Biomechanics Feedback to Olympic Athletes – Two Feedback Models

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KEY WORDS – Biomechanics, Kayaking, Hockey, Skill Acquisition

INTRODUCTION/OVERVIEW: One of the challenges for biomechanics, as a discipline in general, has been to provide meaningful and timely feedback to athletes. This is particularly the case where the biomechanist is working with athletes frequently over a period of time. A number of different approaches in providing feedback to athletes can be made depending upon the question asked, testing setting, and the data collected. These issues need to be balanced when dealing with Olympic athletes.

The Australian Insititute of Sport biomechanics programme has been working with Olympic athletes for over 25 years now. Essential in this programme is the collection of high quality biomechanical data and importantly, the feedback of this information to the athletes. This provision of feedback has seen a number of changes during this 25 years. Initially, feedback models followed a service based approach typified by frequent testing and quick feedback. More recently the environment has changed where a research/project based model is increasingly used in applications where this model is considered more optimal. Another important development has been the addition of Skill Acquisition specialists to the AIS in 2002. There is an ideal symbiosis between biomechanics and skill acquisition, where the main aim is to improve athletes' technique and performance. Meaningful feedback and application of the results and findings of testing is essential.

Service Based Model

A service based model is where tests and analysis are conducted on a regular basis with relative ease and minimal disruption to the training and/or competition program (Baker, 1998; Sperlich & Baker, 2000). Results are then provided to the athletes and coaches in a short space of time so that any findings or recommendations are able to be implemented. Research and/or data mining underpins the variables used as the prime analyses foci.

Prior to the commencement of a scholarship with the AIS Sprint Kayaking program athletes complete a VARK (Fleming et al., 2005) questionnaire to determine their preferred learning style. Where possible the feedback provided to the athletes is then catered around their learning styles.

In light of previous work for AIS sprint kayaking (Baker et al., 1997), the emphasis of the servicing program was on-water force testing. Using a force system developed by the AIS (Hunter & Davis, 2007), it has been possible to test paddlers' on-water and then shortly after, show them results of their force related, and boat movement, parameters. Two of the key factors in sprint kayaking performance are the peak force applied to a paddle during a stroke, and the related impulse. In addition the shape of the force-time curve is important (Baker et al., 1999). With the data and video combined, and the respective coach present, feedback is provided in a group setting where the preferred learning style of the athlete is catered for in the feedback.

In addition to the on-water testing, servicing includes race planning and race analysis. This work is important to provide feedback on athletes' race performance and to improve aspects of the athletes' race plan. The use of GPS and MEMS based sensors are used for this testing.

Project Based Model

A project based model is set up to answer a specific research question. For the Australian Hockey team it was to improve goal keepers' ability to defend goals in short corners, specifically for a drag flick. This project was used as preparation for the 2004 Olympic Games.

Task complexity is a major issue for goalkeepers in a short corner. Apart from the shot itself there are a number of confounding factors to deal with such, as variation plays, and attackers and defenders being actively involved. However the over-riding issue, as verbalised by the goalkeepers and coaches, was the ability to determine drag flick direction.

Based on this task analysis, a three step project was designed:

1. A 3D motion analysis of the drag flick to determine the key kinematic factors.
2. Temporal occlusion testing to help ascertain when goalkeepers start to pick up visual cues from the drag flickers. The temporal occlusion epochs were based on the biomechanical analysis so as specific facets of the movement, which determined direction, were contained within the presented visual phases. Within the temporal occlusion testing a moving-window design was also included to determine whether direction prediction is driven by the content of the visual information presented rather than available processing time.
3. A video-based temporal occlusion training programme to support the on-field training the goalkeepers perform with the team and the goalkeeping coach. The temporal occlusion testing determined information pick-up occurred very late in the drag flick movement. From this result, combined with biomechanical findings, the occlusion training was orientated towards late in the movement.

The outcomes of the project were:

1. The key kinematic parameters of the drag flick and when they occurred in the movement was identified.
2. From a visual-perspective aspect when in the movement goalkeepers started to pick-up information was determined. Furthermore, the occlusion testing determined that kinematic content of the occlusion condition rather than processing time is responsible for the anticipatory skill of goalkeepers (Baker et al., 2010).
3. The video-based training programme increased prediction rates of drag flick direction.

CONCLUSION: Two common methods of feedback used at the AIS have been presented with both achieving their objectives. The Servicing Based Model is used when there is a need for on-going monitoring of athletes' performance. The Project Based Model is typically used when there is a need to answer a specific question, and is often used with sports where there isn't an on-going need for biomechanical analysis. Each feedback method also illustrates the benefit of combining biomechanics and skill acquisition in the elite sport environment. As an addition, task representative design of testing has been a constant issue for biomechanists. Motor learning theorists, principally those from the dynamical systems approach (Arujao et al., 2007), would argue the ecological validity of testing is omnipotent. As biomechanics advances these theories will impact more on our feedback methods, and will need to be addressed.

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