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

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

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

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

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

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

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

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

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

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

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

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

Methods

Participants

Participants were 30 young adults (male = 12, female = 18; age M = 21.8 yrs, SD = 2.4 yrs) with some experience in goal-shooting activities; however, they had not practiced these type of activities (e.g., netball, basketball) for at least 2 years prior the experiment. Participants signed an informed consent form but were unaware of the purpose of the study, and were randomly allocated into a control (CON; 3 male, 7 female), practice (PRA; 7 male, 3 female), or practice with augmented feedback group (AUG; 1 male, 9 female).

Procedure

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

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

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

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

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

Statistical analyses

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

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

Results

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

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

Discussion

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

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

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

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

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

References

Amorose, A. J., & Smith, P. J. K. (2003). Feedback as a source of physical competence information: Effects of age, experience and type of feedback. *Journal of Sport and Exercise Psychology, 25*, 341-359.

Boyce, A. (1991). The effects of an instructional strategy with two schedules of augmented KP feedback upon skill acquisition of a selected shooting task. *Journal of Teaching in Physical Education, 11*, 47-58.

CCPR-Central Council for Physical Recreation (2005). Declaration from the National Summit on Physical Education. Retrieved March 20, 2005, from http://www.ccpr.org.uk/nlstory.cfm?ID=12080&NLID=50264

Chen, D.D. (2001). Trends in augmented feedback research and tips for the practitioner. *Journal of Physical Education, Recreation and Dance, 72*, 32-36.

Christina, R.W. (1987). Motor learning: Future lines of research. In M.J. Safrit & H.M. Eckert (Eds.), *The Cutting Edge in Physical Education and Exercise Science Research* (American Academy of Physical Education Papers No. 20, pp. 26-41). Champaign, IL: Human Kinetics.

Cooper, L.K., & Rothstein, A.L. (1981). Videotape replay and the learning of skills in open and close environment. *Journal of Motor Behavior, 3*, 281-287.

England Netball (2000). *Types of Awards*. Retrieved November 18, 2004, from http://www.england-netball.co.uk/coaching/index.cfm

Field, A. (2005). *Discovering Statistics using SPSS* (2nd ed). London: Sage.

Fredenburg, K. B., Lee, A. M., & Solmon, M. (2001). The effects of augmented feedback on students' perception and performance. *Research Quarterly for Exercise and Sport, 72*, 232-242.

Hebert, E. P., & Landin, D. (1994). Effects of learning a model and augmented feedback on tennis skill acquisition. *Research Quarterly for Exercise and Sport, 65*, 250-257.

Hodges, N. J., & Franks, I. M. (2002). Modelling coaching practice: The role of instruction and demonstration. *Journal of Sports Sciences, 20,* 793-811.

Kernodle, M.W., & Carlton, L.G. (1992). Information feedback and the learning of multiple-degree-of-freedom activities. *Journal of Motor Behavior, 24*, 187-196.

Koka, A., & Hein, V. (2005). The effect of perceived teacher feedback on intrinsic motivation in physical education. *International Journal of Sport Psychology, 36,* 91-106.

Landin, D. (1994). The role of verbal cues in skill learning. *Quest, 46,* 299-313.

Lee, T.D., Swinnen, S.P., & Serrrien, D.J. (1994). Cognitive effort and motor learning. *Quest, 46,* 328-344.

Little, W. S., & McCullagh, P. (1989). Motivation orientation and modelled instruction strategies: The effects on form and accuracy. *Journal of Sport and Exercise Psychology, 11,* 41-53.

Magill, R. A. (1994). The influence of augmented feedback on skill learning depends on the characteristics of the skill and the learner. *Quest, 46,* 314-327.

McCullagh, P., & Little, W. S. (1990). Demonstrations and knowledge of results in motor skill acquisition. *Perceptual and Motor Skills, 71*, 735-742.

Reeve, T. G., Dornier, L. A., & Weeks, D. J. (1990). Precision of knowledge of results: Consideration of the accuracy requirements imposed by the task. *Research Quarterly, 61*, 284-290.

Schmidt, R.A., & Wrisberg, C.A. (2004). *Motor Learning and Performance* (3rd ed). Champaign, IL: Human Kinetics.

Shakespear, W. (1997). *Netball: Steps to Success*. Champaign, IL: Human Kinetics.

Silverman, S. (1994). Communication and motor skill learning: What we learn from research in the gymnasium. *Quest, 46*, 345-355.

Standage, M., & Treasure, D.C. (2002). Relationship among achievement goal orientations and multidimensional situational motivation in physical education. *British Journal of Educational Psychology, 72*, 87-103.

Todorov, E., Shadmehr, R., & Bizzi, E. (1997). Augmented feedback presented in a virtual environment accelerates learning of a difficult motor task. *Journal of Motor Behavior, 29*, 1411-1427.

Tzetzis, G., Kioumourtzoglou, E., & Mavromatis, G. (1997). Goal setting and feedback for the development of instructional strategies. *Perceptual and Motor Skills, 84*, 1411-1427.

Viitasalo, J. T., Era, P., Konttinen, N., Mononen, H., Mononen, K., & Norvapalo, K. (2001). Effects of 12-week shooting training and mode of feedback on shooting scores among novice shooters. *Scandinavian Journal of Medicine and Science in Sport, 11,* 362-368.

Williams, A. M., Ward, P., & Chapman, C. (2003). Training perceptual skill in field hockey: Is there transfer from the laboratory to the field? *Research Quarterly for Exercise and Sport, 74*, 98-103.

Winstein, C. J., Pohl, P. S., & Lezthwaite, R. (1994). Effects of physical guidance and knowledge of results on motor learning: Support for the guidance hypothesis. *Research Quarterly for Exercise and Sport, 65*, 316-323.

Wulf, G., & Shea, C.H. (2004). Understanding the role of augmented feedback: The good, the bad and the ugly. In A. M Williams & Nicola J. Hodges (Eds), *Skill Acquisition in Sport: Research, Theory and Practice* (pp. 121-144). London: Routledge.

Zubiaur, M., Oña, A., & Delgado, J. (1999). Learning volleyball serves: A preliminary study of the effects of knowledge of performance and of results. *Perceptual and Motor Skills, 89*, 223-232.

306 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

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

Notes: Scores are points out of 100 and expressed as mean (*M*) and (*SD*). CON: control group; PRA: practice group; AUG: augmented feedback group.