The effectiveness of penalty takers’ deception: A scoping review

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ABSTRACT

Attacks are supposed to take advantage of producing deceptive actions in competitive ball sports, particularly in penalty situations. We conducted a scoping review of the experimental literature to scrutinize whether penalty takers do indeed benefit from using deceptive actions in penalty situations, especially by increasing the likelihood to score a goal. Studies using video-based and in-situ tasks in which soccer and handball goalkeepers try to save a penalty were evaluated. Results showed that penalty takers’ manipulation of spatial information available to the goalkeeper during deception (i.e., by using misleading and/or disguising actions) is less effective in in-situ than video-based studies. We argue that this difference occurs because goalkeepers adapt differently to the spatiotemporal constraints in the video-based and in-situ tasks. Goalkeepers appear to prioritize picking up spatial information in video-based tasks while prioritizing temporal information in in-situ tasks. Therefore, the manipulation of spatial information appears to be less effective in the more representative in-situ studies than in video-based studies. In order to deceive, penalty takers are advised to manipulate temporal information during on-field penalty situations.

1. Introduction

In many competitive (ball) sports, it is common for performers to make certain actions with the intention to deceive opponents. Grounded in an ecological approach, we consider a deceptive action as an attempt to actively manipulate the information that is available to the opponent, that is, to provide false affordances or possibilities for action (Ramsey, Dicks, Hope, & Reddy, 2022). In the literature, several types of deceptive actions are typically discerned, including disguise, misleading, and distraction (Guldenpenning, Kunde, & Weigelt, 2017). Disguise refers to a deceptive action in which the athlete hides information about the intended action (Helm, Munzert, & Troje, 2017). For example, in a penalty throw in handball, a thrower may mimic an actual throw without releasing the ball, or a penalty taker in soccer may wear printed clothing to mask information generated by the movements of the hip that can tell about the direction of the upcoming ball flight (Causer, Smeeton, & Williams, 2017; Causer & Williams, 2015). Goalkeepers are then forced to either wait long (i.e., until close to ball release or contact) to pick up reliable information (Helm et al., 2017; Ramsey et al., 2022) or to use the less reliable (i.e., more ambiguous) information of the possibilities for action compared to penalties without disguise.

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(Jackson & Cañal-Brulard, 2019). Misleading involves deceptive actions in which athletes provide opponents with wrong, non-aligned information about the possibilities for action (Ramsey et al., 2022). Penalty takers in soccer can act, for instance, by varying run-up angle or gaze direction, as if to aim to one side of the goal, while they intend to shoot to the other side (Dicks, Davids, & Button, 2010). Finally, distraction refers to actions that (re-)direct the attention of opponents from task-relevant, specifying information toward less relevant, non-specifying information (Furley, Noel, & Memmert, 2017). In penalty situations, distraction is typically studied through the actions of goalkeepers rather than penalty takers (e.g., Navarro, van der Kamp, Ranvaud, & Savelbergh, 2013; Wood & Wilson, 2010; Furley et al., 2017). For example, a soccer goalkeeper may wave their arms to redirect attention away from information about the target and/or ball (Wood & Wilson, 2010). The current scoping review focuses on disguise and misleading actions and addresses goalkeepers’ susceptibility to these actions in penalty situations. In particular, we review the empirical evidence, which can inform whether deceptive actions enhance the success of penalty takers (and thus degrade performance of goalkeepers).

In penalty situations, goalkeepers, by virtue of the stringent spatiotemporal constraints of the situation, typically must initiate their blocking or interceptive actions early, that is, before the kicker contacts the ball in soccer (Dicks, Davids, & Button, 2010; Zheng, de Reus, & van der Kamp, 2021) or the thrower releases the ball in handball (Gutierrez-Davila, Rojas, Ortega, Campos, & Parraga, 2011). However, fully reliable (i.e., specifying) information about ball direction, and thus the side of the goal to cover, only emerges after the ball is in flight (Craig, Berton, Rao, Fernandez, & Bootsma, 2006). Consequently, goalkeepers largely depend on less reliable, non-specifying information (i.e., information variables that relate ambiguously to ball flight) generated during the penalty taker’s body movements to anticipate their dive toward the ball. The necessary reliance on information from body movements offers the penalty taker a chance to directly manipulate that information to provide the goalkeeper with false possibilities for action (Ramsey et al., 2022). Hence, in recent years, the penalty situation has become a popular paradigm to investigate the athletes’ susceptibility to deception.

The prevailing research methodology in these studies has been video-based tasks in which participants (i.e., goalkeepers) watch video clips of penalty takers performing penalty actions shown from a goalkeeper’s viewpoint (Panten, Loffing, Baker, & Schorzer, 2019). Typically, participants are required to indicate the perceived outcome (e.g., side or location) of the penalty action verbally or with simple manual responses (e.g., a button press or joystick movement). Often, but not always, the video clip is temporally occluded at predetermined times prior to ball flight (i.e., before fully reliable, specifying information is available about ball flight) and/or spatially occluded by editing out bodily part(s) or movements that are presumed to contain useful, albeit less reliable information about the future ball flight (e.g., the orientation of the hips). In doing so, researchers aim to delineate when and where information pickup occurs (Farrow & Abernethy, 2015).

