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The effect of learner's control of self-observation strategies on learning of front crawl

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ABSTRACT

This study investigated the effect of learner's control of self-observation strategies on motor skill learning. For this purpose, beginner and intermediate learner swimmers practised the front crawl. Seventy college students took part in this experiment. They comprised 40 novice learners, both male ($n = 19$) and female ($n = 21$), with an average age of 20.7 years (± 0.44), and 30 intermediate learners, both male ($n = 17$) and female ($n = 13$), with an average age of 21.1 years (± 0.86). The design involved a pretest (one day), four acquisition sessions (four days), and a retention test (one day). They were divided into three groups: (1) choice, which could choose to watch a video with their best or overall performance during practise; (2) yoked, which were paired to those of the choice group; and (3) control (did not watch any video). The measures included the performance of front crawl and self-efficacy. The results showed that: (1) beginners who chose a type of observation strategy had superior motor skill learning; (2) for intermediate learners, self-observation promoted better motor learning, regardless of the control of choices; (3) self-observation improved self-efficacy beliefs.

1. Introduction

In the last few years, the active involvement of the learner with his/her learning process has been increasingly recognized as one of the most influential aspects of motor learning and performance (Bjork, Dunlosky, & Kornell, 2013; Chen, Hendrick, & Lidor, 2002; Ste-Marie, Vertes, Law, & Rymal, 2012; Wulf, 2007). Studies examining this topic have been developed in order to understand self-controlled learning, i.e., the effects of learners' control on the feedback regimen (Aiken, Fairbrother, & Post, 2012; Fairbrother, Laughlin, & Nquyen, 2012; Patterson, Carter, & Hansen, 2013), practise schedule (Post, Fairbrother, & Barros, 2011; Walter, Bastos, Araújo, Silva, & Corrêa, 2008), goal setting (Boyce, 1994; Corrêa & Souza, 2009; Marques, Walter, Tani, & Corrêa, 2014), and, of special concern for this study, modelling/observation (Fagundes, Chen, & Laguna, 2013; Ste Marie et al., 2012).

In general, researchers have reported that self-control implies the following benefits for the learner: (1) a more active engagement in the learning process, which seems to lead to a deeper processing of relevant information; (2) greater feelings of self-efficacy, and therefore greater intrinsic motivation; (3) perception of self, which leads to greater commitment; (4) more effort and persistence; (5) more individualized and specific experiences; (6) more responsibility for learning; (7) increase in participation, and (8) control of the evaluation of performance by self-regulatory mechanisms (e.g., see Andrieux, Danna, and Thon (2012); Bund and Wiemeyer (2004); Chiviacowsky and Wulf (2005); Clark and Ste Marie (2007); Corrêa and Walter (2009); Ste-Marie et al. (2012); and Wu and Magill (2011)).

With regard to modelling, a strategy known as self-as-a-model, in which the learner observes his/her performance by watching videos, has been used in research on motor learning and performance, including in sport contexts (e.g., Clark and Ste Marie (2007); Dowrick and Dove (1980); Martini, Rymal, and Ste-Marie (2011); Starek and McCullagh (1999); Ste Marie, Rymal, Vertes, and Martini (2011); Ste Marie, Vertes, Rymal, and Martini (2011); and Ste-Marie et al. (2012)). One could say that such body of work have been grounded on Dowrick's proposition that self-modelling makes possible processes of reconfiguration or reorganization (feedforward) and development of consistency of acquired behaviours (positive self-review) (Dowrick, 1999). Specifically, these processes are related to the learner's (1) growth of adaptive behaviour, (2) ability of generalization (transfer), and (3) motivation (Dowrick, 2012; Prater, Carter, Hitchcock, & Dowrick, 2012). The self-modelling (Dowrick, 1999) and self-as-a-model (Clark & Ste Marie, 2007) strategies have been used to refer to the observation of own performance, especially with functions of feedback and feedforward, instead of modelling based on Bandura's (1989) social cognitive theory. For this reason, the term self-observation is used throughout this study to refer to the foregoing phenomenon.

In order to investigate the effects of different types of self-observation strategies on motor learning, Clark and Ste Marie (2007)

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divided children into three groups in a swimming programme: (1) observation of their best performance, (2) observation of their overall performance, and (3) no observation (control). In the first group the emphasis of the observation was on correct behaviour or on the best that an individual could perform. In the second, the observation involved correct and incorrect behaviours. All videos contained 15 s of skill and for this reason the frames were quadruplicate to the last minute of the film. Results showed that the observation of the best performance group obtained better performance and better levels of self-efficacy and motivation than the observation of the overall performance and control groups.

Despite the acknowledged importance, in the motor learning field only a limited number of studies using both the foregoing self-observation procedures (best and overall performance) have been developed. They have involved different learning tasks such as swimming (Clark & Ste Marie, 2007; Martini et al., 2011) and gymnastics (Ste Marie, Rymal, et al., 2011; Ste Marie, Vertes, et al., 2011). Overall, results seem to leave no doubt that watching a performance is more beneficial for learning than not watching. Furthermore, the results are still inconsistent, that is, they do not allow a clear conclusion to be drawn on the effects of these two variables on motor learning, since they point to different directions. For example, whereas Clark and Ste Marie (2007) and Martini et al. (2011) found no differences between the self-observation of best and overall performance in motor learning, Ste Marie, Rymal, et al. (2011) revealed better learning for self-observation of overall performance, and unlike Ste Marie, Vertes, et al. (2011) did it regarding self-observation of best performance.

