Running head: *Anticipation and disguise*

The use of patterns to disguise environmental cues during an anticipatory judgment task

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Abstract

A number of novel manipulations to the design of playing uniforms were used in order to try and disguise the intentions of penalty-takers in soccer. Skilled and less-skilled soccer goalkeepers were required to anticipate penalty-kick outcome while their opponent wore one of three different uniform designs that were intended to disguise the availability of potentially key information from the hip region. Variations of shapes/patterns were designed to conceal the actual alignment of the hips. Three occlusion points were used in the test film: -160 ms, -80 ms before, and at foot-ball contact. Skilled individuals reported higher accuracy scores than their less-skilled counterparts ($p < 0.05$). There were no performance decrements for the less-skilled group across the different uniform conditions ($p > 0.05$); however, the skilled group decreased their accuracy on the experimental conditions compared with the control ($p < 0.05$). Findings highlight the potential benefits of designing playing uniforms that facilitate disguise in sport.

Key Words: Perceptual-cognitive expertise; anticipation; sportswear design; disguise

In recent years there has been significant interest in identifying the processes and mechanisms underpinning successful anticipation and decision making (Causer & Williams, 2013). Most recently, there has been growing interest in how athletes can confuse an opponent by disguising their intentions (Jackson, Warren, & Abernethy, 2006) or by presenting false or non-veridical information (Smeeton & Williams, 2012; Williams, 2009). The aim of the current study was to identify skill-based differences in susceptibility to disguise, using uniform manipulations, in a soccer penalty kick.

The soccer penalty-kick has proved to be one of the most popular tasks for scientific investigation, mainly due to the considerable temporal constraints placed on the goalkeeper. On average, the time it takes the ball to reach the goal from initial ball contact is between 400-800ms (100-50Km/h) (Kuhn, 1988). Furthermore, Hughes and Wells (2002) found 87% of penalties to be struck at 75% of the players' maximal, so taking around 500ms. The lower limit for feedback utilization has been established to be around 250ms (Le Runigo, Benguigui, & Bardy, 2010) in simple interceptive tasks requiring minimal movement of a single effector. Therefore, in a more complex task such as saving penalty kicks, which requires whole body movement, goalkeepers, on the majority of penalties, cannot implement corrective feedback successfully and so have to try and anticipate ball direction before ball contact. Therefore, researchers have predominantly focused on identifying the visual cues emanating from the kicker, and how the goalkeeper can utilize these to maximize their chances of saving the penalty.

There is considerable debate in the literature as to the most effective areas to fixate gaze when attempting to anticipate a soccer penalty-kick. For a

goalkeeper to successfully intercept the ball they must anticipate two variables: height and side. The postural cues needed to anticipate the height of a penalty-kick may be different to the information needed to predict side. Williams and Burwitz (1993) suggested that when trying to anticipate the side the ball would be kicked, information was obtained from the angle of the penalty taker's run-up, the arc of the leg on approach to the ball, and angle of the kicking foot and hips prior to ball contact. The orientation of the hips was deemed particularly informative by participants, with these being positioned more square on to the goal if the ball is placed to the goalkeeper's right hand side (assuming a right-footed penalty-taker), whereas if the ball is intended to be placed to the left side the hips are inclined to slope away from the goalkeeper. Similarly, Williams and Davids (1998) reported that skilled defenders spent a higher proportion of time fixating on the hips when attempting to anticipate an opponent's actions in 1-on-1 dual situations in soccer when compared with less-skilled individuals. However, there are some methodological issues with these papers, given that Williams and Burwitz (1993) used verbal reports and Williams and Davids (1998) did not use a penalty-kick task.