However, research informed by the ecological approach has raised increasing concerns regarding the representativeness of the video-based tasks for on-field performance (for reviews, see Dicks, Davids, & Button, 2009; Dicks, Araújo, & van der Kamp, 2019; Van der Kamp, Rivas, Van Doorn, & Savelbergh, 2008). Most importantly, while video-based tasks may perhaps be effective to examine the information pickup for the spatial control of the dive (e.g., Savelbergh, Van der Kamp, Williams, & Ward, 2005; Savelbergh, Williams, Van der Kamp, & Ward, 2002), they have overlooked the pertinent temporal constraints that emerge from the (inter)actions of the penalty taker and goalkeeper (Van der Kamp, Davids, Navia, & Noel, 2018; Zheng, van der Kamp, Song, & Savelbergh, 2022). In competitive (ball) sports, these temporal constraints typically do not align with the spatial constraints (Navia, Davids, van der Kamp, & Ruiz, 2017). In soccer, goalkeepers can wait longer, until after the ball is kicked, to use the reliable, specifying information of ball flight. This promotes a dive to the correct side, but, very likely, also results in being too late to reach the ball in time, as goalkeepers require more time than is made available by ball flight (Dicks, Davids, & Button, 2010; Zheng et al., 2021). Conversely, goalkeepers may initiate the dive early to enable them to reach the ball (or interception point) in time. Yet, they then must rely on early information available from the penalty taker’s kicking actions, which is demonstrably less reliable regarding the side to dive, increasing the chance of a dive to the wrong side (Diaz, Fajen, & Phillips, 2012; Lopes, Jacobs, Travieso, & Araújo, 2014).

Fajen (2005, 2007), Fajen, Riley, and Turvey (2009) outlined the affordance-based control theory explicating how individuals flexibly adapt to (discordant) spatial and temporal constraints. Accordingly, performers act in ways that sustain the perceived possibility for action afforded by the current situation. On this account, performers must be sensitive to the boundaries that demarcate possible and impossible actions of the situation. This requires that the use of information is scaled to the action capabilities of the performer. To reach the ball in time, the goalkeeper must initiate their dive before the required dive velocity for interception (arriving in the right place at the right time) exceeds the maximum dive velocity they can achieve (Dicks, Davids, & Button, 2010; Van der Kamp et al., 2018). Therefore, the goalkeeper must ensure that the time they need to act does not exceed the time that is available. Hence, a proposal that stems from an affordance-based account of anticipation is that less agile goalkeepers must initiate the dive earlier, coinciding with when less useful information available. The implication is that to fully understand deception in competitive (ball) sports, it is critical to consider the resultant spatiotemporal constraints of the situation (e.g., the time made available from ball flight given the power of the kick relative to the time required given the goalkeeper’s diving capabilities), because they affect when and what information can be used – be they intentionally manipulated to deceive or not (Zheng et al., 2022).

Based on these theoretical considerations from the ecological approach, in the current article we performed a scoping review to scrutinize whether penalty takers do indeed benefit from producing deceptive actions, not only in terms of offering false affordances to goalkeepers but also with respect to actually scoring a goal. We used a scoping review since the current study aimed to collect literature of deception in the penalty situation, before identifying and mapping the emerging evidence (Munn et al., 2018; Peters et al., 2015). In doing so, we first separately evaluated studies using video-based and in-situ tasks and then compare them, because these methods critically differ in the resultant spatiotemporal constraints they impose and the grounding in action of the responses they require (Van der Kamp et al., 2008). We examined if the two types of study demonstrate different efficacy of deceptive actions as would be anticipated based on affordance-based control (Fajen, 2005; Van der Kamp et al., 2018). Finally, we evaluated the influence of
goalkeepers’ experience and learning on the perception of misleading affordances from penalty takers’ deceptive actions.

2. Methods

In keeping with recommendations for conducting a scoping review, an explicit search strategy and standardized data extraction forms were used (Munn et al., 2018). Consistent with these procedures, the following databases were searched on 2021, February 12 and 2022, November 9: Web of Science, Scopus, PsycINFO, and SPORTDiscus, without restrictions on publication time. The search terms were [decept* or fake or fool or feint or disguise] AND [penalt* or 7 m or 11 m]. This resulted in 2080 articles from the first search and additional 146 articles from the second search. A final list of 17 articles were included after initial screening of the title and abstract, followed by full text analysis, and additional hand search based on reference tracking of the included studies (See Fig. 1).¹

![Flowchart of the search and screening process of article selection. The number is based on the combination of two search time-points.](image)

¹ Originally, we intended to include all the sports with penalty situations that have a fixed penalty spot and with no other opponents than goalkeepers trying to block the penalty. However, the initial literature search only uncovered studies with deceptive action in association football or soccer and handball, and did not reveal any relevant articles on deception by penalty takers in, for instance, field hockey, ice hockey, or water polo. So, the penalty situations referred to in the current review are restricted to the futsal and soccer penalty kick, and handball penalty throw.
3. Results

3.1. Video-based tasks

3.1.1. The information for deception

We found 8 articles that used video-based tasks in which the participating goalkeepers were presented with video clips of penalty takers that were temporally occluded at different instances of the penalty taker’s action; mostly commonly before and/or at foot-ball contact or ball release (Table 1). Most studies (e.g., Higueras-Herbada et al., 2015; Tay et al., 2012) only included one occlusion condition, with the clips terminating one frame before or at the moment the ball is kicked or thrown (cf. Causer & Williams, 2015; Smeeton & Williams, 2012). The clips show kicks and throws with and without deceptive actions. In the soccer studies, these deceptive actions mostly involved misleading actions that provide wrong or misaligned information about kicking direction (Smeeton & Williams, 2012), while the handball studies always included disguise or faking in which information of the throw or throwing direction is hidden (Canal-Bruland & Schmidt, 2009). This difference between soccer and handball reflects the laws of the game, where faking a shot is allowed, and often used, in handball but not in soccer. In addition, the experimental tasks are also distinct in the soccer and handball studies. In most handball studies, participants (i.e., goalkeepers) are mostly required to identify whether the thrower intends to throw or merely fakes a throw, typically by pressing a corresponding key (e.g., Smeeton & Williams, 2015) or by making simple hand movements in the direction of the kick (e.g., Tay et al., 2012).

