# The role of colour when perceiving goalkeeper size

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## 1. Introduction

The perceived height of goalkeepers in football is influenced by a litany of factors that go beyond the physical distance indicated by the actual measuring tape. The process of seeing can play an especially important role in the psychological outcomes of any game of soccer and especially in terms of how certain players, namely the attackers, tend to plan their attempt to score a goal. The movements of a goalkeeper can also increase perceived stature in the same manner. A smaller goalkeeper who displays nimbleness and effectively defends the area of the goal may psychologically mislead viewers and opponents about his stature and actually impress them by his long arms and legs effectively punching the ball away from the opponents' strikes at the opposite goal resulting in an image of a huge figure being etched in the mind of any observer (Müller, 2018).This dynamic motion, besides portraying their athleticism, also emphasizes perceived status and control especially in the penalty area. Masters et al., (2010) demonstrated that regard for the action capabilities of a performer influences perceptual judgments of the size of that performer, which can be momentarily modified by performance outcomes.

A goalkeeper who commands the penalty area well and who has the nerve to order his defence around, appears more menacing. It is not only associated with the individual's physical size, but with the authority they hold over the other aspects of the game's defence. Interpersonal activities are responsible for a great personality which includes involving in the formulation of the team strategies on how better to defend itself and being able to keep calm in pressure filled situations. It is considered that a player with greater height has a direct physiological advantage in that a higher reach is important in penalty kicks and when the ball happens to be high up. However, their psychological effect may have a huge impact on the type and nature of the game. The tall build of a goalkeeper might have a psychological effect on other players by making them change their playing style. The feeling of intimidation makes the kicker have second thoughts when placing of the ball hence wasting good scoring opportunities or shooting with less force because of the doubt.

In other words, what an observer thinks of a particular goalkeeper's height is often reflecting the true height, the proportional distribution of the body mass, the level of kinetics and easiness to be dealt with, as well as the position and authority on the field of the goalkeeper that is in questions (Masters et al., 2010). Shim et al. (2014). These components thus all cumulatively

impact the perceived ‘size’ and threat of the goalkeeper in the eyes of the spectators as well as the psychological state of the counterparts.

Additionally, the role of gender in the perception of goalkeeper height is a significant factor. Research indicates that gender stereotypes and biases can influence how athletes are perceived, including their physical attributes and abilities (Koivula, 2001). Female goalkeepers, despite having similar physical capabilities to their male counterparts, might be perceived as less imposing due to societal biases. This perception can affect both the confidence of the goalkeeper and the strategy of opposing players. Conversely, male goalkeepers may benefit from a bias that exaggerates their physical presence and perceived competence. The interaction between the gender of the goalkeeper and the participant’s gender also plays a role. For instance, male participants might perceive male goalkeepers as more dominant and female goalkeepers as less threatening, while female participants might show varying responses based on their own experiences and internalized perceptions of gender roles in sports (Li et al., 2006). Understanding these dynamics is crucial for addressing gender biases and ensuring equitable recognition of skill and capability in sports.

### *1.1. Physical Advantages of a Tall Goalkeeper*

The height factor remains the most useful when it comes to a tall goalkeeper since it does not only affect the physical contact, but also the strategic and the psychological impact of a match. When height is considered as being the principal characteristic of a goalkeeper, which determines their physical abilities, the attribute already holds a certain undisputed advantage in terms of reach.

From the analysis of a goalkeeper’s body attributes, we can also deduce the following benefits from his height. The psychological implication to instil or evoke in each player from the two teams that are on different sides may be a crucial factor. This by itself is an intimidating factor when a gigantic figure dominates the area between the posts and aiming results in confusion and self-doubt of the attackers (Goldschmied et al., 2020). Due to their ability to oversee and organize the defence, along with their elevated position and commanding presence, the role of a goalkeeper is critical to the team’s defensive strategy.

### *1.2. Psychological Impact on Opponents*

In penalty shots, the physical bulk is a severe psychological hindrance to a goalkeeper’s opponent. Kickers often look at the goal prior to the penalty presently taken and the overall height of this target might cause the impression of a smaller goal to the spectator. The perceived

distance of the kick also appears to be smaller which means that there is a great deal of tension experienced by the person who must take the penalty (Tamè et al., 2022). The pressure of having a kicking role and expecting to score against a formidable and imposing opponent builds a psychological burden on the kicker's mind and the experience resulting from this pressure is over-analysis of the placement and as a result the kicker becomes hesitant in striking the ball or misplaces it due to the pressure of seeing little space left.

The influence is also vast in one-on-one situations and one can see that competitiveness is present in daily relations. When the attacker is advancing towards the opponent's goal and about to confront the goalkeeper, the presence of the big structure of the player hinders the attacker's field of vision. This presence is also an issue for the attacker in a methodical sense given that the amount of physical and perceptual ability to place a ball properly is limited. The increased height of goalkeepers enhances their performance by providing longer legs for improved leaping ability and longer arms for faster ground coverage. This puts pressure on the attacker and makes him/her make bad decisions resulting to aims that are shovelled or wonderful touches around the goalkeeper that are not goals.

The psychological effect does not stop at these encounters. How a player in the goal looks can affect an opponent in terms of their approach in the game with a tall and confident Goalkeeper the last thing an opponent wants is to face a shot from him. Each team may adjust its foremost tactics choosing distance shots or other more delicate actions which could be less effective but are considered important in overcoming advantages that the goalkeeper has in close encounters. This movement also can interrupt the regularity and the plan of movements of the opposite team, which means that it also can contribute to the team with the goalkeeper by reducing the pace and the quality of attacks to the goal.

This pressure influences the overall confrontation of the match because a player feels psychologically uncomfortable when facing a tall goalkeeper. In addition to the physical contest of the duel for the ball, the mere stature of goalkeepers creates psychological tension and diversion to the opponent throughout the match. Thus, the psychological advantage that this mental edge affords is a functional resource; it enhances the goalkeeper's performance while also increasing the team morale because of the feeling of safety.