Savelsbergh, Williams, van der Kamp and Ward (2002) reported that expert goalkeepers spent a higher proportion of time fixating the kicking leg and non-kicking leg rather than the hips, whereas novices spent more time fixating on the trunk, arms, and hips. In a subsequent study (Savelsbergh, van Gastel, & van Kampen, 2010), in which a group of expert goalkeepers were differentiated into successful and less successful performers, using their accuracy on the film-based anticipation test as the criterion measure, the non-

kicking leg was implicated as an important information source when attempting to anticipate penalty-kick direction. However, the visual search patterns employed were variable and the goalkeepers spent some time fixating up to eight separate locations across trials, averaging between 2.6 and 3.1 different locations per trial, with the relative importance of these areas fluctuating across the different temporal phases of the penalty-kick. Moreover, no differences in search behaviors were observed when comparing successful against unsuccessful trials, implying that anticipation is only partially dependent on the visual strategy employed (Savelsbergh et al., 2002).

Detailed kinematic analyses of penalty-kicks have shown that several variables correlate highly with ball direction approximately 150ms before ball contact, including the non-kicking foot angle, the knee angle of the kicking leg, and the speed of the kicking foot (Lopes, Jacobs, Travieso, & Araújo, 2014). Kinematic correlates of direction at ball contact include: kicking foot angle, the hip angle, and the movement direction of the kicking foot. Other kinematic analyses have also demonstrated similar results, with the angle of the kicking foot and angle of the hips being reported as reliable predictors of ball direction (Diaz, Fajen, & Phillips, 2012). These data demonstrate that the important predictive cues evolve over the movement and are all located in the lower part of the body. Given that the predictive information is evolving and different cues become available at different times there may be a need to fixate several sources of information over the movement. However, when the goalkeeper saccades from one fixation to another information processing is suppressed. Therefore, a large number of short duration fixations in visual search patterns will decrease the amount of information that is processed. Given the temporal

constraints of the task, this is not an efficient strategy. Piras and Vickers (2011) showed that soccer goalkeepers utilize a 'visual pivot' strategy where point of gaze is centrally located mid-way between the ball and hip region in order to enable optimal use of the fovea and parafovea. Furthermore, an analysis of the final five fixations prior to ball contact indicated that longer final fixations on the ball, head or shoulders were correlated with unsuccessful performance by the goalkeeper, whereas longer fixation durations on the hips, legs and feet were correlated with successful saves. These data show that stabilizing vision throughout the movement on a central source may enable the pick up of the relative motions or relationships between other information sources more efficiently.

In recent years, there has been increasing interest in how individuals can manipulate the information presented in their preparatory movements in order to try and disguise their actions or deceive an adversary. The process of disguise involves hiding the availability of information from a certain area by, for example, delaying its onset. In contrast, deception involves the presentation of misleading or false information rather than genuine cues with the aim of tricking an opponent into preparing for a different action to the one actually planned (Rowe, Horswill, Kronvall-Parkinson, Poulter, & McKenna, 2009). While there have been several attempts to examine disguise and deception in other domains, such as in gambling and personal interaction (Blakemore & Frith, 2005; Frank & Ekman, 1997; Hyman, 1989), there have been very few published reports focusing on these topics in sport. This paucity of research is surprising given anecdotal reports linking deception and disguise to successful performance as well as the potential value of

developing training programmes that could facilitate the acquisition of these skills (Rowe et al., 2009).

Researchers have used manipulations involving other sport tasks where they either asked the actor to try, or not to try, and deceive the opponent (Cañal-Bruland, van der Kamp, & van Kesteren, 2010; Jackson et al., 2006) or they have altered the information presented to individuals by neutralizing or inversing the actor's movement dynamics at certain body locations (Huys, Smeeton, Hodges, Beek, & Williams, 2008; Williams, Huys, Cañal-Bruland, & Hagemann, 2009). An illustration of how whole-body kinematics may potentially be manipulated to examine deception and disguise is provided by the work of Huys and colleagues (Huys, Cañal-Bruland, Hagemann, & Williams, 2009; Huys et al., 2008). These authors presented tennis groundstrokes in stick-figure format where dynamic information from specific areas had been occluded, neutralized or exaggerated (Huys et al., 2009; Huys et al., 2008; Williams et al., 2009).