The handball studies reported that experienced goalkeepers and field players did discriminate fakes (i.e., disguise) and actual throws above chance (i.e., 80% and 60% in Canal-Bruland and Schmidt (2009) and Canal-Bruland et al. (2010), respectively). However, Almeida et al. (2016) found that perception of throwing direction (rather than identifying a throw or fake) in disguised conditions was below chance (i.e., approx. 35%) and less accurate than in non-deceptive conditions. This suggests that handball goalkeepers and field players can detect the deceptive intention of throwers, but still perceive false affordances, suggesting that deception by handball throwers is at least partly successful. This underlines that information for identifying deceptive intentions and information for perceiving throwing direction are non-identical, with the latter being more difficult to attune to (Causer & Williams, 2015). In the soccer studies, both novice and experienced goalkeepers exhibit significantly lower accuracy in perceiving the direction of the kick for deceptive actions compared to non-deceptive actions (Causer & Williams, 2015; Higueras-Herbada et al., 2015; Smeeton & Williams, 2012; Tay et al., 2012). The penalty taker’s deceptive actions prior to ball contact therefore lead soccer goalkeepers to misperceive the direction of the kick, as was observed for the throw in handball (Almeida et al., 2016).

Two soccer studies included more than one occlusion condition (Causer & Williams, 2015; Smeeton & Williams, 2012). Smeeton and Williams (2012) occluded the videos at −240, −160, −80, 0, and 80 ms relative to the foot-ball contact with negative values indicating occlusion prior to contact. For both non-deceptive and deceptive (i.e., misleading) penalty kicks, perceived kick direction was more accurate for late compared to early occlusion conditions. Importantly, the deceptive actions were only effective (i.e., decreasing goalkeepers’ perceptual accuracy) when occlusion occurred before foot-ball contact. Participants were not deceived with occlusions at and after the foot-ball contact. However, findings are contradictory. Higueras-Herbada et al. (2015), who occluded the video at ball contact, reported that participants were significantly misled. Similarly, Causer and Williams (2015) reported that perceptual accuracy of kicking direction was also degraded when the video clip was occluded at foot-ball contact. In this study, video footage was shown of penalty takers who were wearing printed uniforms that concealed information about their body movements. The effect of deception at the point of foot-ball contact was only apparent when goalkeepers anticipated the penalty kicks by players who wore uniforms with zig-zag patterns printed across the hip area, but not with other regular, nonprinted uniforms. This suggests that the zig-zag prints disguised information from the hip movements.

To summarize, the studies using video-based penalty tasks report largely congruent findings that indicate that goalkeepers can be made to incorrectly perceive the direction of the kick or throw if penalty takers deceive by actively manipulating information (i.e., by producing misleading information or by hiding veridical information), even though, in the case of disguise, goalkeepers do recognize the deceptive intentions of penalty takers. It is not entirely clear whether it is in the final milliseconds before or only at ball contact / release that the manipulated information becomes ineffective, because fully reliable, specifying information for kick (or throw) direction becomes available. Notice that we refer to incorrectly perceiving the kick (or throw) direction rather than perceiving false affordances. We do so, because participants in video-based tasks are not acting to actually block the ball. The reduced perceptual accuracy in deceptive compared to non-deceptive penalties was observed in experienced field players (e.g., Smeeton & Williams, 2012), and novice (e.g., Higueras-Herbada et al., 2015) and experienced goalkeepers (Tay et al., 2012). We further detail the role of experience in the next section.

3.1.2. Role of experience

Several studies directly compared novice or inexperienced goalkeepers and players with experienced goalkeepers to address how experience or skill level affects perception when encountering penalty takers that perform deceptive actions to conceal or mislead their intentions (Canal-Bruland & Schmidt, 2009, Canal-Bruland et al., 2010; Causer & Williams, 2015; Smeeton & Williams, 2012). These

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2 The current review aimed to examine the effectiveness of deception from the penalty takers’ perspective. We followed this perspective in the Introduction and Discussion, unless explicitly stated otherwise. However, in this Results section we maintained the original study’s perspective. Consequently, some studies are described from the goalkeepers’ perspective.
studies consistently show that experienced goalkeepers are less deceived than novice goalkeepers. In handball, Cañal-Bruland et al. (2010) compared the perception of deceptive intention between experienced handball goalkeepers, experienced handball field players, and novices. Participants watched videos of penalty takers performing penalty throws with or without deception and indicated whether the penalty taker would throw or fake a throw (i.e., disguise). The videos showed the thrower from the side or the front (i.e., goalkeeper perspective) and were occluded one frame before the release of the ball. The experienced goalkeepers and field players demonstrated more accurate perception of deceptive intention than the novices. In fact, the goalkeepers and field players showed comparable levels of accuracy, even though the goalkeepers presumably had vastly more (perceptual) experience facing penalty throws, especially from the front view. Goalkeepers indeed showed superior accuracy in the front view as compared to the side view, but this was also observed for the field players. The authors thus were unable to pinpoint that specific perceptual experience facilitates the capability to identify deceptive intentions.

Moreover, the experts’ advantage in perceiving ball direction was irrespective of occlusion condition. In soccer, Smeeton and Williams (2012) found that experienced players perceived ball direction more accurately than novices in all occlusion conditions (i.e., –240, –160, –80, 0, or 80 ms relative to the foot-ball contact) in both misleading and non-deceptive penalty kicks. Similar findings were reported by Causer and Williams (2015) for disguised and non-disguised penalty kicks.

