Average Correct Decision Score for Guidance and No Guidance Groups

Figure 3 shows that the occluded lower body group performed better than the occluded upper body group with 49.45% to 48.83%.



Figure 3 Average Correct Decision Score for Lower Body Occluded and Upper Body Occluded

## Discussion

The role of a goalkeeper during a penalty kick is a very difficult one. From the predictions made guidance and type of occlusion had no effect on the prediction of direction for a penalty kick. It was hypothesized that the group with the upper body occluded was the group that was going to perform best. Based on past studies, it appeared lower body cues were more useful. As mentioned before, the groups will guidance provided shared that finding, but the group with no tips did not. One possibility for this could be the tips provided were confusing. Both groups that were not provided tips

performed better, 51.47% LBO and 49.36% UBO. A question at the end asking about the tips' clarity would have been beneficial.

Some limitations encountered are the amount of people who participated. The sample size was very small and choosing a particular type of participants would have worked best. Participants who had more experience with soccer may have affected the results differently. The way participants received the study is also another limitation. A survey online works best when one is trying to recruit several participants but the environment they are in is not controlled at all. Having participants come into a computer lab is a great option. Another possibility for the future is to have participants wear eye tracking eyewear as they watch a video of a kicker taking a penalty kick. That type of approach could also incorporate semiprofessional to professional goalkeepers and start from there.

This study does bring up some gaps in soccer goalkeeping research. Studies on how goalkeepers are being trained are few and how does occlusion work in other soccer scenarios such as free kicks and corners, is another area that might benefit from this. In soccer, goalkeeping is one of the most overlooked positions and many assume it is that way because it is the simplest position. It could be that it is the most overlooked, because it is the hardest to understand or breakdown.

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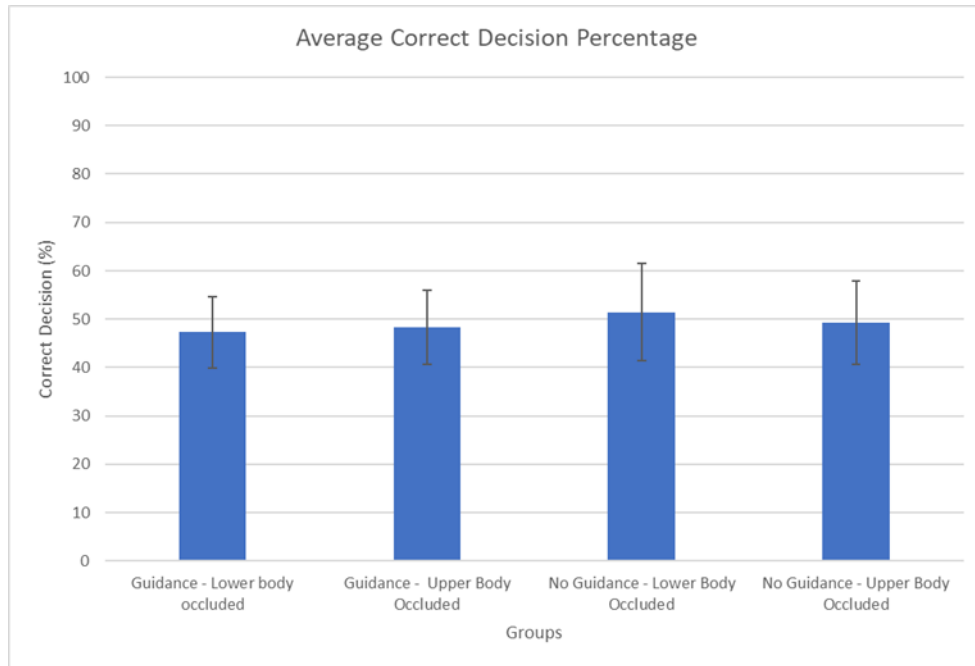
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APPENDIX A