In soccer, Smeeton and Williams (2012) examined the role of exaggerated movement in penalty-kicks, to identify skill-based differences in susceptibility to deception. Novice and skilled soccer players predicted penalty-kick direction under three penalty taker movement conditions: non-deceptive, non-deceptive exaggerated and deceptive. In the biomechanical analysis between deceptive and non-deceptive movements, the authors found several significant differences in lower limb amplitudes, including landmarks in the hip region, especially at the -80 ms occlusion point. These data are corroborated by a recent kinematic analysis reporting the non-kicking foot and the hip angle to be affected by deceptive movement (Lopes et al., 2014). In

the anticipation phase of the study, individuals recorded higher response accuracy in the non-deceptive movements, compared to the deceptive movements, demonstrating that both skill levels were negatively affected by the non-veridical information. These data suggest that there is kinematic information available from the hip region, which, if manipulated, could negatively impact anticipatory judgments. This could be due to critical information being available directly from cues in the hip region, or the relative motion of other cues in relation to the hips.

Another manner in which access to information may be manipulated is through the use of the playing uniforms or apparel worn by individuals. There are published reports to suggest that uniform color can influence the formation of impressions and expectancies in sport (Hill & Barton, 2005) and specifically in the soccer penalty-kick (Greenlees, Eynon, & Thelwell, 2013; Greenlees, Leyland, Thelwell, & Filby, 2008). Playing uniforms may be designed which influence the manner in which athletes pick up information from the postural orientation of an opponent. The use of color, patterns, contrast, hue, color saturation, color values, shapes or size/fit may make it more difficult for performers to pick up the subtle differences in postural orientation that may discriminate two alternative actions (e.g., a penalty-kick to the right or left side of the goal), reducing the accuracy of visual estimations of anticipated player movements. Playing uniforms may be configured in order to make it more difficult to pick up information (i.e., disguise) or to provide an anticipated future movement that differs from the true orientation or actual movement (i.e., deception). For example, Causer, McRobert and Williams (2013) have shown that manipulating uniform design can influence the response time and

accuracy of decision making/anticipation. In laboratory and field-based experiments stimulus intensity was manipulated to increase or decrease information pick up by sewing highly reflective sequins onto key areas of the playing uniforms. The data showed that in the high-intensity situation, performance accuracy significantly increased and response time significantly decreased, compared to the low-intensity condition. These data demonstrate the effectiveness of stimulus strength as a method of increasing the ability of performers to pick up visual cues, which may subsequently facilitate improvements in response time and accuracy. These findings highlight the practical utility of using manipulations to playing uniform design to positively influence performance in sport and other fields of activity.

In the current study, a film-based, temporal occlusion approach was used to identify skill-based differences in susceptibility to disguise. Skilled and less-skilled soccer goalkeepers will be required to anticipate penalty-kick outcome under three occlusion conditions (-160 ms; -80 ms; ball contact) and under three uniform manipulation conditions (control; zigzag; circle), based on research into disguise and camouflage in the animal kingdom (Hall, Cuthill, Baddeley, Shohet, & Scott-Samuel, 2013). The current research design, including the three uniform design manipulations chosen, was based on extensive pilot testing. It is predicted that the skilled individuals would demonstrate superior performance, when compared to their less-skilled counterparts, irrespective of the manipulation of uniform design (Savelsbergh, van der Kamp, Williams, & Ward, 2005; Savelsbergh et al., 2002; Williams & Burwitz, 1993). It is also hypothesized that both groups would record higher response accuracy in the later, compared to the earlier, occlusion points

(Smeeton & Williams, 2012). Due to the paucity of research on deceptive movement, it is unclear whether the uniform manipulations are likely to more greatly impact on the performance of skilled or less-skilled individuals. Despite evidence to suggest that skilled individuals are more inclined than their less-skilled counterparts to extract information from the hips (Williams & Burwitz, 1993), there is contrary evidence to suggest that skilled athletes are less susceptible to the effects of disguise (Jackson et al., 2006).

Methods

Participants

Twenty-four male soccer goalkeepers volunteered to take part in the study. Participants were divided equally into either a skilled or less-skilled group based on playing level and experience. The skilled group consisted of 12 players (mean age = 25.6, *SD* = 6.2 years) who currently played professional or semi-professional soccer and had been participating in the sport for an average of 11.2 (*SD* = 5.4) seasons. The less-skilled group included 12 players (mean age = 23.6, *SD* = 6.8 years) who had only recreational playing experience. Participants were free to withdraw from testing at any stage and approval for the study was gained via the local Ethics Committee of the lead author's institution.