In sum, studies using video tasks suggest that experienced participants are better able to detect and ignore the manipulated information generated in deceptive actions than less experienced and novice participants. Accordingly, they are more skilled in perceiving the opponent’s final intention or the final direction of the kick or throw than novices. However, the exact difference in attunement and/or what kind of experience induce the difference in attunement remain largely unclear.

### 3.1.3. Effect of learning

Since video-based studies show that experienced or skilled players attend more often to non-deceptive information (or more accurately, better ignore the deceptive information) than novices, it stands to reason that goalkeepers can learn to improve the perception of ball direction when confronted with deceptive penalties. Only one study was found that addressed this issue. Almeida
et al. (2016) examined whether experienced handball goalkeepers could improve perceptual accuracy of the direction of non-deceptive and deceptive penalty throws, in which the latter involved the thrower moving the ball back and forth before the actual throw (i.e., disguise). The goalkeepers predicted ball direction instead of identifying deceptive intention as is typically done in handball penalty studies (cf. Canal-Bruland et al., 2009, 2010). In the intervention group, goalkeepers watched videos of non-deceptive and deceptive throws in three conditions: a) the video of the throwers’ whole body was presented at normal speed and stopped one frame before ball release; b) the video of the throwers’ upper body was shown at 25% of normal speed and was also occluded one frame before ball release; and c) the video of the throwers’ whole body was shown without occlusion and with a sign denoting the direction of the throw. It was argued that the training would prompt participants to pick up the more reliable information from the throwers’ upper body instead of the lower body. Other participants were assigned to a control (i.e., without training) or placebo group (i.e., watching training films). After 7 training sessions, participants in the intervention group had improved the response accuracy for both the non-deceptive (i.e., 25% increment) and the deceptive throws (32%) in the post test. The improvements in perceptual accuracy after training suggest that participants had indeed converged to more reliable information in both the non-deceptive and deceptive throws, even if the information was hidden as in the deceptive throws. However, it remains to be verified whether the increases perceptual accuracy generalize to on-field penalty goalkeeping, especially because on-field goalkeeping not only requires responding to the correct side, but also at the correct time.

3.2. Results from in-situ paradigms

3.2.1. Information for deception and its effectiveness

We identified nine articles using in-situ tasks. The past decade has seen a surge in studies that investigated penalty kicks in-situ, especially in soccer where goalkeepers are asked to dive and save penalties on the field. A few studies have also included deception actions by the penalty taker (i.e., Dicks, Button, & Davids, 2010a; Dicks, Davids, & Button, 2010; Hunter et al., 2018; Lopes et al., 2014; Navia et al., 2017; Zheng et al., 2022). As shown in Table 2, the penalty takers are typically required to mislead the goalkeeper by manipulating information about the side they intend to kick toward (e.g., by using gaze and/or runup angles that are incongruent to kick direction). In situ, goalkeepers not only have full and non-occluded view of the penalty taker but also of ball flight. Yet, goalkeepers must and do typically initiate their dive before the ball is struck (Table 2) and thus necessarily must rely on not fully reliable, non-specifying information generated in the penalty takers’ actions (Craig et al., 2006). Comparable to video-based studies, producing deceptive actions that aim to manipulate information presumes that goalkeepers indeed utilize this information, and doing so would lead to the perception of false affordances (i.e., manifested in a dive to the wrong side).

Intriguingly, unlike in video-based tasks, the effects of misleading deceptive actions in in-situ studies are mixed. Dicks and associates (Dicks, Button, & Davids, 2010a; Dicks, Davids, & Button, 2010) had experienced goalkeepers face deceptive penalties, in which the kickers used incongruent gaze and runup angle strategies. In both studies, the goalkeepers dived less often to the correct side and saved fewer penalties with deceptive action in comparison to non-deceptive penalties (see also Wood et al., 2017). By contrast, others have reported that the number of dives to the correct side and saves were comparable for deceptive and non-deceptive penalty kicks (Hunter et al., 2018; Lopes et al., 2014; Navia et al., 2017). Finally, a recent study (Zheng et al., 2022) suggested that the effects of deceptive action were moderated by gender. Male goalkeepers were not affected by the misleading actions of the penalty taker, while female goalkeepers showed reduced performance.

3.2.2. Role of experience

One study, which was presented as a conference paper, compared experienced (i.e., semi-professional and professionals with 10.6 ± 2.6 years of experience) and less experienced (i.e., amateurs with 6.7 ± 2.1 years of experience) goalkeepers (Dicks & van der Kamp, 2016). The same penalty taker executed penalty kicks for the two groups. The deceptive actions involved incongruent gaze and runup angle strategies (i.e., misleading). In contrast to the expert advantage reported in the video-based studies, this in-situ study reported that both the experienced and less experienced goalkeepers dived to the correct side at chance level. In addition, the deceptive manipulation of information did not affect goalkeepers’ performance. Both groups showed similar rates of dives to the correct side for non-deceptive and deceptive penalties. However, the experienced goalkeepers still did outperform their less experienced counterparts by making more saves. This advantage resulted from an earlier initiation of the dive (i.e., relative to their maximum action capabilities), enabling them to convert the dives to the correct side more often into a successful save. This was true for both non-deceptive and deceptive penalties. One implication is that goalkeepers may be merely guessing the side and instead prioritize the timing of the diving action. Hence, the goalkeepers might not have used the misleading spatial information generated in the penalty kick to perceive the direction of the dive.