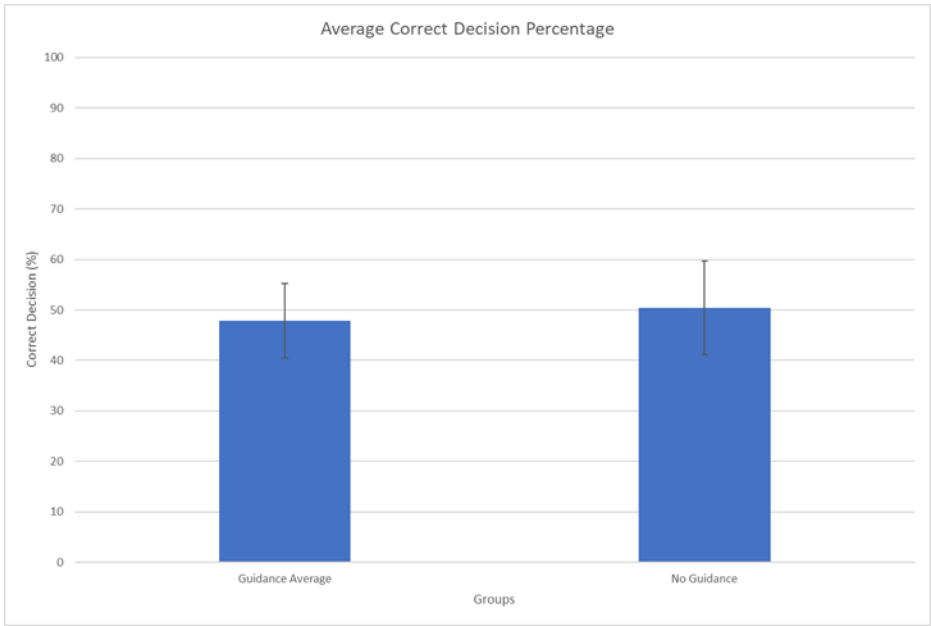
BAR GRAPH DISPLAYING AVERAGE CORRECT DECISION PERCENTAGE FOR  
GUIDANCE GROUP – LOWER BODY OCCLUDED VS GUIDANCE GROUP –  
UPPER BODY OCCLUDED VS NO GUIDANCE GROUP – LOWER BODY VS NO  
GUIDANCE – UPPER BODY



APPENDIX B

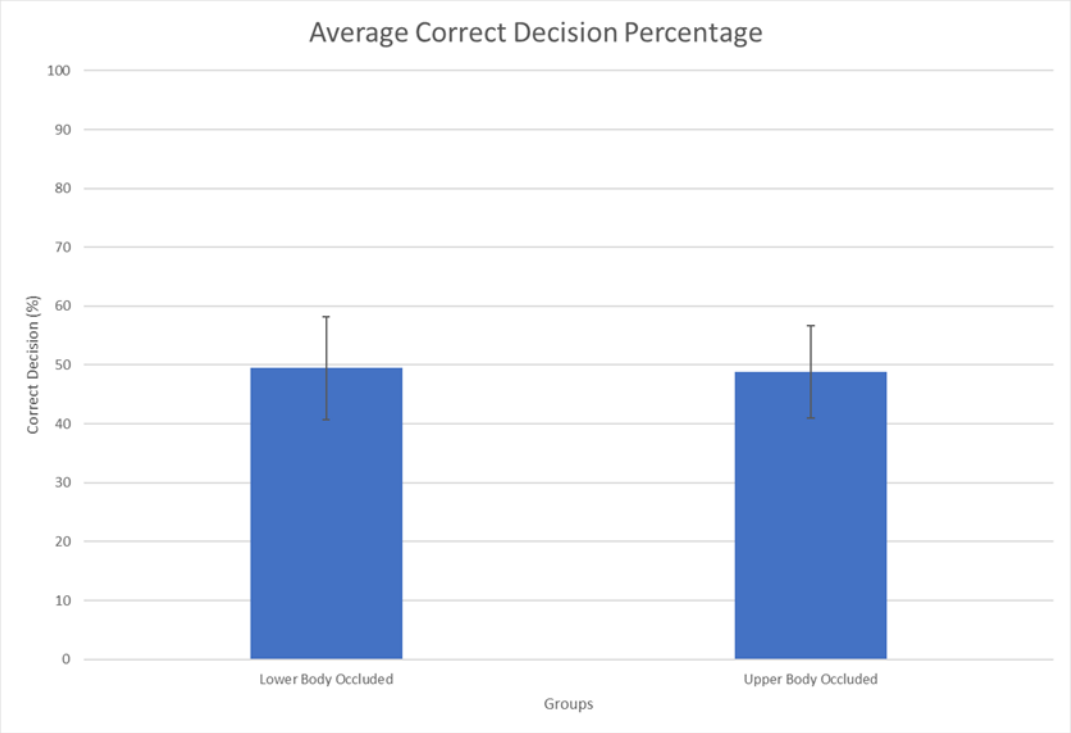
BAR GRAPH DISPLAYING AVERAGE CORRECT DECISION PERCENTAGE FOR  
GUIDANCE GROUP VS NO GUIDANCE GROUP





APPENDIX C

BAR GRAPH DISPLAYING AVERAGE CORRECT DECISION PERCENTAGE FOR  
LOWER BODY OCCLUDED GROUP VS UPPER BODY OCCLUDED GROUP



APPENDIX D

IRB APPROVED ON OCTOBER 15, 2019

## Notification of Approval

**To:** Robert Gray

**Link:** [STUDY00010787](#)

**P.I.:** [Robert Gray](#)

**Title:** Advance Cues

**Description:** This submission has been approved. You can access the correspondence letter using the following link:  
[Correspondence\\_for\\_STUDY00010787.pdf\(0.01\)](#)

To review additional details, click the link above to access the project workspace.

APPENDIX E

TIPS

Look at the hip area of the kicker to predict direction of the shot  
Look at the foot position at time of contact with the ball  
Focus on lower body area