A NOVEL COMBINATION OF NON-SELF MODELLING AND REAL-TIME VISUAL FEEDBACK TO IMPROVE ROWING PERFORMANCE

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This study assesses the use of a method of concurrent video feedback combined with non-self modelling to assist learning and performance in rowing. A video image, containing a live video feed, is presented to the participant combined with a pre-recorded video sequence of an elite rower at various stroke rates. Sixteen volunteers participated in the study (20.8+1.7 years); eight were allocated to the experimental group (E) and eight to the control group (C). Data pertaining to rowing skill (stroke length (SL) and stroke rate (SR)) and rowing performance (overall distance (D) and average power (AP)) were obtained during a pre- and post-test separated by a seven-week intervention period. The results illustrate significant changes in all four parameters for the experimental group; D – P=0.013, AP – P=0.011, SL – P=0.001, & SR – P=0.042. The control group demonstrated significant changes in skill (SL – P=0.003; SR – P=0.005) and no significant differences in performance (D – P=0.21; AP – P=0.093). The results indicate that concurrent real-time video feedback had a positive effect on both skill acquisition and performance of the rowing motor skill for beginner rowers.

KEY WORDS: rowing, concurrent feedback, non self modelling, demonstration

INTRODUCTION: Individual ability in rowing incorporates psychological, physical and technical parameters, each of which requires training and development over time. However, success in competitive rowing has shown to be strongly related to technical skill (Henry et al., 1995). It is important to consider the rowing skill as a motor pattern which makes it possible for the athlete to achieve the fastest rowing times and the highest average boat speed over the rowing distance on the basis of his/her individual available energy potentials at the lowest possible external resistance (Schwanitz, 1991). Rowing can be described as a continuous motor skill with a specific repetitive beginning and end location and a gross motor skill because of the mass of musculoskeletal function required to perform the skill. As no optimal rowing stroke exists for a specific individual (Atkinson, 2002) a beginner will benefit by attempting to replicate an advanced stroke pattern to learn the fundamentals of the rowing stroke prior to specific analysis by a coach or sport scientist. Therefore, rowing, as a complex motor skill, may benefit from both augmented feedback and demonstration during learning stages.

Lintern et al. (1990) propose that a positive learning effect will occur with concurrent feedback if it facilitates the important characteristics or relationships in the action. In rowing, the concept of observational learning (Williams et al., 1999) may be used effectively where the subject watches a model technique, from, for example, an elite rower. However, it has been suggested that a learner can watch a demonstration of a skill and still feel they do not have the capability to carry out that skill no matter how good the demonstration is (Schempp, 2003). However, self-modelling, regarded as an athlete seeing themselves perform a skill correctly (Magill, 2004), may be beneficial to the aim of learning the rowing skill.

Video can be used to provide visual knowledge of performance related augmented feedback. The combination of real-time feedback with concurrent demonstration and self-modelling has the potential to become a highly effective training tool. The development of a combined feedback tool where demonstration is merged with real-time feedback and self modelling has been hindered in the past by technical obstacles. However, the continual development of video based tools and the inexpensive nature of consumer electronics have led to the required equipment becoming affordable and available.

This study aims to determine if real-time video feedback combined with real-time demonstration can overcome these issues with the creation of a feedback mechanism

consisting of a non-self demonstration model merged with the real-time video feedback of the participant allowing concurrent demonstration and feedback. The demonstration model is based on an international level rower (the creation of the model is discussed later) and the real-time video is obtained in the sagital plane. The participant is then instructed to attempt to replicate the model (the experienced rowers) by observing the merged video feed, consisting of real-time feedback, demonstration model, and information pertaining to self-modelling. It is hypothesised that this novel feedback mechanism will result in an increased learning ability in a complex motor skill and an increased performance level.
METHODS: Sixteen participants were recruited – experimental (E) (n=8; age - 20.8+1.7 years) and control (C) (n=8; age - 21.7+1.7 years). To be included in the study the participants must have had very little or no experience of rowing. The subjects completed an informed consent form and pre-test questionnaire and received an individualised information sheet. Participants were familiarised with the testing procedures and any possible risks were outlined. Ethical approval for this study was obtained from the University Research Ethics Committee.
The feedback mechanism consists of two components which are combined to produce the final mechanism; a non-self model and real-time visual feedback.