3.2.3. Effect of learning

In another in-situ study, novices were trained to enhance goalkeeping performance for both deceptive and non-deceptive penalty kicks (Dicks et al., 2017). The researchers used a novel method to train goalkeepers. Participants were divided into two groups. The first group trained with a single penalty taker, while the second group trained with three penalty takers who ran toward the ball simultaneously but only one of them kicked the ball. The authors hypothesized that goalkeepers facing the multiple penalty takers would be constrained to attune to the more reliable, non-deceptive information closely before ball contact. Following a training of 80 penalties across four sessions, the goalkeepers facing the single penalty taker training group had not increased the number of saves and dives to the correct side, whereas the goalkeepers facing multiple penalty takers during training group showed a marginally increased number of dives to the correct side both for non-deceptive (8%) and deceptive (5%) penalties. However, they did not save more shots.
Table 2
Characteristics of the included in-situ studies (n = 9).

<table>
<thead>
<tr>
<th>Study</th>
<th>Study design and Sport</th>
<th>Participants</th>
<th>Deception instruction (type)</th>
<th>Dive onset time</th>
<th>Correct side and/or save</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dicks, Davids, and Button (2010)</td>
<td>Within subject comparison Soccer</td>
<td>Experienced GKs</td>
<td>Gaze direction and runup angle incongruent with kicking direction (misleading)</td>
<td>Approx. -150 ms (D) approx. -164 ms (ND)</td>
<td>Correct side: Not available Save: ND (55.7%) &gt; D (11.4%) with early runup information Correct side: ND (96.3%) &gt; D (55%) Save: ND (50%) &gt; D (10%)</td>
</tr>
<tr>
<td>Dicks, Button, and Davids (2010a)</td>
<td>Within subject comparison Soccer</td>
<td>Experienced GKs</td>
<td>Shoot to one side while pretend to shoot to other side (misleading)</td>
<td>Approx. -150 ms (D) approx. -150 ms (ND)</td>
<td>Correct side: ND (67%) &gt; D (45.9%) Saves: ND (23%) &gt; D (10.6%)</td>
</tr>
<tr>
<td>Wood, Vine, Parr, and Wilson (2017)</td>
<td>Within subject comparison Soccer</td>
<td>Experienced GKs</td>
<td>(Retrospective analyses on the kick rather than instructions before the kick) Final fixation opposite to kicking direction (misleading)</td>
<td>-164 ± 100 ms</td>
<td>Correct side: Before training: ND (46%) ≈ D (47%) After training: ND (52%) ≈ D (54%) Save: Before training: ND (15.2%) ≈ D (15.6%) After training: ND (18%) ≈ D (17%)</td>
</tr>
<tr>
<td>Hunter, Angilletta Jr., and Wilson (2018)</td>
<td>Within subject comparison Soccer</td>
<td>Experienced GKs</td>
<td>(Retrospective analyses rather than instructions before the penalty kick) Runup angle incongruent with kicking direction (misleading)</td>
<td>Not reported</td>
<td>Correct side: ND (63.9%) ≈ D (65.9%) Save: ND (13.6%) ≈ D (17.8%)</td>
</tr>
<tr>
<td>Dicks, Pocock, Thelwell, and van der Kamp (2017)</td>
<td>Within subject comparison Soccer</td>
<td>Novice Gks</td>
<td>Gaze direction and runup angle incongruent with kicking direction (misleading)</td>
<td>Not reported</td>
<td>Correct side: ND (55%) ≈ D (48%) Saves: ND (20%) ≈ D (20%) Less experienced Gks Correct side: ND (52%) ≈ D (45%) Save: ND (12%) ≈ D (8%)</td>
</tr>
<tr>
<td>Dicks and van der Kamp (2016)</td>
<td>Within-between subject comparison Soccer</td>
<td>Experienced and less experienced GKs</td>
<td>Gaze direction and runup angle incongruent with kicking direction (misleading)</td>
<td>Experienced: approx. -230 ms (D) approx.-230 ms (ND) Less experienced: approx.-170 ms (D) approx.-170 ms (ND)</td>
<td>Correct side: ND (50%) ≈ D (48%) Saves: ND (20%) ≈ D (20%) Less experienced Gks Correct side: ND (52%) ≈ D (45%) Save: ND (12%) ≈ D (8%)</td>
</tr>
<tr>
<td>Lopes et al. (2014)</td>
<td>Within subject comparison Soccer</td>
<td>Experienced players</td>
<td>Shoot to one side while pretend to shoot to other side (misleading)</td>
<td>Not reported</td>
<td>Correct side: ND ≈ D (chance level) Save: ND (20%) ≈ D (18%)</td>
</tr>
<tr>
<td>Navia et al. (2017)</td>
<td>Within subject comparison Futsal</td>
<td>Experienced GKs</td>
<td>Shoot to one side while pretend to shoot to other side (misleading)</td>
<td>6 m: -133 ± 72 ms (D) -133 ± 98 ms (ND) 10 m: 213 ± 25 ms (D) 198 ± 26 ms (ND)</td>
<td>Correct side: ND (50%) ≈ D (50%) Save: ND (20%) ≈ D (20%) 10 m Correct side: ND (95%) ≈ D (92%) Save: ND (60%) ≈ D (58%)</td>
</tr>
<tr>
<td>Zheng et al. (2022)</td>
<td>Within-between subject comparison Soccer</td>
<td>Experienced male and female Gks</td>
<td>Gaze direction and runup angle incongruent with kicking direction (misleading)</td>
<td>Male: -110 ± 28 ms (D) -114 ± 29 ms (ND) Female: -172 ± 41 ms (D) -154 ± 46 ms (ND)</td>
<td>Correct side: ND (55%) ≈ D (60%) Save: ND (12%) ≈ D (14%) Female Correct side: ND (63%) &gt; D (44%) Save: ND (24%) &gt; D (14%)</td>
</tr>
</tbody>
</table>

Note: ND = non-deceptive condition; D = deceptive condition.
Although these observations are consistent with the hypothesis that the second group have learned to attend to more reliable, non-deceptive information, this attunement may also have resulted in goalkeepers waiting too long, preventing them from reaching the ball in time.