### *1.3. Height and Psychological Warfare*

Tallness also brings extra physical strength in protecting the goalpost but also a weapon in psyching out fellow footballers on the pitch. Taller goalkeepers can use various techniques to

intimidate and thus attempt to influence the opponent mainly in critical moments of the match. These strategies other than mere physical projection by use of strategic gestures that enhance their hooliganism character and studying actions with the objective of disrupting concentration of the rival player.

The various studies done on goalkeepers' behaviour during penalty kicks, researchers have looked at the positioning of goalkeepers such as off-centre positioning and movement such as arm extension and goal line pacing (Pereira & Patching, 2021; Weigelt et al., 2012; Weigelt & Memmert, 2012). Although such strategies may affect the penalty kicker's decision-making, the main goal of such actions may not be limited to generating ambiguity over where to aim for the shot. Thus, these actions might have several functions like psychological pressure to demoralize the kicker to distract him/her to spoil their concentration and decrease their preparedness rate to kick, thus improving the goals placer's possibility to make a save Müller et al. (2018).

Tall players especially goalkeepers might be able to shorten the distance of contact by applying their long legs and arms when nearer to the attacker. Thus, they reduce the possible trajectory for the attacker's movement and the time he or she has within which to take a shot, thereby forcing the foe to make quicker, less precise moves. This proactive strategy not only challenges the opponent's shot physically, but also creates a mental strain on the attacker and disrupts his psychological wellbeing. Strategic positioning serves as another psychological tactic. Tall goalkeepers often position themselves towards the back of the goal, leading attackers to perceive more open space to shoot. However, this positioning actually minimizes the goal's apparent size, subtly influencing the attackers' visual perception and decision-making. Based on this, the weakest areas of the goal have been determined to be its farther edges because these are the hardest areas to hit accurately; the attacker therefore will have a high likelihood of missing the target.

The psychological authority can be boosted by the communication approach of a goalkeeper with a tall structure. The goalkeeper can also self-organise loudly and with confidence, asserting the committal to the patterns that limits the opposition team's play potential. The loud behaviour of the goalkeeper can add to their physical presence, thus stressing on the key role of the players in the defensive strategy. The psychological war strategies include the overall interaction of the tall goalkeeper with the referees and other players. Because the opponents will respect them due to the manner, they appear to be commanding both off and, on the field,

sometimes loose decisions can just be softly influenced especially during corner kicks and penalty scrambles.

*1.4. Physiological impact of uniform colours on players*

Colours, with specific reference to red, have been established to cause drastic positive changes on expectations of aggression and dominance ((Jonauskaite et al., 2020; Walters et al., 1982Wiedemann et al., 2010). The impact of these colour associations is particularly evident in how male spectators view fellow male athletes: Therefore, some colours may direct mental preparedness and aggression, which can translate into performance results. Such colours may influence the concept of the psychosocial priming effect which makes athletes ready for the game by increasing the adrenaline hormone levels and overall spirit of competitiveness.

The uniform colour might impact cognitive impressions including sizing up the enemy and judging how threatening or big they are, which makes athletes think that those in red are more threatening and dominant. This perception could lead to strategic changes taking place or alter the confidence levels of athletes while in competitions. Studying these dynamics opens an opportunity to understand how even such a seemingly insignificant aspect as the choice of colour influences changes in the perception of athletes by others as well as the athletes' behaviour and attitudes during the sports competition. From this context, it is possible to expand the analysis of colour psychology in sports to findings regarding its impact on behaviour, strategies, and performance (Tedford et al., 1977).

*1.5. Overview of Relevant Research*

When considering the psychological discoveries there is evidence that explains colour as a phenomenon that works covertly yet has an effect on people's behaviour. Greenlees et al. (2013) described the extant literature that has explored personality effects on athletic success and population-based differences before hypothesising how sport participation may contribute to personality development. Author stated that personality is an important determinant of long-term success in sport and identifies clear personality differences between individuals that participate in organized sport and individuals that do not participate in organized sport. They also observe important personality differences between sub-samples of athletes and outline the contribution of personality to intragroup relationships and team effectiveness in team sport. The interaction of genetic and environmental influences is presented as a promising avenue of inquiry that can strengthen our understanding of personality effects on sport and exercise

participation and athletic success. They conclude by outlining implications for applied sport psychology.

Continuing the discussion on the choice of the colour of sportswear, Attrill et al. (2008) agree that the English football squads in team games have fared admirably when wearing red as statistics showed that they win more, particularly when at 'home', probably since red offers a psychological or visual advantage which is credited for the colour. Subsequently, Allen and Jones (2012) examined over 7700 matches from the English Premier League and found that red-shirted teams substantially performed comparatively better at home, although the home advantage is not increased when the spectators' home side competence is included. These studies, thus, point at a very intricate social interaction of colour with peoples' psychological conditions as well as influence on the group behaviour including the matter of competitiveness in sport; hence, it can be stated that the role of colours is a rather multifarious factor in affective modulation of various aspects of people's lives.

Speaking of the sphere of colour psychology, scholars have strived to describe as far as possible how such colours as red, blue, and green influence people psychologically. The last characteristic to highlight was that, due to sexuality, which means that compared to other people's preferences of colour, red was preferred by those men and women of 17 – 23 years old because it demonstrated domination and was sexually stimulating as identified by Briki and Hue (2016). This paper endeavours to provide insights on how colour influences the disposition of the psychological facet. Accordingly, Hill and Barton (2005) researched on use of red in animal species in respect of indication of masculinity and quality and arrived at the conclusion that it might be similar to that in case of human beings and mentioned that athletes prefer red colours more frequently, on average, at the rate of higher success and on that basis, invoking the theory of 'biological mentality,' declared that red colour has biological factor in terms of competition. In a second level of consulting the presence of colour in sport, there is a systematic review by Elliot (2019) who organized from the behaviour of colour where they also use analytical methodology such as the PRISMA guidelines and other p-curve analysis to affirm on the existing data base Elliot (2019). Given the fact that colour has certain implications especially in the red and blue resigned on the achievement of the sports teams, revealed a significant effectiveness of colours in the results of the sporting activities.

Regarding the historical and modern movement of the sports psychology, the hue of the athlete's garment has very much become a factor of concern and analysis. It is important to

note that the previously stated bias revealing the referee in focus showing more preferences towards judo athletes wearing blue uniform more than the white ones was also checked by Dijkstra et al. (2018) with the help of large sample of international judo competitions of different years. They failed to establish the proximity between a team in a uniform of one hue to success, thus disputing the previous studies and emphasizing the use of a big data base to negate other variables. However, Dreiskaemper et al. (2005) investigated colour before combat fights among sportsmen, which experienced raise heart rate pre-combat and strength and thereby the authors demonstrated that colour affects the indices under conditions of risk. Altogether, these papers present a picture of how even the least of these – the colour and feedback – affects the athletic performance and their mentalities, which clearly demonstrate how intensive the perception, physiological and behavioural interaction is in competitive arenas.

Usually, colour as a combination or colours as stimuli affects people's perceptions and actions during sporting events. More recently, some researchers have seen it constructive to analyse uniform choice based on colour in relation to competitors. Webster et al. (2012) tried to focus on the efforts of seeking the aggressive penalties due to colour of both the National Hockey League's teams wear and offenders through 25 seasons and over 52,000 games databases. They realized that the teams in black uniforms were receiving more penalties, and it is usual to think that darkness leads to aggression and the white-uniform teams received fewer penalties and it is assumed that it is difficult to be aggressive in light colours. On the other hand, Krenn, (2015) even more explained the subjectivity of people aggressiveness and fairness concerning the combat sport as boxing, Taekwondo and Wrestling which were addressed. In some of the experiments, Krenn, (2013) altered the colour of the athletes' vests in the photograph and observed that if the athletes were depicted wearing red, they were considered more likely to be aggressive and likely to win in boxing and wrestling matches compared to other athletes; however, green clad athletes were considered fair ones. However, it can be pointed out that no colour impacts were particularly seen in the case of Taekwondo. Taken collectively, these works contribute to the cultivation of the knowledge about the influence of colour on the perceived level of the teams' and players' aggressiveness, as well as on the hike of the actual penalties in the sport settings atop of highlighting the role of the visual cues.

Goldschmied et al. (2020) launched an extensive investigation to reveal the impact of uniform colours on sports performance. They systematically reconsidered 33 studies: using Elliot and Maier's (2007) colour in-context theory. It was their intention to synchronize and define how

and how not into detail the colour perspective filter affects not only the physical performance of an athlete but also the psychological condition of athletes which was a major achievement to distinguish the performances from the perceptive effects. Similarly, Feltman and Elliot (2011) also chose the psychological perspective to exploration regarding the role of the colour red for the impressions about the dominance and threat in sports. They concluded that both options – wearing red and observing an opponent dressed in red – led to a change in psychology and an increase in the indicated parameters; this was true in both cases regardless of the gender of the person who observed an opponent. This bidirectional effect stood for a tremendous impact of colours which consciously and unconsciously conditioned the players involved in the contests, as well as the spectators.

Gentilucci et al. (2001) continued the analysis of the psychological aspects of colour and studied its physical impact, namely, the impact on motor coordination in sports. That is, while receiving stimuli of red targets athletes open a larger gap by their fingers when grasping targets in comparison with green targets; all this evidence gives examples of how the colour chromaticity and lightness can influence the execution of physical movements in sports activities directly. Building another level of interference in colour's influence in sports, Müller et al. (2018) analyse how perceived stature and reputation of the goalkeeper as well as his/her predominantly coloured uniform of choice influences the shooting precision of a penalty taker in soccer games. Goalkeepers in their research believed they must be tall or look more respectable because of their attire made penalty takers shoot less accurately. This phenomenon brought out the fact that psychological aspects such as colour boosts can be used in the protraction of games to clinch victory.

Furthering this analysis of colour's utilization in this manner, Piatti et al. (2012) researched thirty years' worth of Australian Rugby League games to discover if teams who wore red had a large advantage. Nevertheless, their findings indicated that the colour red had effect which is why sport teams wearing the colour red had a higher probability of winning, although this relationship could only be generalized if more literature reviews took into consideration the range of factors that can affect sporting results. Extending this analysis of colour's use in this way, Piatti et al. (2012) sought to examine whether Australian Rugby League sides enjoying a huge advantage were the teams who wore red. Despite this, they noted that the colour red had an appealing effect which is why the sport teams that wore the colour red had the tendency of winning more than the other teams; though, the authors pointed out that such relationship could

only be generalized provided that other literature reviews noted that there are several factors that influenced sporting outcomes.

In a more extensive perspective, Johnson et al. (2010) stressed the need for adopting a systematic model of athletes' development by considering factors such as genetic endowment, environment, and psychological variables. Their work stressed the multidimensionality of athlete performance that is determined by several factors which cannot be regarded as strictly related to the sports arena and activity. Finally, Wiedemann et al. (2015) continued the talk about the interaction of colour to non-aggressive conditions, revealing how red uniform influence the perceptions of aggression and dominance. Their research demonstrated that the color red not only affects perceptions of aggression and dominance but also significantly impacts emotions, altering the nature of interactions both on and off the sporting field.

Collectively, these papers build a complex history of how colour has an effect in different aspects of sports ranging from mentality perceptions, physical activity performance, to countering game strategies; an indication of how deep and wide the impact of colour runs in the sports field. Hence, experiment one was designed to examine effect of uniform colour on size perception.

### *1.6. Hypothesis of the study*

**Hypothesis 1:** Goalkeepers wearing red, yellow, and black uniforms will be perceived more effective in comparison to those wearing blue or green uniforms.

**Hypothesis**: Uniform color significantly influences the perceived size of goalkeepers, and this effect varies depending on the goalkeeper's gender and the participant's gender.

## 2. Methodology for Experiment 1

### *2.1 Participants*

Twenty-five participants were recruited for Experiment 1, but two participants reported colour blindness. Therefore, 23 participants were analysed ($M_{age}$ = 20.87 years, SD = 3.05, 11 males,12 females). Five participants indicated football as their primary sport, and one reported to be left-handed. Ethical approval for the study was provided by the University of Human Research Ethics Committee and informed consent was obtained from all participants.

*2.2. Experimental Design and Procedure*

To examine the effect of uniform colour on size perception, participants were asked to estimate the height of the goalkeeper relative to the ball on a vertical line. Participants were shown a series of images with a goalkeeper standing either on the left or right side of the screen (left, right counterbalanced). The images were projected onto a plain white wall. The goalkeeper was standing in a neutral position (i.e., legs spread shoulder-width) with his/her arms in a ready position (i.e., both hands in front of the chest), and a football was placed between their feet (see figure 1). The gender of the goalkeeper (male, female) and the colour of the uniform (red, yellow, green, blue, black) varied. The colour of the uniform was altered using GIMP software (GNU Image Manipulation Program). Only the hue of the colour was altered while saturation and value were equated on the HSV (hue, saturation, value) model for red (0, 100, 100), yellow (55.5, 100, 100), green (120, 100, 100), and blue (235.5, 100, 100). The HSV value for black was 0, 0, 0. The male goalkeepers were sized to be approximately 186 cm tall, and the female goalkeepers were sized to be approximately 166 cm tall relative to the ball. There were 20 trials in total, randomly mixed.

**Figure. 1 Goalkeeper neutral position**

Participants were tested in a group of five to seven people. Each participant was given a response booklet. On the cover of the booklet, participants provided their basic demographics (i.e., age, gender, handedness, primary sport). Once everyone in the group completed the demographics, they were instructed to flip one page. On the left side, there was a trial number (e.g., Trial 1) and, on the right side, the top half of the perpendicular line with a football at the point of interaction was shown (see figure 2). Participants were asked to view the image of the goalkeeper projected on to the wall and estimate the height of the goalkeeper by putting a mark on the vertical line. We waited until everyone completed the size estimation before moving onto the next trial. On the last page of the booklet, participants answered two funnel debrief questions that probed for awareness of the purpose of the experiment (e.g., "What did you think this experiment was about?") and, if colour was mentioned, queried for specifics (e.g., "What do you think was our hypothesis for this experiment?"). This method was adapted from Elliot et al. (2007) to ensure there was no bias in size estimation based on previous knowledge about colour-size perception. Participants also indicated which colour their national teams wore (e.g., "What colour do you identify with national identity [i.e., All Blacks]), colour blindness (yes or no) and, if reported colour blindness, which colour they cannot see.

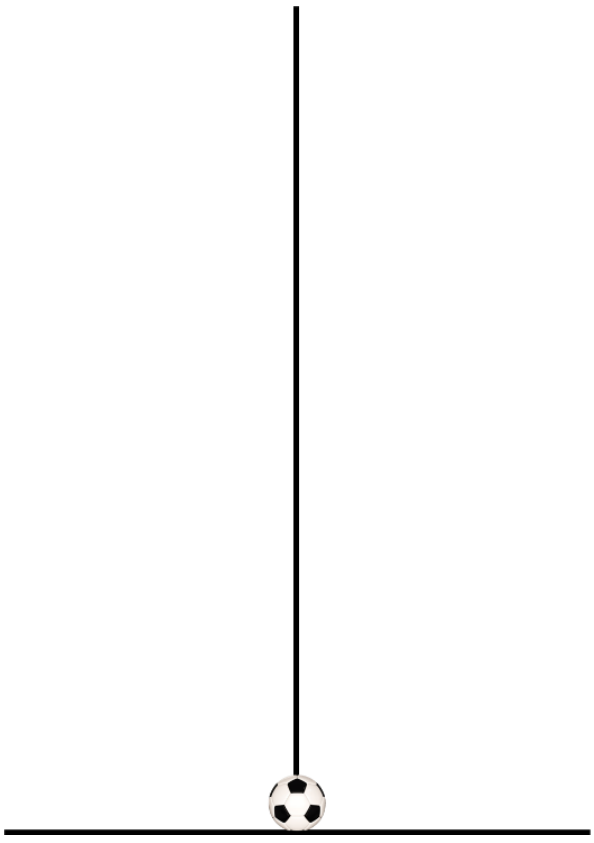

**Figure .2 Goalkeeper size estimation sheet**

*2.3. Data Analysis*

As a dependent measure, we calculated the difference between the actual size of the goalkeeper and the estimated size of the goalkeeper:

$$\text{Height estimation relative to actual size (\%)} = \frac{\text{Estimated size} - \text{Actual size}}{\text{Acutal size}} \times 100 \quad (1)$$

Positive values indicate that the participants overestimated the size of the goalkeeper. Negative values indicate that the participants underestimated the size of the goalkeeper. Using a 2 (Goalkeeper's gender) × 5 (Uniform colour) × 2 (Participant's gender) repeated measures ANOVA, the main effects and interaction effects of the variables were determined for Experiment 1. Any significant results of ANOVA were followed using Fisher's Least Significant Difference (LSD) test. Statistical significance was set at $p < 0.05$.

## 3. Results of Experiment 1

There was a significant main effect of Goalkeeper's gender, $F(1, 21) = 42.590$, $p < 0.001$, $\eta_p^2 = 0.670$. Male goalkeepers were estimated to be 10.3% larger than their actual size whereas female goalkeepers were estimated to be 1.0% larger than their actual size ($p < 0.001$, see Figure 3).

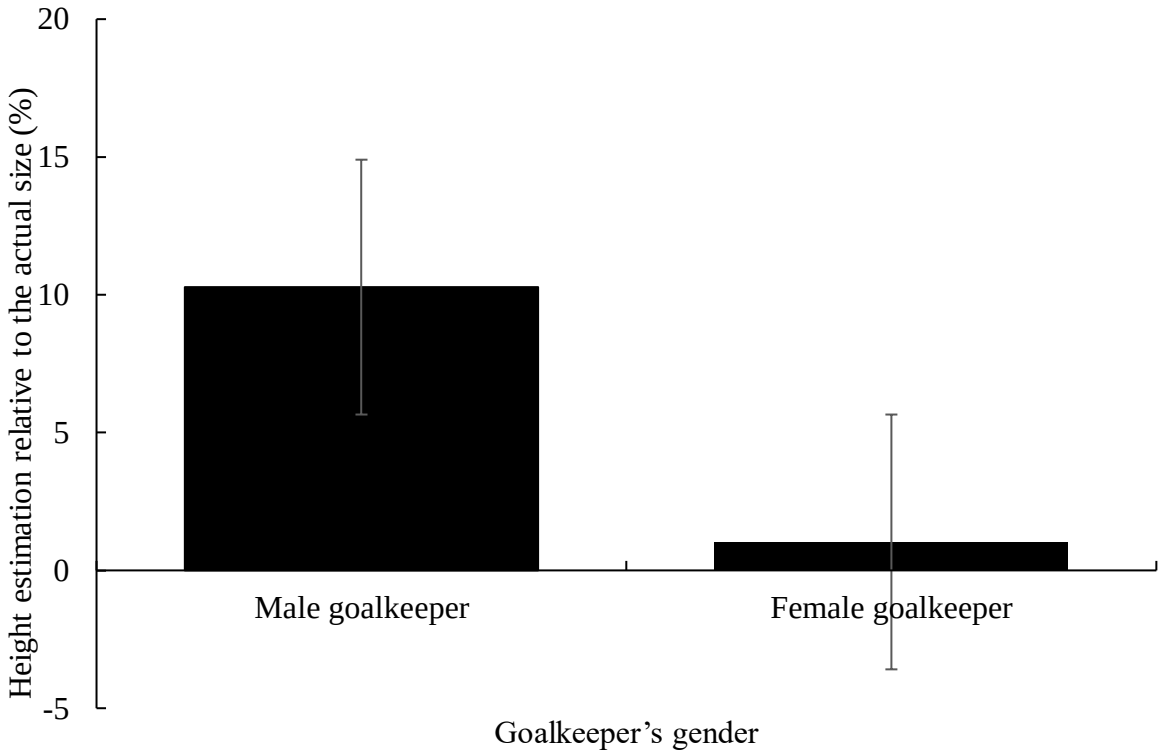


**Figure 3. Height estimation relative to the actual size (%) by Goalkeeper's gender.**

There was a significant main effect of uniform colour, F (4, 84) = 3.051, $p = 0.021$, $\eta_p^2 = 0.127$. Follow-up analysis using Fisher's LSD test showed that goalkeepers in a red uniform were estimated to be larger than goalkeepers in blue ($p = 0.008$) and goalkeepers in yellow were estimated to be larger than goalkeepers in blue ($p = 0.042$, see Figure 3). There was an approaching significance when comparing goalkeepers in red uniform and green uniform ($p = 0.061$). There was no significant difference in size estimation between goalkeepers wearing uniforms of other colours ($p > 0.050$).

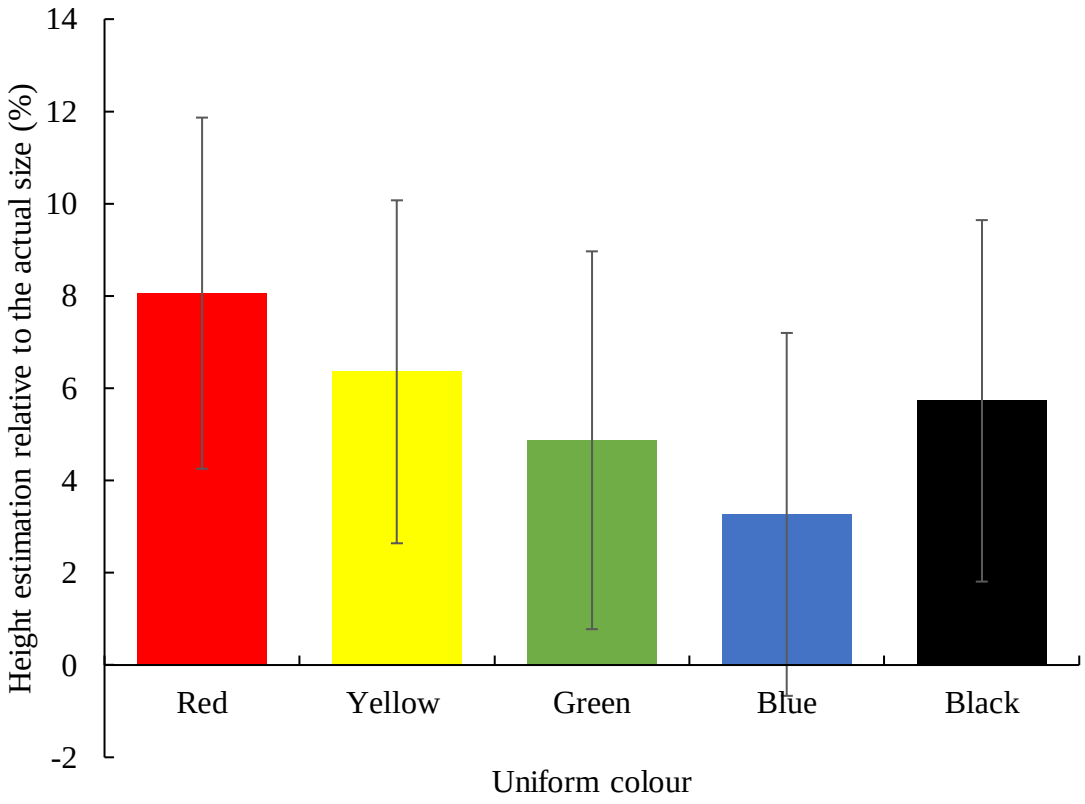


**Figure 4. Height estimation relative to the actual size (%) by Uniform colour.**

There was no significant main effect of Participant's gender, F (1, 21) < 0.001, $p = 0.987$, $\eta_p^2 < 0.001$, indicating that there was no difference in size estimation between male and female participants. There were no significant interactions between Goalkeeper's gender and Participant's gender, F(1, 21) = 0.144, $p = 0.708$, $\eta_p^2 = 0.007$, Goalkeeper's gender and Uniform colour, F(4, 84) = 1.455, $p = 0.223$, $\eta_p^2 = 0.065$, nor Uniform colour and Participant's gender, F(4, 84) = 0.804, $p = 0.526$, $\eta_p^2 = 0.037$. There was no significant three-way interaction, F (4, 84) = 1.683, $p = 0.162$, $\eta_p^2 = 0.074$.

### 4. Discussion of Experiment 1

In the initial experiment of our study, we observed that goalkeeper gender significantly influenced size perception, with male goalkeepers perceived as larger than female ones. This aligns with the common psychological association of males with greater physical size and presence, a factor that could influence decision-making in sports, as discussed by Goldschmied et al. (2020). The significant effect of uniform colour, particularly red and yellow, on perceived size provides intriguing insights. Goalkeepers wearing red were perceived as larger compared

to those in blue, reinforcing the idea that red might enhance perceptions of dominance and threat in competitive settings, as indicated in previous studies like those by Wiedemann et al. (2015) and Piatti et al. (2012). The similar, though less pronounced, effect observed with yellow uniforms suggests that bright colours more broadly may impact perceptions of size and presence.

## 5. Experiment 2

Experiment 2 was designed to improve the methodology of Experiment 1. In Experiment 1, some participants would peer into other's response booklets or rush their response so that they were not delaying the group behind. Therefore, Experiment 2 was conducted one-on-one in person in an attempt to decrease the influence of other's response on the participant's response and increase participant's attention to the task.

Methods

### *5.1. Participants*

In Experiment 2, 88 participants were recruited, but we excluded one participant because he/she correctly guessed the hypothesis of our study. No colour blindness was reported. Therefore, 87 participants were analysed for Experiment 2 ($M_{age}$ = 21.03 years, SD = 5.273, 41 males, 46 females). Twenty-five participants indicated football as their primary sport and eight reported to be left-handed. Ethical approval for the study was provided by the University of Human Research Ethics Committee and informed consent was obtained from all participants.

### *5.2. Experimental Design and Procedure*

Like Experiment 1, participants were asked to estimate the height of the goalkeeper relative to the ball on a vertical line. Participants were shown a series of images with a goalkeeper standing either on the right or left side of the screen (right, left counterbalanced). The images were displayed on an Acer Gateaway NE46Rs 14-inch screen. To maintain consistency, the same laptop was used throughout the experiment. The goalkeeper was standing in a neutral position (i.e., legs spread shoulder-width) with his/her arms in a ready position (i.e., both hands in front of the chest), and a football was placed in between their feet. Unlike Experiment 1, the height of the male goalkeepers and female goalkeepers were sized to be the same (186 cm tall relative to the ball). The colour of the uniforms was identical to Experiment 1 (red, yellow, green, blue,

black). There were 20 trials in total, randomly mixed four times to create four sets (Set 1, 2, 3, 4), which was administered in order.

Participants were tested alone. Each participant was given a response booklet. On the cover of the booklet, participants provided their basic demographics (i.e., age, gender, handedness, main sport). Once they complete the demographics, they were instructed to flip one page. On the left side, the top half of the perpendicular line with a football ball at the point of interaction was shown. On the right side, the trial number was shown (e.g., Trial 1). We purposely switched the placement of the response sheet and trial number to minimize copying of the answer from the previous trial. If the response sheet was placed on the right side, it may leave an indentation mark on the next page, which can bias responses, especially given that the goalkeeper's height was the same throughout all the trials. Participants were asked to view the image of the goalkeeper projected onto the laptop screen and estimate the height of the goalkeeper by putting a mark on the vertical line. Participants were given maximum 20 seconds per trial to respond. On the last page of the booklet, participants answered two funnel debrief questions that probed their awareness of the purpose of the experiment (e.g., "What did you think this experiment was about?") and, if colour was mentioned, queried for specifics (e.g., "What do you think was our hypothesis for this experiment?"). This method was adapted from Elliot et al. (2007) to ensure there was no bias in size estimation based on previous knowledge about colour-size perception. Participants also indicated which colour their national teams wore (e.g., "What colour do you identify with national identity [i.e., All Blacks]), colour blindness (yes or no) and, if reported colour blindness, which colour they cannot see.

*5.3 Data Analysis*

We calculated the difference between the actual size of the goalkeeper and the estimated size of the goalkeeper using the same equation in Experiment 1 (see Equation 1). Positive values indicate that the participants overestimated the size of the goalkeeper. Negative values indicate that the participants underestimated the size of the goalkeeper. We also conducted a 2 (Goalkeeper's gender) × 5 (Uniform colour) × 2 (Participant's gender) three-way ANOVA. Any significant results of ANOVA were followed using Fisher's Least Significant Difference (LSD) test. Statistical significance was set at $p < 0.05$.

## 6. Result of Experiment 2

There was a main effect of Goalkeeper's gender, F (1, 85) = 263.748, $p < 0.001$, $\eta_p^2 = 0.765$. Male goalkeepers were estimated to be larger than female goalkeepers with a mean difference of 10.480 (SE = 0.645, $p < 0.001$, 95% CI [9.197, 11.763]). Male goalkeepers were perceived to be 16.8% larger than their actual size, while female goalkeepers were perceived to be 6.3% larger than their actual size (see Figure 5). There was no main effect of Uniform colour, F (4, 340) = 1.205, $p = 0.308$, $\eta_p^2 = 0.014$, and no main effect of the Participant's gender, F (1, 85) = 0.289, $p = 0.592$, $\eta_p^2 = 0.003$.

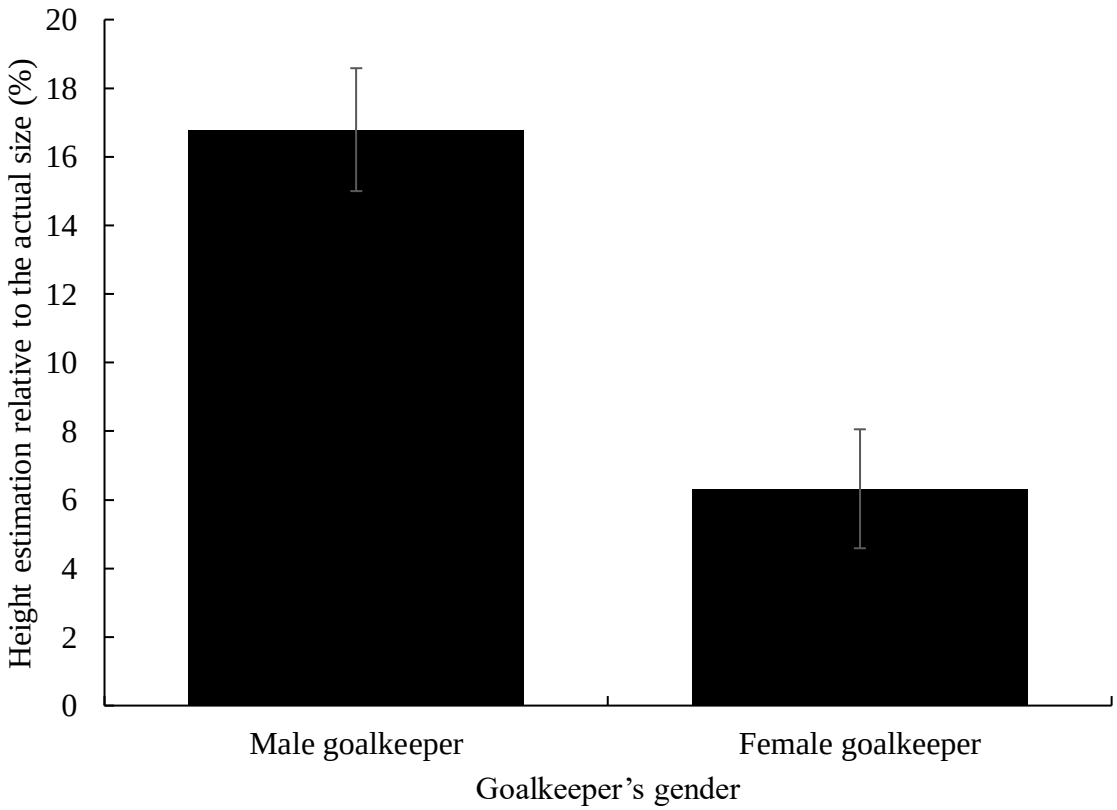


**Figure 5. Height estimation relative to the actual size (%) by Goalkeeper's gender.**

In terms of interactions, a significant interaction was found between the Goalkeeper's gender and the Participant's gender, F(1, 85) = 8.593, $p = 0.004$, $\eta_p^2 = 0.092$. Male participants estimated male goalkeepers to be larger than female goalkeepers, with a mean difference of 8.588 (SE = 0.938, $p < 0.001$, 95% CI [6.722, 10.454]). Female participants also estimated male goalkeepers to be larger than female goalkeepers, with a mean difference of 12.372 (SE = 0.886, $p < 0.001$, 95% CI [10.610, 14.133]). Specifically, male participants estimated male

goalkeepers to be 14.9% larger and female goalkeepers to be 6.3% larger than their actual size, while female participants estimated male goalkeepers to be 18.7% larger and female goalkeepers to be 6.3% larger than their actual size (see Figure 6).