Test Film

The test film was produced in conjunction with a professional soccer club in the UK. Four full-time, academy players were filmed from the goalkeeper's perspective taking penalty-kicks. The penalty takers were blind to the purpose of the study. The film clips were recorded using a digital video camera (Canon DM-XM2 PAL, Tokyo, Japan) positioned in the middle of the

goal at eye level (1.7 m). The players were asked to take the penalty-kick using the strategy that they would use in normal competition. Two of the players were right footed and two were left footed penalty takers. A regular dimension goal was used and players were required to shoot into each of the four corners of the goal in turn. If the ball finished in the middle of the goal, the trial was discarded. Each film clip included the penalty taker's approach to the ball and all his preparatory actions until the ball was kicked. Players were required to place one penalty in each corner while wearing one of three different uniform designs (i.e., 16 penalties for each uniform), providing a total of 48 penalties. The players were informed that they should imagine that they were taking a penalty in a competitive match situation. The footage was then digitally edited using Adobe Premiere Pro CS4 software (Adobe Systems Incorporated, San Jose, CA) so that each clip was temporally-occluded at either the moment of ball contact, 80 ms before ball contact (-80 ms) or 160 ms before ball contact (-160 ms). An illustration of the approach is provided in Figure 1.

Insert Figure 1 here

Procedure

The film clips were back-projected, using a LCD video projector (Hitachi CP-X345, Yokohama, Japan) onto a 2.7 m x 3.6 m large projection screen (Draper Cinefold, Spiceland, IN). Participants stood 3.5 m away from the screen so that the film image subtended a visual angle of approximately 70º in the horizontal and 55º in the vertical direction; these angles and

distances were used to match those of a live penalty-kick. Participants were required to verbalize the direction of the penalty kick (top left, top right, bottom left, bottom right), and also move as if there were trying to save the penalty kick. The movement was not recorded as a dependent variable, but used to increase the fidelity of the task. Participants were also required to verbalize a confidence rating of their decision after each shot (0 = not at all confident, 10 = extremely confident) (Smeeton & Williams, 2012). Confidence ratings were used to determine whether the experimental uniform design effected performance through presenting deceptive or disguised information. If performance decrements were aligned to decreases in confidence ratings, this would suggest disguised information; the availability of the critical cues is compromised. Conversely, if performance decrements were aligned with high confidence ratings, this would suggest deception; the participant is using false/misleading cues (Rowe et al., 2009). No feedback was given in relation to response accuracy. A sample of six random practice trials was shown pre-experiment to help the participants familiarize themselves with the task. After familiarization, 48 film clips were presented. Shot presentation sequence was randomized across the conditions. Each trial lasted approximately 2 seconds, with 5 seconds between trials for the participant to response and reset for the next trial.

Experimental manipulations

The penalty takers were asked to wear three different uniform designs: control, zigzag and circle. Based on the research presented in the introduction (Piras & Vickers, 2011; Williams & Burwitz, 1993; Williams & Davids, 1998), there appears to be information available from the hip region that is critical to

successful anticipation of penalty-kicks. Therefore the uniforms were designed to either increase or decrease the access to important information such as: waist location, location of vertical body centerline, and hip angle. Data from biological sciences have shown that techniques such as differential blending with the background, and internal contrast between adjacent color patches can cause the appearance of false (non-object-bounding) edges (Hall et al., 2013). These effects can disrupt the continuity of a surface and make body segments and motion more difficult to detect, especially when place closer to the edge of the body (Stevens & Cuthill, 2006). The overall purpose of this is to disguise the shape and edges of an object (Thayer & Thayer, 1918). With this in mind, we designed three uniforms. The control uniform consisted of a yellow shirt with black shorts; with the intention being to present a clear line or contrast between the color of the shirt and shorts so that the waistline and hip alignment are clearly demarked, making the pick-up of information from this region relatively easy. The two experimental conditions were intended to try and confuse visual attempts to precisely locate the wearer's waist or body orientation, and attenuate the effectiveness of attempts to anticipate likely subsequent motions. The zigzag uniform consisted of blue zigzags (or irregular lines/edges) across the hip area on a yellow shirt and shorts. This was to try and disguise the natural edges of the segments (Stevens & Cuthill, 2006). The circle uniform consisted of blue circles covering the hips on top of yellow shirt and shorts, the circle on the right of the uniform was higher than the circle of the left to further disrupt information pick-up. This was to provide internal contrast with false alignment (Hall et al., 2013). The different playing uniforms are presented in Figure 2.