3.2.4. Drawbacks of deceptive actions

Finally, when considering its effectiveness, it is also pertinent to consider if deceptive actions affect the kicking action itself. In this respect, several in-situ studies (Dicks et al., 2010; Navia et al., 2017; Zheng et al., 2022) reported consistently longer ball flight times for deceptive penalties in comparison to non-deceptive penalties. This would provide goalkeepers with more time before starting the diving and/or reach the ball to save the penalty. Indeed, ball velocity (i.e., the inverse of ball flight time) is positively correlated to the velocity of the kicking foot (Barberi et al., 2010), which is produced by a proximal-to-distal movement chain from the pelvis to the kicking leg. Most likely, for deceptive penalties, this proximal-to-distal chain is (slightly) perturbed, resulting in decreased kicking velocity.

4. Discussion

In the current study, we performed a scoping review of the literature for experimental studies on soccer and handball penalty situations to assess whether penalty takers do indeed benefit from utilizing deceptive action and score more goals as would obviously be their intention. In deceptive actions, penalty takers manipulate information such that it offers goalkeepers false affordances for diving (Ramsey et al., 2022), with the aim of increasing the likelihood of scoring a goal. The scoping review revealed pertinent differences depending on research methodology, suggesting that unlike video-based studies that show high effectiveness for deception, findings from more representative in-situ studies are mixed.

First, the review indicates that in video-based studies, irrespective of experience (and likely also skill level), goalkeepers are consistently reported to be susceptible to misperceiving the direction of the kick, while in reports from in-situ studies on perceiving false affordances, goalkeepers are equivocal with respect to diving to the correct side. And while in some of these studies deceptive actions did result in goalkeepers diving to the wrong side more often (Dicks, Button, & Davids, 2010a; Dicks, Davids, & Button, 2010; Wood et al., 2017; Zheng et al., 2022), it is also very apparent that the magnitude of this effect is much larger in video-based studies (i.e., rates of selecting the incorrect side for deceptive penalties: 80% [Tay et al., 2012], 70–80% [Smeeton & Williams, 2012], 65% [Alsharji & Wade, 2016], 50–65% [Causer & Williams, 2015], and 55% [Wood et al., 2017], 55% [Zheng et al., 2022], 55% [Dicks, Button, & Davids, 2010a], for video-task and in-situ studies, respectively).

Second, the video-based studies show a clear effect of skill with experienced goalkeepers being deceived less often in comparison to the less experienced participants (Causer & Williams, 2015; Smeeton & Williams, 2012). By contrast, the only in-situ study we had available did not report skill differences in perceiving false affordances (Dicks & van der Kamp, 2016). The experienced and less experienced goalkeepers dived equally often to the correct side, both when the penalty takers used deceptive strategies or not.

Third, in video-based tasks, a few short training sessions are sufficient to substantially increase perceptual accuracy for deceptive penalties (i.e., 25%), presumably by directing attention to more reliable, non-deceptive information (Alsharji & Wade, 2016). However, the single in-situ training study available showed a much smaller but significant increase in diving to the correct side (i.e., 5%). Yet, this did not improve save performances (Dicks et al., 2017).

4.1. Spatial and temporal control

In the video-based studies, goalkeepers indicate the side to which the ball is directed without moving to intercept the ball. This allows goalkeepers to successfully adapt to task requirements by mostly (or perhaps only) attuning to spatial information about the impending ball direction. Thus, video-based anticipation does not require the control of action to be in time and utilize temporal information about when the ball would pass the line (for a review, see Van der Kamp et al., 2018). Indeed, gaze-tracking confirms that in video-based tasks, soccer goalkeepers predominantly fixate the kickers’ body during the runup (e.g., Dicks, Button, & Davids, 2010b). And although information generated within the penalty taker’s actions does not fully specify ball direction (Craig et al., 2006), the movement kinematics during the runup and kick (e.g., hip, non-kicking and kicking leg) do increasingly correlate with ball direction (Diaz et al., 2012; Lopes et al., 2014). Consequently, occlusion of relevant body parts (e.g., hip) significantly decreases goalkeepers’ perceptual accuracy (Causer et al., 2017). Importantly, deceptive movements with these body parts contain misleading information that suggest a kick to the opposite direction. For instance, kinematic analyses by Lopes et al. (2014) showed that in soccer penalty kicks, hip movements provide goalkeepers with relatively reliable information for penalties without deception but also generate the misleading information in deceptive penalties. Because in video-based studies, the tasks constraints bias participants toward attending to spatial information, participants are likely to pick up this deliberately misleading spatial information, and thus misperceive ball direction.

