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**A novel on-field training intervention improves novice goalkeeper penalty
kick performance**

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Abstract

29 This study developed an on-field anticipation training intervention with the aim of
30 improving novice goalkeeper penalty kick performance. Eighteen participants were allocated to
31 either one-player (OP); or three-player (TP) training. The OP group faced “traditional” practice,
32 with one player running-up to execute each kick. The TP group faced three players in a form of
33 variable practice; two players stopped their run-up approximately 1.2m from the ball with the
34 third-player executing the kick. Following training, results revealed that TP made significantly
35 more saves when facing non-deception kicks in comparison with OP. An implication for
36 applied practice is that there are potential gains to be made through training anticipation skills
37 via new on-field practices rather than the current research focus on video-based training.

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Introduction

40 Research in the visual anticipation literature has revealed that differences in the
41 performance accuracies of expert and less-skilled performers can be reconciled by variations in
42 the locations of information pick-up and timing of actions (Triolet, Benguigui, Le Runigo, &
43 Williams, 2013). For instance, when anticipating the direction of an opponent's deceptive
44 movements, elite rugby players outperformed novices by attending to *honest* (centre of mass)
45 information and waiting later before initiating their movement response (Brault, Bideau, Kulpa
46 & Craig, 2012). In contrast, the earlier response time of novices did not negatively affect
47 performance for non-deceptive movements, where both experts and novices achieved ceiling
48 levels of anticipation accuracy (97%) (see also, Jackson, Warren & Abernethy, 2006). These
49 findings are corroborated by football penalty kick research, where results indicate that penalty
50 takers' use of deception ensures that early kinematic information (e.g., approach angle) is
51 incongruent with kick direction (Lopes, Jacobs, Travieso & Araújo, 2014). However, if
52 goalkeepers attend to kinematic information (e.g., non-kicking foot placement) that unfolds
53 when the penalty taker is approximately 1.2m from the ball, this increases the likelihood of
54 success when facing deceptive kicks (Dicks, Button, & Davids, 2010).

55 Differences in anticipation between expert and less-skilled performers, have led
56 perceptual learning researchers to explore the benefits of different training methods (see
57 Farrow, 2013, for a review). Recently, perspectives in ecological psychology have proposed
58 that variability in practice conditions may be particularly effective in improving anticipation
59 accuracy (see Dicks, van der Kamp, Withagen & Koedijker, 2015; Smeeton, Huys & Jacobs,
60 2013). For example, Smeeton and colleagues (2013) revealed that the prediction of tennis serve
61 direction can be improved through the implementation of *reduced usefulness training*, which
62 has the aim of directing novice (learners) search to more reliable information through changes
63 in practice conditions. It is thought that variable practice conditions reduce the availability of
64 variable or less useful information (e.g., early run-up information from a penalty taker), while

65 information with minimal variability (e.g., the orientation of the penalty taker's non-kicking
66 foot) (Dicks, Button et al., 2010; Lopes et al., 2014) remains present. Thus, variable practice
67 which leads to a reduction in the availability of less useful (variant) information is thought to
68 force learners to search for alternative, more reliable information (Smeeton et al., 2013).

69 The aim of this study was to examine whether a novel on-field training intervention
70 improves the anticipation performance of novice football goalkeepers for deceptive and non-
71 deceptive penalty kicks. Participants were allocated to either a one-player training group (OP)
72 or a three-player training group (TP). The OP group faced "traditional" practice, with one
73 penalty taker running up to execute the kicks. The TP group faced three players running-up to
74 the ball, with only one of the three players continuing the run-up to execute the kick. The other
75 two players stopped their run-up approximately 1.2m from the ball (cf. Dicks, Button et al.,
76 2010). The rationale for choosing this distance, and subsequently the aim of TP, was to orient
77 goalkeeper attention towards the more reliable information that unfolds towards the end of the
78 run-up. Following Smeeton et al. (2013), we rationalised that TP would act as a form of reduced
79 usefulness training, by minimising the availability of early penalty taker information. If TP
80 achieves this aim, we hypothesised that the TP group would learn to attend to reliable
81 information in the kicking action of penalty takers (e.g., non-kicking foot placement) and
82 perform significantly better than OP, leading to better post-test anticipation performance in
83 deception and non-deception trials.