Insert Figure 2 here

Statistical analysis

Response accuracy (%) was measured by comparing the participants response on a trial to the location the ball crossed the line. Successful performance was recorded when the participant correctly predicted both the side and height of the penalty-kick. A percentage performance score was calculated for each uniform design and occlusion point for both skill groups. Confidence ratings of whether a participant's anticipatory judgment was correct were recorded after each shot. Mean ratings were calculated for each condition. Response accuracy and confidence ratings were analyzed using separate 2 group (skilled, less-skilled) x 3 uniform (control, zigzag, circle) x 3 occlusion point (-160 ms, -80 ms, ball contact) mixed design ANOVAs. Effect sizes were calculated using partial eta squared values (η_p^2). Significant effects were followed up using pair-wise comparisons. The alpha level for significance was set at 0.05. The Greenhouse-Geisser correction was applied when violations to sphericity were observed.

Results

Response accuracy (%)

There was a significant main effect for group, $F_{1, 22} = 116.19$, $p < 0.001$, $\eta_p^2 = 0.84$. The skilled group recorded significantly higher accuracy scores, compared to the less-skilled group, see Figure 3. There was a significant main effect for uniform, $F_{2, 44} = 14.53$, $p < 0.001$, $\eta_p^2 = 0.40$. Response accuracy was significantly higher in the control ($p < 0.001$) and circle ($p = 0.013$)

uniforms, compared to the zigzag uniform. There was a significant main effect for occlusion, $F_{2, 44} = 62.97$, $p < 0.001$, $\eta_p^2 = 0.74$. Response accuracy was significantly higher in the ball contact, compared to the -80 ms ($p < 0.001$) and -160 ms ($p < 0.001$) conditions. Response accuracy was also significantly higher in the -80 ms, compared to the -160 ms condition ($p < 0.001$).

There was a significant group x uniform interaction, $F_{2, 44} = 4.07$, $p = 0.024$, $\eta_p^2 = 0.16$. *Post hoc* testing revealed that while there were no significant differences in response accuracy between uniforms for the less-skilled group (all $p > 0.05$), the skilled group decreased their response accuracy significantly from control to zigzag ($p < 0.05$) and circle ($p < 0.05$) conditions. The response accuracy for the skilled group was also significantly higher in the circle, compared to the zigzag ($p < 0.05$) condition.

There was a significant group x occlusion interaction, $F_{2, 44} = 4.671$, $p = 0.014$, $\eta_p^2 = 0.18$. The less-skilled group significantly improved response accuracy from the -160 ms to -80 ms condition ($p < 0.05$), and from the -80 ms to the ball contact ($p < 0.05$) condition. However, although the skilled group improved their response accuracy from -80 ms to ball contact ($p < 0.05$), there was no significant difference between the -160 ms and -80 ms ($p > 0.05$) conditions. There were no significant uniform x occlusion ($F_{4, 88} = 2.42$, $p = 0.055$, $\eta_p^2 = 0.10$), or group x uniform x occlusion ($F_{4, 88} = 1.60$, $p > 0.05$, $\eta_p^2 = 0.07$) interactions.