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3 In video-based studies, the perceptual accuracy of ball direction is higher when the video is occluded at or after ball contact compared to when it is occluded before contact (Smeeton & Williams, 2012). However, perceptual accuracy in the studies with occlusion at ball contact only are not comparable to the in-situ studies in which goalkeepers initiated the movements about 100–200 ms before ball contact. Hence, we did not list the study by Higueras-Herbada et al. (2015). In addition, Causer and Williams (2015) had kickers wear special clothes to disguise actions instead of manipulating the movement kinematics. Disguise is less effective than misleading in deceiving opponents (Jackson & Canal-Bruland, 2019).
Unlike typical video-based tasks, trying to stop a penalty in-situ also imposes a strong temporal constraint to ensure that goalkeepers initiate the dive in time (Van der Kamp et al., 2018). Goalkeepers thus must satisfy both spatial and temporal constraints (Dicks et al., 2019; Navia et al., 2017). Accordingly, empirical evidence indicates that successful adaptation in-situ is associated with attunement to different information than in video-based tasks (Dicks, Button, & Davids, 2010b). Gaze-tracking reveals that instead of attending to the penalty taker’s trunk and hips during the runup, soccer goalkeepers in-situ shift their gaze to the ball in the early stage of the runup and spend at least as much time fixating the ball area as the kicker’s body (Navia, van der Kamp, & Ruiz, 2013; Dicks, Button, & Davids, 2010b; Piras & Vickers, 2011). We have previously proposed that gaze directed to ball area, which during the kick roughly encompasses the feet, likely underpins the attunement to temporal information for initiating the dive (Navia et al., 2017, Zheng et al., 2021; van der Kamp & Zheng, 2022). If indeed task constraints of video-based and in-situ tasks result in goalkeepers being attuned differently, and in more strongly prioritizing temporal information in-situ tasks, then it stands to reason that goalkeepers would be less likely deceived by manipulating spatial information in in-situ compared to the video-based studies. This could also explain why spatial misleading is less effective in-situ (i.e., equivocal results on the effectiveness of deception) than video-based (i.e., consistent positive results of deception) studies.

In fact, there is some empirical evidence to more directly corroborate this conjecture. In an in-situ study, Lopes et al. (2014) found that experienced amateur goalkeepers dived to the correct side at chance level for penalty kicks with and without deception. Goalkeepers were not deceived by the misleading spatial information. The same group of researchers, then transformed the video-recordings of the penalty takers’ runup and kick recorded in the study of Lopes et al. (2014) into 2D point light video displays (Higueras-Herbada et al., 2015). Using a video-based task, they found that novice participants now demonstrated above chance levels in perceptual accuracy (i.e., perceiving the ball direction) for non-deceptive penalties, and a significant decrease in perceptual accuracy for deceptive penalties. In other words, the effects of the same deceptive actions were clearly different between video-based and in-situ tasks.

4.2. Experience in spatial and temporal control

In video-based tasks, less experienced goalkeepers were more likely to misperceive ball direction than more experienced goalkeepers (e.g., Causer & Williams, 2015; Smeeton & Williams, 2012). This experience-related differences in spatial control did not transpire in the one in-situ study that was available. Experienced and less experienced soccer goalkeepers dived equally often to the correct side in both deceptive and non-deceptive penalties (Dicks & van der Kamp, 2016). The advantage of experienced goalkeepers was only reflected in more adaptive timing of the dive, enabling the experienced goalkeepers to stop more penalties (if they dived to the correct side).

In the video-based studies, experienced players were less likely to misperceive the direction of the kick for deceptive penalties. This was true for all occlusion times (Smeeton & Williams, 2012), before and after ball contact. This indicates that experienced goalkeepers not only attended to the most reliable and available information (e.g., after ball contact), but were also more likely to be attuned to less reliable, non-deceptive information available before ball contact. That is, they did not attend to the deceptive information, a finding that is consistent with gaze tracking studies (Kunde, Skirde, & Weigelt, 2011; Sebanz & Shiffrar, 2009). Similarly, Mori and Shimada (2013) had collegiate rugby players and novices judge the direction change of a video-recorded running player approaching with and without deception actions. With a deceptive action, the running player made one or two sidesteps before the direction change, while in a non-deceptive run the player changed the direction without any sidestep. The researchers found that experienced players responded earlier and more accurately (i.e., by pressing a corresponding key) to the occluded video clips. And importantly, the experienced players spent more time fixating body parts that are not involved in misleading the opponent (e.g., chest), while by contrast, the novices were fixating body parts that produce the deceptive actions (i.e., hip and leg).

As argued above, to act successfully when facing penalty kicks in-situ, there is a requirement to satisfy temporal constraints, which is absent when watching video footage. Accordingly, in-situ, experienced goalkeepers are observed to better scale the onset of the dive action to the time they have available (i.e., based on ball flight time) relative to the time they need to make the dive (Dicks et al., 2010: Zheng et al., 2021). Therefore, it stands to reason that in-situ, the skill or experience advantage should at least partially show up in the temporal control. Indeed, Dicks and van der Kamp (2016) report that experienced goalkeepers tended to initiate the dive within their action boundaries (i.e., satisfying the temporal constraints) whereas the less experienced goalkeepers were too late, they initiated their dive outside of their action boundaries. In fact, with respect to spatial control, both the experienced and less experienced goalkeepers dived to the correct side at chance level, a finding that corresponds to notational analyses of penalties taken in professional competitions in which goalkeepers have been shown to dive to the correct side in about 50% of the penalties (Avugos, Azar, Gavish, Sher, & Bar-Eli, 2019; Almeida et al., 2016; Almeida and Volossovitch, 2023; Zheng et al., in preparation). Collectively, these observations indicate that, in-situ, soccer goalkeepers prioritize diving in time over diving to the correct side to such a degree that they may only use, non-specifying situational information about a penalty taker’s historical kicking preferences or even guess the side (Dicks & van der Kamp, 2016).
They are seemingly not attending to information that relate to or specify the side to dive to. Accordingly, the skill advantage among goalkeepers would then mostly be reflected in temporal, not in spatial control. For soccer penalty takers, this would imply that deceptive actions are more, and perhaps only, beneficial if they afford false timing rather than false dive direction.