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Method

Participants

87 Eighteen novice goalkeepers ($Mage = 20.89 \pm 0.96$ years) participated in the study. All
88 participants were male and had at least three years' football playing experience at a competitive
89 recreational level but no specific experience as a goalkeeper. Five penalty takers ($Mage = 21.17$
90 ± 0.98 years) were recruited to execute penalty kicks. All penalty takers had between five and

91 ten years' experience at a competitive recreational level and experience of taking penalties in
92 competition. The players had no previous experience of taking penalties against any of the
93 goalkeepers. Ethical approval was obtained from the local University ethics committee and all
94 participants provided written informed consent.

95 **Apparatus and Procedure**

96 The pre-test and post-test, consisted of 30 penalty kicks executed by three different
97 players. All participants faced kicks from the same three players in the pre-test and post-test.
98 The penalty takers approached the ball from a distance of 4m and followed a script that
99 determined the angle of run-up to the ball, which side of the goal to aim for (bottom left, bottom
100 right) and whether to use deception or no deception (see Dicks, Button et al., 2010). During
101 deception trials, players executed kicks as though they intended to aim to one side of the goal,
102 before shooting at the opposite side. In non-deception trials, the penalty taker shot directly at
103 the desired goal location without any deceptive intent (Lopes et al., 2014). The script ensured
104 that the three penalty takers executed 10 penalties each (five deception, five non-deception) that
105 were directed evenly to the bottom corners of the goal. In addition to the 30 penalties, a further
106 six kicks were executed to various predetermined goal locations to remove participants'
107 awareness of the task procedure (cf. Dicks, Button et al., 2010). Each player took two of these
108 kicks and goalkeeping performance was not analysed for these trials. All penalty kicks were
109 executed at a full size goal (7.32 x 2.44 m), using a size five football from the regulation
110 distance (11m) on an outdoor Astroturf pitch.

111 **Training.** Following the pre-test, performances were ranked based on the number of
112 saves for deception and non-deception trials, before allocating participants to one of two
113 training groups in order to ensure an equal range of visual anticipation performance at baseline
114 for the two groups (cf. Hopwood, Mann, Farrow, & Nielsen, 2011). The two training groups
115 were as follows: one-player training (OP) and three-player training (TP). Participants in both
116 groups faced a total of 80 kicks distributed equally across four training sessions during the

117 intervention (Smeeton, Williams, Hodges & Ward, 2005). The OP training consisted of
118 “traditional” kicks in which one player ran-up from a distance of 4m and executed the penalty.
119 The TP training consisted of three players running up to the ball from 4m, side-by-side, at three
120 different orientations to the ball (left, central, right), with only one of the three players
121 executing the penalty. The ordering of when each of the three players executed the kick was
122 randomised. The other two penalty takers stopped their run-up 1.2m from the ball (Dicks,
123 Button et al., 2010). It was pre-arranged which player was going to take each penalty although
124 goalkeepers were not aware of this arrangement. Different markers were placed along the
125 approach to the ball, and unknown to the goalkeepers, one pair of markers denoted 1.2m from
126 the ball. Penalty takers in TP and OP training did not follow a script but checks were made in
127 order to ensure an even distribution of kicks to either side of the goal.

128 **Dependent Measures and Analysis**

129 Goalkeeper performance for deception and non-deception trials was assessed by
130 recording the number of dives to the correct side of the goal and the number of saves in each
131 condition. Tests of normality indicated the data to be normally distributed. For dives, one
132 sample t-tests were performed on post-test performance to determine if training led to
133 performance that was greater than chance. Number of saves were analysed using a two (group:
134 OP, TP) x two (testing phase: pre-test, post-test) analysis of variance (ANOVA). Pre-test
135 performance was analysed using an independent samples t-test to ensure there were no
136 differences between the OP and TP group prior to training. Effect sizes are reported using η^2 for
137 ANOVA and Cohen’s *d* for post-test comparisons.

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139 **Results**

140 For the TP group, the number of dives to the correct side of the goal was statistically
141 greater than chance (7.5) for both deception ($M = 10.33$, $SD = 2.06$) and non-deception ($M =$
142 10.78 , $SD = 2.86$), $ts(8) = 4.12$ and 3.44 , respectively, $ps < .01$. In contrast, for the OP training

143 group, there was no difference between the number of dives to the correct side of the goal and
144 chance for both deception ($M = 9.11$, $SD = 2.67$) and non-deception ($M = 8.33$, $SD = 1.66$),
145 $t(8) = 1.81$ and 1.51 , respectively, $ps > .05$