Non-self Model Creation - The non-self model was based on an International level female rower (age – 21.2 years). The rower was asked to row for 5000 m on a RowPerfect ergometer (CARE RowPerfect, The Netherlands). The session was divided up into six 1000 m phases (1000m at 28, 26, 24, 22, & 20 strokes per minute) and was videotaped in the sagital plane. From each phase one stroke was selected; a stroke which displayed higher than average power output and an average stroke length; considered, in this case, to be close to optimal. The video footage of each of these strokes was repeated continuously for 330 seconds using commercially available video-editing software (Adobe Premiere 6.0, Adobe, San Jose, USA). Each stroke repetition was joined precisely to the previous one to create the illusion of continuity.

Real-time Visual Feedback - The real-time visual feedback component is used to illustrate the participants sagital view in real-time. The images are captured using a DV camera (Canon MV600i, Canon Inc., Japan) and are displayed on a 3 m by 4 m screen positioned directly in front of the rower at their natural eye level. Therefore, the participant obtains a real-time view of themselves as if they were observing themselves in the sagital plane.

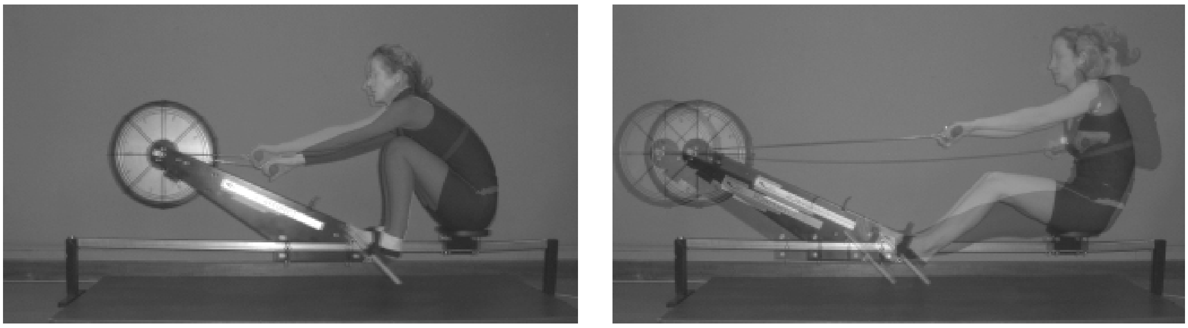

Figure 1 – The video image displayed to the participant during the intervention session; left – when the participant matches the expert well and right – when there is a considerable difference (simulated)

Creation of Final Feedback Mechanism – Each of these feedback mechanisms, i.e. non-self model and real-time visual feedback, may be used independently of each other. However, this study reports on combining each of these to offer a novel and potent alternative. To achieve this, the non-self model (pre-recorded footage) and real-time visual feedback (live footage) were combined using an analogue video mixer (Videonics MX-1, Focus Enhancements Inc., USA). The resulting image consisted of a merged image with the live feed and recorded feed being reduced to 50% opacity in real-time and superimposed on top of each other (see Figure 1).

Study Design – The pre- and post- tests for both groups (E & C) consisted of a 330 s maximal effort session on a RowPerfect ergometer. During the pre-test the following data was obtained – stroke length (SL), stroke rate (SR), overall distance (D) and average power (AP). SL and SR were indicative of rowing skill whereas D and AP were indicative of rowing performance. Prior to each of the seven intervention sessions all participants viewed sixty seconds of video illustrating the expert rower and provided with a specific coaching point to focus on for that session. Group C completed seven intervention sessions over a seven week period and received no further information or feedback during or outside the intervention sessions. Group E completed seven sessions over a seven week period while using the previously described feedback mechanism. Session 1 was treated as an introduction to the experimental set-up and the feedback mechanism was set at 28 strokes per minute (spm). Sessions 2 – 7 all used the feedback mechanism which was set at 28 spm, 26 spm, 24 spm, 22 spm, 20 spm and 28spm respectively. After completion of the intervention period a post-test was carried out. The structure of the post-test was identical to the previously described pre-test. The performance data and skill data were analysed separately using full factorial repeated measures general linear model Analysis of Variance (ANOVA). Mauchly's test of sphericity was used to determine the sphericity assumption within the data, and where this test was significant a Greenhouse-Geisser correction was used. Pairwise comparisons were made on the resultant data; a Bonferroni correction was applied for multiple comparisons; a significance level of 0.05 was used to infer a statistical difference.

RESULTS & DISCUSSION: Rowing Performance – Group E demonstrated a significant improvement in D, with a mean increase of 215±61.5 m (P=0.013). There was no significant change in D post intervention detected for Group C, with a mean increase of 110±76.2 m (P=0.21). Group E also demonstrated a significant increase in AP, with a mean increase of 43.8+12.13 Watts per stroke (P=0.011). There was no significant change in AP from pre to post detected for Group C , with a mean increase of 22.9+17.30 Watts per stroke (P=0.21). The increase in power per stroke and distance in the intervention group may be explained by the change in technique of the participants, this was confirmed by visual inspection. Also, rowers who apply a steady force on the oar are able to produce the largest power. This was also evident in the majority of participants by qualitatively assessing the RowPerfect data.

Rowing Skill – Both Groups E & C demonstrated significant improvements in SL, with a mean increase in SL for Group E of 20.9±3.6 cm (P=0.001) and a mean increase in SL for Group C of 17.6±2.2 cm (P=0.003). Both Groups E & C also demonstrated significant improvements in SR, with a mean decrease in SR for Group E of 8.6±3.3 spm (P=0.042) and a mean decrease in SR for Group C of 9.1±2.9 spm (P=0.005). In summary, both groups (C & E) were successful in improving both SL & SR. The underlying reasons may be due to the emphasis placed on stroke rate and stroke length during both intervention sessions for groups C & E. Both SL & SR are easier to judge using kinaesthetic feedback than AP & D, therefore both groups may be provided with enough feedback during the intervention sessions to learn to increase stroke length and decrease stroke rate. However, the improvements in these relatively simplistic measures of rowing skill were not mirrored by significant improvements in rowing performance. Therefore, it may not be as important to consider the rowers movements patterns without taking into account the performance measures.

It has been reported that successes build a strong belief in one's personal efficacy (Bandura, 1994). The idea that the participants were learning from their own mistakes as well as through the guidance obtained from the expert may explain their increase in rowing performance and rowing skill. McCullagh & Caird (1990) found that performance after watching a learning model was better than performance after watching an expert model. It is

evident from this study that a combination of both a learning model and an expert model may be an effective method of learning. It is clear that a combination of improvements in all parameters affected the overall skill and performance levels in each of the participants. However, from the control data it is evident that certain changes may occur simply as a result of time spent on a rowing ergometer but it must considered that a significant improvement in these parameters (SL & SR) was not mirrored by an improvement in rowing performance.
CONCLUSION: In conclusion, both performance and skill parameters were significantly improved illustrating that the feedback mechanism proposed herewith has a positive effect on overall rowing performance. However, skill parameters also improved significantly in the control group and therefore these changes may not be solely as a result of the intervention but as a result of practice and time. These skill indicators are relatively crude and although measured accurately, may not connect with the actual technique to a high level. However, these two measures (stroke length and stroke rate) are utilised by coaches, rowers and sport scientists on a daily basis as the basic tool for verbal feedback during regular coaching and training. It may be that practice alone can improve these parameters. However, it must considered that a significant improvement in both of these parameters was not mirrored by an improvement in rowing performance. Ultimately it is rowing performance and not rowing skill that will decide the winner of a rowing race at any level. Anyone who is involved with rowing must appreciate that visual improvements in technique do not necessarily cause improvements in performance. The feedback mechanism proposed here was successful in improving both performance and skill level and therefore when considering feedback to rowers however this is delivered (i.e. verbally through the coach or via a complex feedback system), the correct information must be fed to the rower that links directly to the preferred outcome.

In summary, the relatively inexpensive feedback mechanism proposed herewith based upon a non-self model combined with real-time visual feedback offers a potent combination to provide a rower or coach a tool which may offer information pertaining to both skill and performance and offer improvements in both.

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