Importantly, none of the aforementioned studies provided the learner with control of the type of self-observation, that is, they failed to give learners the opportunity to choose which of their performances to observe. On this basis, self-observation strategies could be optimized by providing choice to the learners. Another important limitation of the studies previously mentioned is that only a few of them used adequate tests to infer motor learning occurrence, i.e., retention and/or transfer tests (e.g., Clark, Ste Marie, and Martini (2006) and Ste Marie, Rymal, et al. (2011)). As is well known, retention and transfer tests are important for assessing the permanent and generalizable effects of practise, i.e., learning phenomenon (Schmidt & Lee, 2011). Therefore, we sought to understand the effect of learner's control on types of self-observation in motor skill learning.

Motor skill learning is conceived as a process that unfolds in identifiable sequential phases whose developments imply gain in comprehension and control of the task (see Tani et al. (2014), for a review). For instance, Fitts and Posner (1967) described motor skill learning as occurring through cognitive, associative, and autonomous phases. In the cognitive phase, the learner is overwhelmed by a wealth of information surrounding the performance context, and attempts to reduce it. In the cognitive phase, the understanding of the task requirements and the elaboration of the action plan occur. By the time of the associative phase, the learner understands the task goal, and tries gradually to reduce the discrepancy between the intended and the actual performance. Finally, the autonomous phase is characterized by a minimal amount of conscious involvement during the performance of motor skill. As a consequence, accurate and coordinated movements are performed autonomously. In the light of this, it seemed reasonable to hypothesise that learners in the initial stage of learning would not benefit from freedom of choice. Because of their difficulty in understanding the task requirements and elaborating the action plan, they would not be able to make adequate choices in relation to their needs. Otherwise, only type of self-observation could affect these learners. On the other hand, we thought that the learners in the intermediate stage of learning would be benefited by choosing self-observation of best performance or self-observation of overall performance, because they would be able to identify and select the best information in order to better their performance. Thus, the choice of the type of self-observation could be manipulated in terms of the initial and intermediate stages of motor learning.

2. Method

2.1. Participants

Seventy college students took part in this experiment. They comprised 40 novice learners, both male ($n = 19$) and female ($n = 21$), with an average age of 20.7 years (± 0.44), and 30 intermediate learners, both male ($n = 17$) and female ($n = 13$), with an average age of 21.1 years (± 0.86). The study was approved by the Ethics Committee on Human Research at the State University of Maringá, Brazil and participation required the written consent of the learner.

The inclusion criteria were: (1) being over 18, (2) being up to 1.75 m tall in order to allow for evaluation through swimming footage, (3) the absence of respiratory or muscle/joint problems which would interfere with the performance of swimming, (4) being physically active, (5) showing a minimum rate of 60% of motivation for learning the front crawl as assessed by Clark et al.'s (2006) questionnaire, and (6) participation in all experimental phases.

2.2. Task and equipment

As previously mentioned, the front crawl was used as the learning task. This motor skill was selected because learners are unable to observe themselves during their performance. Furthermore, this skill has been used in experiments on self-as-a-model (Clark & Ste Marie, 2007; Dowrick & Dove, 1980) and therefore there are some well-established research protocols.

The following camera equipment was used: a JCV Everio HD®, GZ300, resolution 1080/60P, 3CCD, 200× digital zoom and 10× optical used at a frequency of 60 Hz for aerial footage, and an HD Camera AEE Xtrax of Sports® model SD20, picture setting 1080/60P, at a frequency of 30 Hz for underwater footage. Virtualdub 13.0 software was used for editing videos. For videos available to the learners before the practise session, we used an HP Ultrabook® brand 14 Intel core i3®, and the software used to run the videos was Kinovea 7.0.

2.3. Design and procedures

The experiment consisted of three phases: pretest, acquisition, and retention. In the first phase, learners received explanations about the purpose of the pretest and were asked to swim the front crawl for 25 m. Beginners were those participants who obtained between 15% and 29% of success in the crawl based on a specific qualitative checklist (Madureira et al., 2008; Madureira, Bastos, Corrêa, Rogel, & Freudenheim, 2012), and intermediate participants were those who achieved between 30 and 55% in the aforementioned checklist. This checklist was validated in the light of the expertise of researchers and coaches on the influence of errors related to the hydrodynamic resistance and propulsion generation and their respective weights on the swimmer's displacement (Madureira et al., 2008, 2012). They are: (1) attack and recovery, (2) release, (3) synchronization of the upper limbs, (4) respiration, (5) synchronization between upper limbs and respiration, (6) scan down, (7) scan inside, (8) upward sweep, (9) body positioning, (10) lower limbs, (11) synchronization between the lower limbs and breath, and (12) synchronization between lower and upper limbs. The errors for each component are contralateral, pointing to the right and left side of movement by using weights of partial (0.5 for items 6, 7, 8, 10, and 1.5 for other items) and total errors (1.5 for items 6, 7, 8, 10, and 2.0 for other items). If no error occurs, zero is assigned. The scores are based on errors with a maximum score of 152. Thus, the lower the score, the better the performance.

After learners were assessed as beginners or intermediate, they were randomly assigned into the following experimental groups:

–*Choice* (beginners $n = 15$; intermediate $n = 10$): before each practise session learners could choose the video they wanted to watch: