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1 Running head: Practice and augmented feedback on Netball

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3 Augmented feedback over a short period of time: Does it improve netball goal shooting

4 performance?\*

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### Abstract

The aim of the present study was to evaluate the effect of practice and augmented feedback on a complex motor skill (netball goal-shooting) on an indoor netball court, without restricting the interaction time between the learner and the instructor. Thirty participants were randomly allocated into a control (CON), practice (PRA), or practice with augmented feedback group (AUG), and completed 20 netball goal-shots at pre- and post-practice testing sessions. PRA and AUG participated in 3 consecutive practice sessions lasting 20 minutes each. In addition, the AUG group received goal-shooting instructions. The AUG group showed a significant greater improvement in scoring performance compared to CON and PRA, which highlights the importance of augmented feedback in the acquisition of complex motor skills. The current study provides a bridging step between laboratory motor learning and applied research.

Keywords: verbal cues, skill acquisition, beginners

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61 Augmented feedback provision over a short period of time: Does it improve netball goal  
62 shooting performance?

63 Augmented feedback is the information that a learner does not normally receive directly  
64 from their senses (Lee, Swinnen & Serrien, 1994) and is usually delivered by external sources  
65 using verbal cues (Landin, 1994). It can be given during (concurrent) and/or after (terminal)  
66 performance. The information provided concerns (a) the outcome of performance (the action  
67 outcome), usually termed knowledge of results (KR), and/or (b) the movement characteristics  
68 (the action pattern), usually termed knowledge of performance (KP). Augmented feedback  
69 has been extensively studied within the field of motor learning research and has been found to  
70 be a key tool in learning and improving motor skills (for reviews see Schmidt & Wrisberg,  
71 2004; Wulf & Shea, 2004).

72 Evidence exists that KR and KP together enhance performance (e.g., Viitasalo, Era,  
73 Kontinen, et al., 2001). It has also been shown that KR alone can be more effective than KP  
74 alone (e.g., Tzetzis, Kioumoutrazolou & Mavromatis, 1997), and vice versa (e.g., Zubiaur,  
75 Oña & Delgado, 1999). These equivocal results may be attributed to the characteristics of the  
76 skill itself and/or the learner (Magill, 1994); accuracy requirements imposed by the task  
77 (Reeve, Dornier & Weeks, 1990); age, experience and types of feedback (Amorose & Smith,  
78 2003); instructional strategies (Boyce, 1991); and motivational orientation of the learners  
79 (Little & McCullagh, 1989).

80 Although previous studies have fully achieved their aims, little attention has been given  
81 to both the field restraints of the methodologies used and the practical implementations of the  
82 findings reported. Most studies (a) used tasks, such as the Tower of Hanoi puzzle cognitive  
83 complex problem solving (Fredenburg, Lee & Solmon, 2001); (b) were laboratory based  
84 (McCullagh & Little, 1990); and (c) used a different and wide range of intervention durations

85 (Reeve et al., 1990; Winstein, Pohl & Lezthwaite, 1994; Zubiaur et al., 1999). As a result, the  
86 application of the knowledge gained from this nature of research has had limited  
87 transferability into situations where skill instruction occurs (Boyce, 1991). As first suggested  
88 by Christina (1987) and later by Silverman (1994), there is an inevitable trade-off between  
89 internal and external validity as we move from the laboratory and motor learning research  
90 towards applied research.

91 This lack of external validity revolves around the specificity of the tasks employed, the  
92 experimental settings utilized, and time-related issues. Firstly, with regard to the task  
93 employed when investigating the effects of KR in motor skill acquisition, McCullagh and  
94 Little (1990) employed a task consisting of displacing seven vertical barriers with the right  
95 hand moving through a prescribed pattern in 2,100 msec. This timing task has no real  
96 resemblance to a typical athletic skill.

