

AUGMENTED FEEDBACK – THE TRIPTYCH CONUNDRUM

Ross Anderson

Biomechanics Research Unit, University of Limerick, Ireland

KEY WORDS – motor skills, real-time augmented feedback, feedback technologies

INTRODUCTION - The area of artificially augmented feedback of biomechanical parameters has received increased attention over the past decade; the advancement in miniature sensors and increased computer speeds has made real-time artificially augmented feedback of data (rtAF) commonplace in sport. The conundrum which exists in biomechanics, having easy access to technologies enabling rtAF, is ensuring an effective triptych – (1) the feedback must be accurate and relevant, (2) the feedback must be timely and delivered correctly, and (3) the feedback must be decipherable by the athlete. Research over the past decade in our group at the University of Limerick has attempted to shed light on this conundrum.

The first part of the triptych must be related to the type of feedback technology – our research has reported that elite coaches, when presented with either still or video images, are unable to correctly identify simple angle measurements accurately (O'Halloran & Anderson, 2005). This finding sets the scene for non-subjective feedback protocols to be considered. The traditional approach of oral feedback after visual observation must, therefore, be augmented by artificial sources of data. The development of sensors such as MEMS based accelerometers, gyroscopes, GPS etc. enables the biomechanist to design sensors which can provide accurate data to the coach/athlete/scientist combination. The decision on whether this is relevant data is then required; traditionally this involved subjective discussion between the coach, athlete, and scientist. Our current research (see Tucker et al., 2010) is attempting to answer this question with mathematical modelling related to golf; if we can alter the club head velocity (the outcome measure) by altering, for example, the variability at the right knee joint, it illustrates that this parameter has a direct influence on outcome; thus this may be worthy to be considered as a data source in the feedback protocol. Part one of the triptych conundrum is complete.

The second part of the triptych requires communication between the sports psychologist (or motor skill specialists) and biomechanists. The variety of ways this feedback data can be presented to an athlete is limitless and only governed by the imagination of the software programmer. Whether this feedback is to be delivered aurally or visually, concurrent or post-performance, blocked or random are questions that require consultation. The field of motor skill learning and development contains the answers, or at least the route to the answer, to most of these questions. However, the lab based experiment is still required; there is not a single scenario that suits all applications. We have completed work using aural feedback in gait (Hanlon & Anderson, 2005), visual feedback in rowing (Anderson et al, 2005), concurrent feedback in golf (Fitzpatrick & Anderson, 2007), post-performance feedback in swimmers (Meehan & Anderson, 2004) and numerous other combinations which have all resulted in positive results for feedback. The vital link between these research studies was the consultation with the motor skills specialists (see Butfield et al, 2009 for further discussion). Part two of the triptych conundrum is now complete.

The third part of the triptych is often overlooked by the scientists – the ability of the athlete to decipher and process the information provided to them via the feedback

loop. If the feedback is too complex and delivered concurrently the athlete has a propensity to switch off. There is anecdotal evidence from our work that, if the feedback is delivered visually, the athlete just closes their eyes and removes the feedback. Preliminary research examined this question from two perspectives. Firstly, during a maximum effort task (2000m row) athletes were asked to respond to either a verbal instruction, a visual distraction, or a combined task (O'Leary & Anderson, 2002). The results indicated that overall performance did not change when the athlete carried out these tasks – the implication of this is that the athlete has a reserve of processing power even when participating in a maximal effort highly complex motor skill; therefore feedback of information that requires some processing is acceptable. Secondly, it seems very beneficial for the athlete to understand the direct link between their actions and the resultant outcomes. During a simulated line-out throwing task in rugby one group was provided with two 1 hour sessions on the physics of the ball flight, impact of ball rotation, projectile motion etc. and outperformed the control group in the post test (Anderson et al., 2005). Resultantly, we must enable the athlete with the skills to interpret and decipher the information being provided to them within the feedback protocol. Hence, part three of the triptych conundrum is now complete.

CONCLUSION - Feedback of biomechanical data in sport can be very successful, and lead to performance gains in both outcome measures and movement characteristics; both essential for the advancement of sport. However, to gain this success consideration must be given to all parts of the triptych. Each part must support the other, if one fails the whole triptych fails – and the conundrum will then remain unanswered. The presentation will discuss this conundrum in more detail and outline the process we have gone through at the University of Limerick to ensure our triptych is in place and functions well.

REFERENCES

- Anderson R, English H, Healy AC, O'Neill RA, Stanley EJ, McCormack WG, Kelly BC (2005) Performance Versus Understanding: Does the understanding of biomechanical principles affect the performance of motor skills?, *Unpublished Honours Thesis*, University of Limerick
- Anderson R, Harrison AJ & Lyons G (2005) Accelerometry-based Feedback – Can it Improve Movement Consistency and Performance in Rowing?, *Sports Biomechanics*, 4:179-195, 2005
- Fitzpatrick K, Anderson R (2007), The Effect of Golf Kinematics on Putting Performance, In: *Proceedings of the 25th International Symposium of Biomechanics in Sport*, Ouro Preto, Brazil, August 23 – 27,
- Hanlon M & Anderson R (2005) Effect of audio versus visual bandwidth kinematic feedback in learning and replication of a simple lower limb movement skill, In: *Proceedings of 3rd International conference of Biomechanics of the Lower Limb in Health Disease and Rehabilitation*, Manchester. 156
- Meehan J & Anderson R (2004) Investigation into the Development of an Automatic Stopwatch for use by Competitive Swimmers, *Unpublished Honours Thesis*, University of Limerick
- O'Halloran J & Anderson R (2005) An evaluation of the accuracy of joint angle magnitude perception, In: *Proceedings of the European College of Sport Science 10th Annual Congress*, Belgrade, Serbia, 461
- O'Leary E & Anderson R (2002) The Effect of Distraction on the Biomechanical Technique of Rowing, *Unpublished Honours Thesis*, University of Limerick
- Tucker C, Kenny I, & Anderson R (2010) Development of a large-scale golfer computer model to study swing kinematics, accepted for publication *Proceedings of the 8th International Conference of the Engineering of Sport*, Vienna, Austria