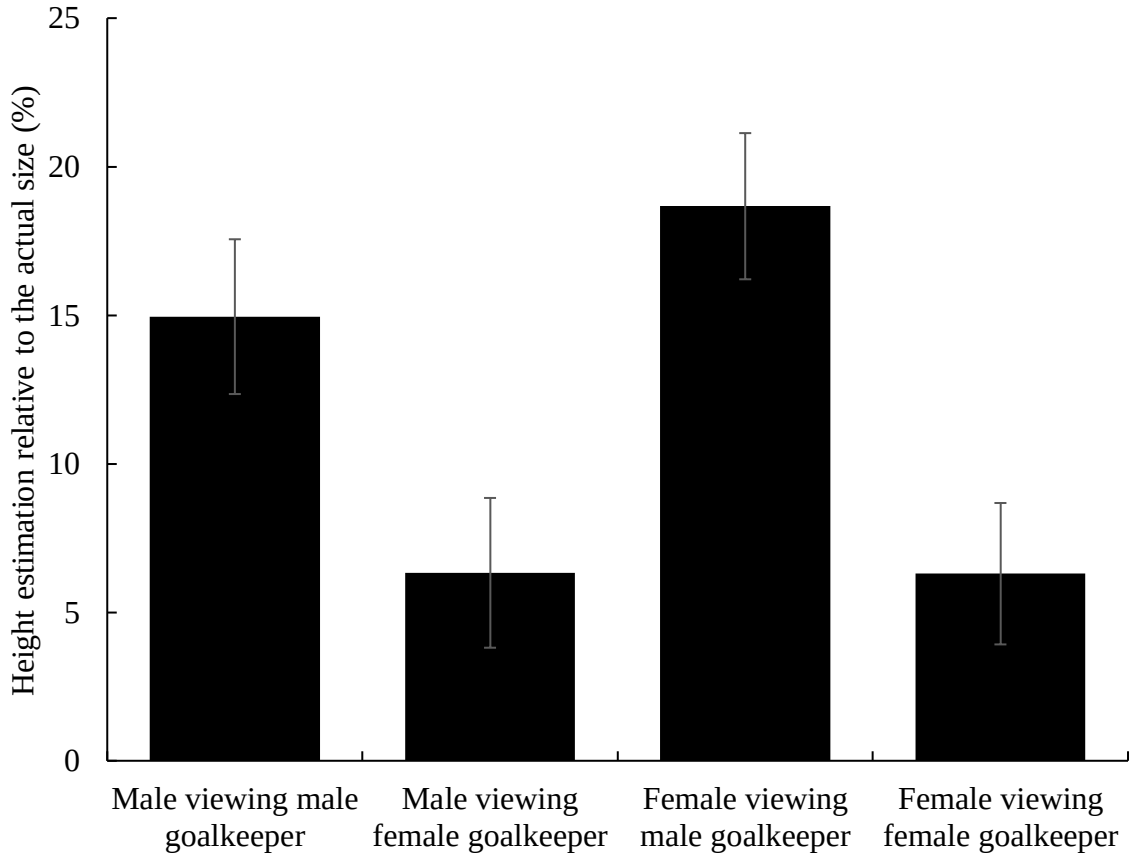


**Figure 6. Height estimation relative to the actual size (%) by Observer Goalkeeper gender.**

No significant interactions were found between Uniform colour and Participant's gender, $F(4, 340) = 1.149$, $p = 0.333$, $\eta_p^2 = 0.013$, or between Goalkeeper's gender and Uniform colour, $F(4, 340) = 0.694$, $p = 0.597$, $\eta_p^2 = 0.008$. There was no significant three-way interaction between Goalkeeper's gender, Uniform colour, and Participant's gender, $F(4, 340) = 1.733$, $p = 0.142$, $\eta_p^2 = 0.020$.

## 7. Discussion of Experiment 2

In the second experiment of the present study, there were main effects and interactions with respect to goalkeeper gender, uniform colour, and participants' gender. More importantly, an effect of goalkeeper gender was evident for size estimation in which male goalkeepers were rated as significantly larger than the female ones. This is in concordance with the Wiedemann

et al. (2015) who observed that aggressive impressions could be eroded based on visual epics like the clothes colour; however in the present study, the size aspect of the colour was related to the general perceived size even though Uniform colour, which was manipulated as a between-participants independent variable, had no main effect on size estimation different from the study conducted by Piatti et al. (2012) which suggested that the colour red enhances performance on tasks relevant for sports, it means that the effect of colour can be contingent on the circumstance or when it is not inclusive of other features of competition like results. This may also mean that, unlike size estimates, uniform colour affects performance in sports as shown by Goldschmied et al. (2020).

The significant interaction of the size estimation of goalkeepers between the gender of the goalkeepers and the gender of the participants as both male and female gauged males' goalkeepers to be larger, could be explained by this general psychological research on stereotype theory (Radvansky et al., 2010). Unfortunately, this study has to some extent confirmed the conclusions of Müller et al. (2018) when the goalkeepers' perceived reputation due to gender stereotype biases impacted the direction of the penalty shots. Lack of interaction such as facilitating uniform colour and other or lack or any study that showed three-way interaction indicates that there could be overpowering factors of the controllable factors highlighted in prior studies such as that of Gentilucci et al. (2001) where it was noted that uniform colour defended preference for size.

## 8. Conclusion

The research undertaken in this study primarily aimed to investigate how the colour of goalkeepers' uniforms influences perceptions regarding their size and effectiveness in sports settings. Building upon existing literature, the study sought to deepen our understanding of the psychological impact that colour can have on the way athletes are viewed by others, particularly in highly competitive environments like sports. By focusing on specific colours—red, yellow, blue, green, and black—the research explored whether certain colours enhanced the perception of goalkeepers as being larger and more intimidating compared to others. The study reveals that uniform colour significantly affects psychological perceptions of size, with red and yellow colours increasing male goalkeepers' perceived size. This highlights the potential of uniform colour as a subtle yet impactful psychological tool in competitive sports.

Key findings from the study highlighted significant effects of uniform colour on perceived goalkeeper size. Notably, goalkeepers wearing black, red or yellow uniforms were consistently estimated to be larger than those wearing blue or green. This suggests that warmer colours might carry visual or psychological cues that enhance perceptions of size and presence, potentially affecting opponent's perceptions and behaviours during competitions. Moreover, the study found a pronounced effect of the goalkeeper's gender on size perception. Male goalkeepers were perceived to be substantially larger than female goalkeepers, irrespective of the uniform colour they wore. This gender difference in perception could reflect underlying biases in how athletic capabilities are viewed across genders.

The implications of these findings are multifaceted. From a theoretical standpoint, they contribute to the growing body of knowledge on colour psychology in sports, suggesting that colour not only has a psychological impact but also alters perceptions of physical attributes like size. Practically, these insights could be instrumental for sports team management and kit designers in considering how uniform colours could strategically influence game dynamics. Choosing certain colours could potentially offer teams a non-verbal, psychological advantage over their competitors by altering how players are perceived by opponents and spectators alike. However, it is crucial to acknowledge the limitations of this study, which include a relatively small sample size and the inclusion of only a handful of colour choices. These factors may limit the generalizability of the findings across different sports and cultural contexts.

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