146 Independent samples t-test revealed no differences in the pre-test between the OP and
147 TP groups for number of saves in non-deception, $t(16) = .263$, $p = .796$, $d = 0$, and deception
148 trials $t(16) = -.447$, $p = .661$, $d = 0.12$. The subsequent ANOVA showed for non-deception trials
149 that there was a significant main effect for group, $F(1,16) = 6.682$, $p < .05$, $\eta^2 = 0.29$, testing
150 phase, $F(1,16) = 11.22$, $p < .01$, $\eta^2 = 0.41$, and a significant interaction effect, $F(1,16) = 14.01$,
151 $p < .01$, $\eta^2 = 0.47$ (Figure 1). Follow-up tests revealed the TP training group made significantly
152 more saves than the OP training group in the post test for non-deception trials, $t(16) = -4.03$, $p <$
153 $.001$, $d = -1.89$. The TP training group made significantly more saves in the post-test compared
154 to the pre-test, $t(8) = -5.37$, $p < .005$, $d = -2.01$, but no significant difference was found between
155 the two testing phases for the OP training group, $t(8) = 0.26$, $p = 0.79$, $d = 0.11$.

156 Insert Figure 1 Here

157 For deception trials, there was no significant main effect for group $F(1, 16) = 0.045$, $p =$
158 0.83 , $\eta^2 = 0.003$, testing phase, $F(1, 16) = 0.15$, $p = 0.70$, $\eta^2 = 0.009$, and there was no
159 significant interaction effect, $F(1, 16) = 0.15$, $p = 0.70$, $\eta^2 = 0.009$ (Figure 2).

160 Insert Figure 2 Here

161

162 Discussion

163 The present study examined whether a highly feasible, new on-field training
164 intervention improved novice goalkeeper penalty kick performance. The aim of TP, as a form of
165 reduced usefulness training (Smeeton et al., 2013), was to direct goalkeeper attention towards
166 the use of kinematic information that unfolds in the final phase of a penalty taker's kicking
167 action (Dicks, Button et al., 2010). For dives to the correct side of the goal, results revealed that
168 the TP group performed significantly better than chance in the post-test for both deception and

169 non-deception trials. In contrast, there was no difference from chance for the OP group for both
170 kick conditions. Moreover, results revealed that the TP group made significantly more saves
171 than OP during non-deception trials following training (Figure 1). There were no differences in
172 the number of saves between the two groups for deception trials (Figure 2).

173 For non-deception, the TP group performed above chance levels following training and
174 showed a significant improvement for number of kicks saved in comparison with the OP group.
175 Thus, comparable to previous video-training research, the intervention used in the present study
176 indicates the potential benefit of using variable practice conditions for enhancing anticipation
177 performance (Dicks et al., 2015; Smeeton et al., 2013). Further to previous video-training
178 studies (e.g., Hopwood et al., 2011), our approach has shown that performance improvements
179 can be elicited from research-informed modifications to existing on-field training interventions.
180 The implication of this finding for applied practitioners is that new on-field training practices
181 are a viable intervention to enhance athlete anticipation and decision-making skills (Ford,
182 Yates, & Williams, 2010). In this respect, there are potential gains to be made by exploring
183 new approaches aimed at training anticipation skill via variations of on-field practice rather than
184 the current research focus of video-based training (Dicks et al., 2015).

185 For deception, the TP group performed above chance levels following training although
186 the TP group did not make more saves in comparison with the OP group. Previous research has
187 suggested that the timing of actions in anticipation tasks influences performance accuracy
188 (Triolet et al., 2013). Specifically, in the case of anticipating deceptive actions, moving early
189 can lead to an increased likelihood of being deceived (Brault et al., 2012). Furthermore, penalty
190 kick findings indicate that the timing of movement initiation is correlated to goalkeeper agility,
191 with slower goalkeeper's moving earlier and having an increased susceptibility to deception
192 (Dicks, Davids & Button, 2010). It is therefore plausible that the differences observed for the
193 effects of training in response accuracies for deception and non-deception kicks could be
194 reconciled by the timing of goalkeeper movements. However, as movement times were not

195 recorded, we are unable to verify this claim. Given the complexity of anticipation tasks, which
196 comprise deception, it is possible that novices may benefit less from the mode of reduced
197 usefulness training examined in this study in comparison with more skilled goalkeepers. Indeed,
198 the short period of 80 practice trials (cf. Smeeton et al., 2005) used in the current study may be
199 insufficient for eliciting meaningful improvements in real-time anticipation skill, particularly
200 given that no differences were observed in the OP group from pre- to post-test. Future work,
201 including gaze control and movement measures, participants of different skill levels, and
202 interventions of different durations is needed to understand the changes in control mechanisms
203 that occur after a period of perceptual training (Dicks et al., 2015).