97 Secondly, in relation to the experimental settings utilized, Todorov, Shadmehr and Bizzi  
98 (1997) used a virtual environment to demonstrate the positive effect of training with a specific  
99 form of augmented feedback on the performance of a multijoint movement shot in table  
100 tennis. During training a computer displayed a realistic three-dimensional simulation of the  
101 environment consisting of a graphical representation of the experimental set-up, the  
102 participants and model's paddles (with electromagnetic sensors attached to enable tracking of  
103 the position and orientation from them), and the ball. Although the use of such technology  
104 would enhance the quality of the feedback provided to learners, a similar high-technology  
105 experimental set-up would be practically impossible to utilize in a traditional environment  
106 where Physical Education (PE) and/or sport are delivered.

107 Finally, past research has not systematically considered time-related issues. Studies have  
108 expanded over prolonged (Tzetzis et al., 1997), short (McCullagh & Little, 1990; Reeve et al.,  
109 1990) or non-specified (Winstein et al., 1994) periods of time. More specifically the length of

110 contact time with learners and the time constraints imposed on the execution of the  
111 performance under investigation have limited the ability to generalize the findings.

112 In relation to the length of the contact time with learners, Williams, Ward and Chapman  
113 (2003) investigated the transfer of goalkeepers' anticipation skills at the penalty flick from  
114 laboratory-based setting to the game of field hockey. The actual individualized feedback  
115 provision (45 minutes on an individual basis) is probably unrealistic for most sporting  
116 situations, due to the time commitment required from the instructor. With regard to the time  
117 constraints imposed on the execution of the performance, Zubiaur and colleagues (1999)  
118 restricted the time lapse between the performance of a volleyball serve and the presentation of  
119 the feedback after the ball hit the ground, and the interval between serves (5 and 25 sec.,  
120 respectively). Similar artificial time constraints are not found in natural sporting situations.

121 Establishing the influence of practice and augmented feedback on motor skill  
122 acquisition, while attempting to address the abovementioned constraints, is of practical value  
123 to physical educators and coaches. Therefore, the aim of the present study was to evaluate the  
124 effect of practice and augmented feedback on performance of a complex motor skill (i.e.,  
125 netball goal-shooting). The assessment was carried out on an indoor netball court without  
126 restricting the interaction time between the learner and the instructor.

## 127 Methods

### 128 *Participants*

129 Participants were 30 young adults (male = 12, female = 18; age  $M = 21.8$  yrs,  $SD = 2.4$   
130 yrs) with some experience in goal-shooting activities; however, they had not practiced these  
131 type of activities (e.g., netball, basketball) for at least 2 years prior the experiment.

132 Participants signed an informed consent form but were unaware of the purpose of the study,  
133 and were randomly allocated into a control (CON; 3 male, 7 female), practice (PRA; 7 male,  
134 3 female), or practice with augmented feedback group (AUG; 1 male, 9 female).

135 *Procedure*

136 Testing and practice took place on an indoor netball court over a blocked schedule of a  
137 five-day period. All participants attended, on an individual basis, pre- and post-practice  
138 testing sessions on the first and last day of the 5 days, respectively. At the pre-practice testing  
139 session, participants were provided with an introductory description and demonstration of the  
140 appropriate netball goal-shooting technique. In addition, both at pre- and post-practice testing  
141 sessions, participants were given practice trials to allow familiarization with the task, ball, and  
142 shooting distance, before the actual testing commenced. Twenty netball goal-shots were  
143 executed from a standard goal-shooting position (2 meters away and directly opposite to a  
144 standard 3.05 meters high netball post).

145 The practice sessions for the PRA and AUG groups took place on three consecutive  
146 days (days 2-4). Following Shakespear's (1997) suggestions on practicing netball goal-  
147 shooting, each practice session lasted 20 minutes. Participants attended the practice sessions  
148 on an individual basis. A flexible time interval between shots was permitted to allow  
149 participants to choose their own shooting pace freely. Additionally, the AUG group received  
150 instructions (i.e., augmented feedback) from a Level 3 qualified netball coach<sup>1</sup>. The coach  
151 was selected due to her experience in coaching netball and educational background in PE.