Insert Figure 3 here

Confidence ratings

There was a significant main effect for group, $F_{1, 22} = 76.13$, $p < 0.001$, $\eta_p^2 = 0.78$. The skilled group recorded significantly higher confidence ratings, compared to the less-skilled group, see Figure 4. There was a significant main effect for uniform, $F_{2, 44} = 19.22$, $p < 0.001$, $\eta_p^2 = 0.47$. Confidence ratings were significantly higher in the control, compared to circle ($p = 0.019$) and zigzag uniform ($p < 0.001$). Ratings were also significantly higher in the circle uniform, compared to the zigzag uniform ($p = 0.014$). There was a significant main effect for occlusion, $F_{2, 44} = 68.85$, $p < 0.001$, $\eta_p^2 = 0.76$. Confidence ratings were significantly higher in the ball contact, compared to the -80 ms ($p < 0.001$) and -160 ($p < 0.001$) conditions. Confidence ratings were also significantly higher in the -80 ms, compared to the -160 ms condition ($p < 0.001$).

There was a significant group x uniform interaction, $F_{2, 44} = 4.97$, $p = 0.011$, $\eta_p^2 = 0.18$. There were no differences in confidence ratings between the uniforms for the less-skilled participants (all $p > 0.05$), whereas there was a significant decrease in confidence rating for the skilled group from the control ($p < 0.05$) and circle ($p < 0.05$) conditions to the zigzag condition. There was a significant group x uniform x occlusion interaction ($F_{4, 88} = 3.07$, $p = 0.020$, $\eta_p^2 = 0.12$). The skilled group reported significantly higher confidence ratings in all conditions, compared to the less-skilled group, apart from the zigzag uniform at the -80 ms occlusion point. There were no significant group x occlusion ($F_{2, 44} = 3.03$, $p = 0.058$, $\eta_p^2 = 0.12$) or uniform x occlusion ($F_{4, 88} = 2.37$, $p = 0.056$, $\eta_p^2 = 0.10$) interactions.

Insert Figure 4 here

Discussion

The aim of the current study was to identify skill-based differences in susceptibility to disguise. It was predicted that the skilled individuals would demonstrate superior performance, when compared to their less-skilled counterparts, irrespective of the manipulation of uniform design (Savelsbergh et al., 2005; Savelsbergh et al., 2002; Williams & Burwitz, 1993). It was also hypothesized that both groups would record higher response accuracy in the later, compared to the earlier, occlusion points (Smeeton & Williams, 2012). Due to the paucity of research on deceptive movement, we made no strong predictions on whether the uniform manipulations would have a greater impact on the performance of skilled or less-skilled individuals.

In line with previous research, the skilled individuals demonstrated significantly higher anticipation accuracy, compared to the less-skilled group, demonstrating construct validity for the test procedure. These data also support previous work (for a review see, Causer & Williams, 2013; Williams, Ward, Bell-Walker, & Ford, 2012), suggesting that skilled individuals have developed task-specific knowledge that helps them focus their attention on more pertinent areas of the display, making it easier to surmise situational probabilities from events previously experienced. These task-specific adaptations also enable the more effective processing of contextual information and experienced performers can use their superior knowledge base to dismiss highly improbable events and allocate attention to the most likely occurring events (Williams, 2009).

Despite the general expert advantage in anticipation, there were differences in the effects of the uniform manipulations between skill groups. The skilled group decreased their accuracy on both the circle and zigzag uniforms when compared to the control condition. This was also mirrored by the confidence rating for the skilled group, with lower confidence scores for the experimental uniforms designs. Although the response accuracy data followed a similar trend to the skilled group for the less-skilled group in the -160 and ball contact condition, there were no significant performance decrements in the experimental uniform conditions. These data suggest that the disguised uniform conditions had a negative effect on the skilled group, but not the less-skilled group. It appears that the zigzag and circle designs make it more difficult to anticipate penalty-kick outcome, presumably because they obscure the ability to pick up information from the vertical mid-line of the body and the orientation of the hips relative to the observer. There is evidence that skilled soccer players rely on information from the hip region, when making anticipation judgments (Smeeton & Williams, 2012), implying that this group would be more likely to be negatively impacted if information from this area of the body was disguised. However, it may be that the skilled individuals are fixating the hip region as a ‘visual pivot’, whereby they can optimize the use of the fovea and parafovea (Piras & Vickers, 2011). If this is the case, the disguised uniforms may be disrupting the relative motions or relationships between other information sources, such as the trunk and the non-kicking leg, both of which have been shown to contain information related to kicking direction and height (Williams & Burwitz, 1993; Williams & Davids, 1998).