5. Limitations and future research

First, the review indicates that goalkeepers flexibly adapt to the spatiotemporal task constraints, and therefore attune differently to video-task and in-situ penalty situations. Consequently, the effectiveness of penalty takers’ deceptive actions (and the goalkeepers’ performances) differs between the two types of studies. Importantly, however, despite indications that anticipation of the same deceptive actions are clearly different between video-based (Higueras-Herbada et al., 2015) and in-situ tasks (Lopes et al., 2014), there are no studies that directly compared the effectiveness of deceptive actions in video and in-situ penalty situations. Additionally, we have assumed that in-situ studies are more representative or generalizable than the video-task studies with respect to competitive penalties on the field. We have no doubts in this regard, but the degree of representativeness of in-situ experimental studies for penalties in competition needs to be scrutinized in much more detail, not the least because of the radically larger performance pressure associated with competition.

Second, the conjecture that deception is information-based entails that the perception of ball direction and the side to dive to should be below chance level with misleading and at chance level for disguise (Jackson & Canal-Bruland, 2019). That is, misleading information would guide goalkeepers to dive to the wrong side, resulting in below chance choice of the correct side. Hiding information would leave the goalkeeper guessing, or diving to the correct and incorrect side equally. Yet, most studies merely compared goalkeepers’ performance between penalties with and without deception (e.g., Causer & Williams, 2015). To test the stronger hypothesis that deception indeed reflects the manipulation of information, and additionally that different types of manipulation (i.e., misleading and disguise) can be used, future research may benefit from assessing how performance compares to chance level. Further to this point, only two studies (one in-situ and one video-based) verified whether the available kinematic information actually differed for deceptive and non-deceptive penalties (i.e., Lopes et al., 2014; Smeeton & Williams, 2012). These studies confirmed that differences existed, suggesting that for non-deceptive penalty kicks the information was indeed manipulated. Nonetheless, for future studies it is imperative to verify differences in kinematic as well as non-kinematic information (e.g., gaze direction) between non-deceptive and deceptive penalties.

One may argue that with current technological developments, virtual reality (VR) can -unlike video-tasks -create interactive scenarios with spatiotemporal constraints that closely match in-situ penalty situations. Indeed, performance of handball goalkeepers against penalty throws in VR strongly resembled in-situ performance (Bideau et al., 2003). This would allow researchers to isolate and control kinematic information including the deceptive elements (Bideau et al., 2003). If this is indeed possible is largely an empirical issue. We remain somewhat reserved, because thus far VR did not permit goalkeepers to make an actual interception with the ball (Shimi et al., 2021; Zaal & Michaels, 2003). Yet, according to affordance-based control theory, it is imperative that goalkeepers can continuously calibrate their actions (e.g., the lateral dive velocity or the vertical impulse applied against the ground at take-off) to the available information to enable them to perceive whether they act within action boundaries or not (Fajen, 2007; Van der Kamp et al., 2018; Zheng et al., 2021). Once VR allows goalkeepers to cover the same expanse with the same time constraints, then VR may be sufficiently representative, providing that the interaction between the avatar and goalkeeper in VR is also equivalent to the interaction between the penalty taker and goalkeeper in situ (e.g., Ramsey et al., 2022). This may currently be more feasible for handball than soccer given the goal size and complexity of the goalkeeping actions. Moreover, it might turn out that haptic information generated by contact with the ball is critical for calibration, and may present a harder problem to overcome in VR.

Third, we have argued that by virtue of the stringent time constraints in the in-situ paradigm, soccer goalkeepers likely prioritize picking up temporal information over spatial information. In soccer, for example, penalty takers sometimes use a little jump between the backswing of the kicking leg and the landing of the non-kicking leg to deceive goalkeepers. This little jump prolongs the duration of the backswing of the kicking leg and delays the time to contact with the ball, which potentially deceives the goalkeeper to initiate their dive early. In fact, the disguise in handball penalty throw is an example of manipulating temporal information (i.e., disguise). During fake throws, handball goalkeepers appear to time their actions relative to the performers’ throwing actions in order to block the ball; yet, the throwers do not release the ball but initiate within a subsequent throw. However, as shown in Tables 1 and 2, the studies reviewed for the soccer penalty kick only included manipulation of spatial information. Deception by manipulating temporal information has not been investigated in the soccer penalty kick. Such investigation should also include a direct comparison of effectiveness of spatial and temporal deception strategies.

6. Conclusion

To conclude, from an affordance-based control perspective, the goalkeeper’s perception and action must be scaled to the constraints resulting from the goalkeepers’ diving and stopping capabilities and the time and spatial constraints stemming from the power
of the kick (Fajen, 2007; Zheng et al., 2022). In penalty situations, goalkeepers are typically unable to be pick up specifying information that ensures that they are in the right place at the right time because of limited action capabilities. Hence, they must abide to one constraint at the expense of the other. The way goalkeepers appear to satisfy these spatiotemporal demands depends on the resultant constraints of the task, which differs between in-situ and video-based paradigms. Goalkeepers prioritize picking up spatial information in video-based tasks and temporal information during in-situ conditions, respectively. Accordingly, deception based on the manipulation of spatial information is less effective in in-situ than in video-based studies. Since the in-situ situation is arguably more representative for competitive penalty situations, penalty takers are thus advised to use temporal deception in penalty situations provided temporal constraints are stringent.

CRediT authorship contribution statement

Ran Zheng: Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. John van der Kamp: Conceptualization, Formal analysis, Methodology, Writing – review & editing. Matt Miller-Dicks: Conceptualization, Formal analysis, Methodology, Writing – review & editing. Jose Navia: Conceptualization, Formal analysis, Methodology, Writing – review & editing. Geert Savelsbergh: Conceptualization, Formal analysis, Methodology, Writing – review & editing.

Declaration of Competing Interest

None.

Data availability

Data will be made available on request.

References


R. Zheng et al.

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