152 The provision of augmented feedback followed Chen's (2001) general suggestions for  
153 practitioners and Shakespear's (1997) specific instructions for netball goal-shooting. A  
154 loosely structured rather than scripted feedback was adopted (Hebert & Landin, 1994); each  
155 participant was informed by the instructor of the appropriate correction after each error.  
156 Verbal cues were employed to help participants focus their attention on the key aspects of  
157 their goal-shooting technique (Landin, 1994). Depending on the margin of the error, the  
158 instructions would focus on either general or specific technical flaws. For example, statements  
159 may have been, "Good effort, now you try to extend your legs before releasing the ball" for a



160 short shot, or “Good shot, next time make sure you follow through the shot until all fingers  
161 point to the ground” for a skewed shot (Shakespeare, 1997).

162 An objective rating system was employed to record the scores achieved at pre- and post-  
163 practice testing sessions, similar to that utilised by Tzetzis and colleagues (1997). For each  
164 shot, participants in the current study received zero points if they missed completely, two  
165 points if they hit the goal-ring of the netball post, and five points if they scored. Therefore, the  
166 maximum points any participant could achieve were 100. Participants were required to follow  
167 the appropriate netball goal-shooting technique demonstrated by the instructor at the pre-  
168 practice testing session.

### 169 *Statistical analyses*

170 Normality of the data was examined using the Kolmogorov-Smirnov test and  
171 subsequently confirmed. A one-way Analysis of Variance (ANOVA) was carried out to  
172 examine whether the goal-shooting performance was influenced by the gender of the  
173 participants, in both the pre- and post-practice testing sessions.

174 The effect of the intervention on the total score was analyzed using a 3 (Groups; CON,  
175 PRA, AUG) x 2 (Measurements; pre-test, post-test) MANOVA, followed by Tukey’s *post-*  
176 *hoc* when differences were found. Homogeneity of the data was examined first using  
177 Levene’s test, and secondly Box’s test (Field, 2005). The significance level was set at  $p < .05$ .

### 178 Results

179 One-way ANOVA showed no differences between females and males in pre-practice  
180 ( $F(1, 28) = 3.14, p = .087$ ; females:  $M = 53.89, SD = 12.3$  points, males:  $M = 46.33, SD = 9.9$   
181 points) and post-practice ( $F(1, 28) = .241, p = .627$ ; females:  $M = 62.72, SD = 12.4$  points,  
182 males:  $M = 60.5, SD = 11.6$  points) training session scores. Therefore, the data was collapsed  
183 for gender for the remaining analyses.

184 Levene's test (pre-practice:  $F(2, 27) = 0.274, p = .763$ ; post-practice:  $F(2, 27) = 0.951, p$   
185  $= .399$ ) and Box's test ( $F(6, 18169.0) = 0.606, p = .726$ ) verified the homogeneity of the data.  
186 MANOVA revealed a significant effect ( $F(2, 27) = 4.048, p = .029$ ). Univariate analysis  
187 showed no significant difference ( $F(2, 27) = .714, p = .499$ ) in the pre-practice testing session  
188 scores but did reveal a significant difference ( $F(2, 27) = 3.72, p = .037$ ) in the post-practice  
189 testing session scores (see Table 1 for descriptive data). Further Tukey's *post-hoc* analysis  
190 showed a significant difference between CON and AUG only ( $p = .035$ ).

### 191 Discussion

192 The present study examined the effect a brief instructional intervention had on netball  
193 goal-shooting performance, without restricting the interaction time between the learner and  
194 the instructor. The results showed that the participants in the AUG group improved their  
195 performance over the 3 training sessions compared to the CON and PRA groups. This finding  
196 supports the salient role of augmented feedback in the acquisition of complex motor skills  
197 (Schmidt & Wrisberg, 2004; Wulf & Shea, 2004).

198 Findings related to the role of feedback and verbal instruction in the early motor  
199 learning stages remain inconclusive (Wulf & Shea, 2004). Past research has shown that the  
200 combination of KR and KP is a key tool in learning and improving motor skills (Schmidt &  
201 Wrisberg, 2004), yielding greater results than practice alone (Hebert & Landin, 1994;  
202 Viitasalo et al., 2001). On the contrary, Magill (1994) stated that the learning of a complex  
203 motor skill does not necessarily benefit from the provision of augmented feedback any more  
204 than simply practicing the skill. Additionally, Hebert and Landin (1994) suggested that verbal  
205 feedback does not have an immediate impact on performance outcomes. Our findings support  
206 the view that the combination of KR and KP had a positive impact on the acquisition of  
207 complex motor skills (Cooper & Rothstein, 1981; Kernodle & Carlton, 1992).

208 In the current study, a short intervention period was sufficient for beginners to develop  
209 physical competence of a complex motor skill, through practice with augmented feedback.  
210 The impact the brief intervention had on the examined athletic action reinforces the necessity  
211 for instruction and feedback during practice sessions. Although time-related constraints (e.g.,  
212 50 minutes PE lesson) pose difficulties for practitioners to provide enough feedback to all  
213 learners, it is important for them to recognize that feedback impacts on the acquisition of  
214 complex skills. This finding highlights the need for policy initiatives to promote more practice  
215 time within PE and sporting activities. For example, in the UK, all schools must provide a  
216 minimum of 2 hours for PE and sport within curriculum to all children, which was not  
217 previously the case (CCPR, 2005).

218 Boyce (1991) suggested that motor skill learning studies had not utilized sports skills,  
219 nor had they been conducted in field-based settings. A decade later, Hodges and Franks  
220 (2002) stated that the validity of previous laboratory-based findings had still not been verified  
221 in more applied settings. The current study, although not fully enabling us to understand  
222 motor skill teaching/learning, attempted to maintain a balance on the motor learning  
223 continuum (Christina, 1987) to fill an acknowledged gap in the field of motor skill  
224 acquisition. Hence, the study aimed to provide a bridging step between laboratory motor  
225 learning research and applied research (Silverman, 1994) by not restricting the time allowed  
226 for interaction between the learner and the instructor during practice, on the netball court.

227 However, future research should “*preserve the integrity of the teaching/learning*  
228 *environment*” further (Boyce, 1991, p. 55) by investigating feedback to a group vs. an  
229 individual only. Also, researchers should consider the learner-instructor interaction (e.g., in a  
230 PE setting; Koka & Hein, 2005) as well as the psychological aspects that affect such  
231 interaction (e.g., motivation, goal orientation, perceived competence; Standage & Treasure,  
232 2002) and the effect of practice and feedback on skill retention (Lee et al., 1994).

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Footnotes

307 1. Holders of England Netball Level 3 Coaching Certificate (“County Coach Award”) possess  
308 both theoretical knowledge and practical experience in netball coaching. This enables them to  
309 help groups of beginners to play and practice in a safe and enjoyable environment, by setting  
310 meaningful learning and coaching situations (see England Netball, 2000, for further details).

311

312 Table 1. Descriptive Data for the Scores of the Three Groups at Pre- and Post-Practice Testing  
 313 Sessions

	Pre-practice testing scores		Post-practice testing scores	
	M	SD	M	SD
CON	52.3	13.0	56.3	11.1
PRA	47.2	12.7	59.9	8.8
AUG	53.1	9.9	69.3	12.7

314

315 *Notes:* Scores are points out of 100 and expressed as mean (*M*) and (*SD*). CON: control

316 group; PRA: practice group; AUG: augmented feedback group.

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