The availability of information used to make anticipatory judgments changes throughout the movement. In support of our predictions and previous research (Farrow, Abernethy, & Jackson, 2005), higher accuracy for both groups was found in the later occlusion times, where players have more access to critical cues. However, the skilled group showed no difference in performance between the -160 ms and -80 ms occlusion points in the zigzag and circle conditions. These data suggest that the skilled individuals maybe trying to utilize postural information from the hip region around -80 ms before ball contact. As the information is disguised the skilled individuals cannot accurately or easily extract this information, leading to decreased performance and lower confidence ratings. These findings support work by Smeeton and Williams (2012), who found that deceptive kinematics at -80 ms before ball contact significantly reduced the anticipation accuracy of soccer players. Given that the accuracy of the skilled group dramatically increases in the ball contact occlusion point, it appears that the athletes are able to utilize other information later in the movement to accurately determine penalty-kick direction, whereas, in the -80 ms condition, they are reliant on the disguised hip information. These data may suggest that goalkeepers are able to pick up on evolving information and relevant cues as they become available (Dicks, Button, & Davids, 2010; Savelsbergh et al., 2005; Savelsbergh et al., 2010; Savelsbergh et al., 2002). It may be that if we provided non-veridical information of the non-kicking leg/foot at ball contact, then this may decrease accuracy in this condition.

The current dataset contradicts research that suggests that skilled athletes may be more robust to the effects of deception and disguise (Huys et

al., 2009; Huys et al., 2008), presumably because of their tendency to rely on more global rather than local sources of information (Jackson et al., 2006; Rowe et al., 2009; Williams et al., 2009). However, the current data suggests that the skilled individuals are still trying to use information from the hip region to make their anticipatory judgments in the deceptive uniform conditions. The fact that the decreases in performance were aligned with decreases in confidence rating for the skilled individuals shows that the deceptive uniforms did not lead to overconfidence in an incorrect anticipatory judgment, as in previous research (Smeeton & Williams, 2012). Rather, the skilled players were generally less confident about the outcome of the penalty-kick. This suggests that the experimental uniforms disguise critical information rather than provide deceptive information. Deception involves the presentation of misleading/false information rather than genuine cues with the aim of tricking an opponent into preparing for a different action to the one actually planned (Rowe et al., 2009). Instead, disguise simply makes the information more difficult to pick up, both reducing response accuracy and increasing response time. These findings corroborate previous research examining stimulus intensity of uniform designs, which showed that high-intensity uniforms enable individuals to pick up information quicker and more accurately compare to low-intensity uniforms (Causer et al., 2013). Decreasing the intensity/availability of the cues in the current study had a similar effect, leading to lower accuracy scores.

Findings from the current study show the potential impact uniform design can have on anticipatory judgments in temporally constrained environments. In future researchers should look to identify the specific

mechanisms by which anticipation is disrupted by patterns and shapes on uniforms. Despite the laboratory-based nature of this paper, the data has obvious applied implications regarding how coaches/athletes can increase the effective presentation of deceptive information. Conversely, coaches can use this knowledge to help design uniforms to increase the saliency of critical information to improve performance (Causer et al., 2013). Specifically, coaches could develop training aids that use uniform designs to highlight the important information in a particular action.

In summary, the current study demonstrates that although skilled athletes are better able to anticipate upcoming events based on postural cues, they are also susceptible to deceptive information, more so than less-skilled athletes. Furthermore, the data suggest that the time course of the availability of veridical and non-veridical information can be critical to the successful anticipation of upcoming actions. Our findings illustrate the practical utility of using manipulations to playing uniform design to make it harder for the perceiver to pick up the important information underpinning anticipation judgments. These data have implications for research on deception as well as coaches and athletes looking to gain an advantage over opponents.

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