204 In conclusion, the present study had the aim of training novice goalkeepers to exploit the
205 kinematic information that unfolds in the penalty taker's kicking action (i.e., approximately the
206 final 1.2m of the penalty taker's run-up). Following training, goalkeepers in the TP group
207 performed above chance levels for both deception and non-deception trials but this was not the
208 case for OP. When facing non-deception kicks, goalkeepers in the TP group made significantly
209 more saves in comparison with OP. In contrast, novice goalkeepers in the TP group did not
210 make more saves than OP in deception trials. Future research is needed to build on these efforts
211 through the implementation of rigorous measures (e.g., gaze and movement control) to fully
212 capture changes in control processes following training. An implication for applied practitioners
213 is that there are potential gains to be made through new approaches to training anticipation
214 skills via on-field practice rather than the current focus on video-based training (Dicks et al.,
215 2015).

216

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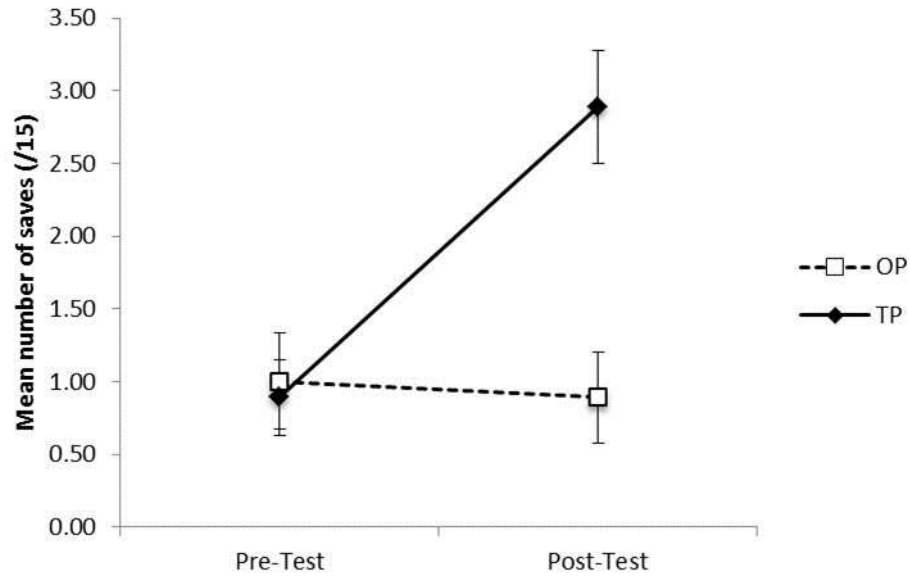
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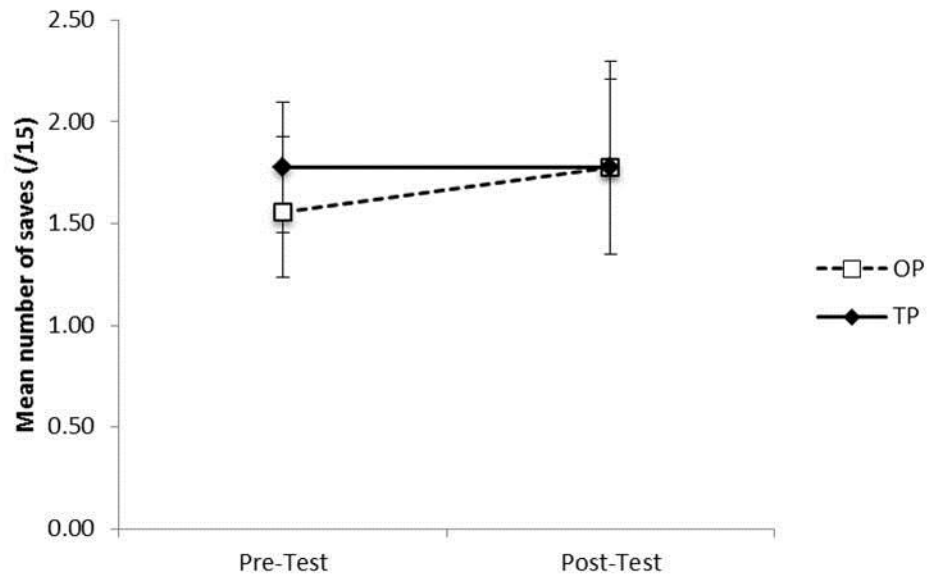
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262 **Figure 1:** Mean number of saves in response to non-deception kicks for one-player (OP) and
263 three-player (TP) training groups.

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266 **Figure 2:** Mean number of saves in response to deception kicks for one-player (OP) and three-

267 player (TP) training groups.

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