Observational Learning
Self-observation Can Be Detrimental to Learning

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1 OBJECTIVES

Observation of a model who is performing a motor skill improves naïve observers' learning of that skill (for a recent review see Ste-Marie et al. 2012). Research has indicated that action observation and action production share a common neural network, which is activated when individuals perform a given motor task and when they observe others performing that same motor task (Buccino et al. 2001; Cross et al. 2009). Recent research has shown that optimal observational learning occurs with the observation of both novice and expert models rather than either a novice or an expert model alone (Andrieux and Proteau, 2013; Rohbanfard and Proteau, 2011). The aim of the present study was to determine whether self-observation or a combination of expert and self-observation would promote learning better than observation of an expert model and a "generic" novice model. Such a scenario could be the case because self-observation would underline errors that are specific to oneself, whereas the combination of expert and self-observation would have the additional benefit of allowing the learner to determine what to do to improve his or her performance.

The task that we chose required that the participants change the relative timing pattern that naturally emerged from the task constraints to a new imposed pattern of relative timing. This is similar to changing one's tempo when executing a serve in tennis or a drive in golf.

2 METHODS

One hundred right-handed university undergraduate students (55 males and 45 females; mean age = 21.2 years; SD = 1.8 years) participated in the experiment. The participants had no prior experience with the task. The participants completed and signed an individual consent form before participation.

The apparatus was similar to that used by Rohbanfard and Proteau (2011). The task consisted of successively hitting four barriers of equal size in a clockwise motion. The distances between each barrier were 15, 32, 18, and 29 cm. The participants were required to complete each of the four segments of the task in an intermediate time (IT) of exactly 300 ms for a total movement time (TMT) of 1200 ms. All of the participants performed four experimental phases over a period of three consecutive days.

On day 1 and before the first experimental phase, all of the participants received verbal instructions regarding the TMT and IT goals. The first experimental phase was a preparatory phase, in which the participants performed 40 trials with knowledge of the results (KR) of their TMT but not their ITs. The participants were filmed during this first experimental phase. At the end of day 1, the participants were randomly assigned to one of five groups: control (C), physical practice (PP), expert and "generic" novice observation (EGO), expert and self-observation (ESO), and self-observation (SO). Day 2 began with a pre-test in which all of the participants performed 20 trials without knowledge of the results (KR) of their TMT and ITs. The pre-test was followed by an acquisition phase. In this phase, the participants in the PP group physically practiced the experimental task for 40 trials. The participants in the EGO group individually watched a video presentation of two models (an expert and a "generic" novice model) performing 20 trials each. The films recorded in the preparatory phase were edited and used in the acquisition phase of the study for the ESO and SO groups. The ESO group observed 20 trials performed by an expert model and 20 randomly chosen trials of their own performance filmed during the preparatory phase (EGO). For both the EGO and ESO groups, the model was alternated every 5 trials (i.e., expert model 1: trials 1–5 and generic novice or oneself: trials 6–10 and so on). The participants in the SO group observed the 40 trials of their own performance that were filmed during the preparatory phase. For the PP, EGO, ESO

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and SO groups, KR of both the TMT and ITs was provided in ms after each of the physically performed (PP group) or observed (EGO, ESO, and SO groups) trials. The participants in the control group did not take part in the observation or physical practice protocol but rather read a provided magazine for the same duration as the observation phase for the other groups. All of the participants completed the third and fourth experimental phases: 10-min and 24-hour retention phases that were similar in all points to the pre-test. The retention tests were performed on day 2 and day 3.

For each trial, we computed a root mean square error (RMSE) of relative timing, which indicates in a single score how much each participant deviated from the prescribed relative timing pattern. For each trial,

$$\mathrm{RMSE} = \sqrt{\sum_{\text{Segment } 1}^{\text{Segment } 4} \left(\frac{(\mathrm{ITi\text{-}target})^2}{4} \right)} \qquad (1)$$

where ITi represents the intermediate time for segment “i”, and the target represents the goal movement time for each segment of the task (i.e., 300 ms).

A preliminary analysis of the individual data revealed two patterns of results depending on the initial level of performance of the participants in the pre-test. To better understand how the initial level of performance influenced the learning of the new relative timing pattern, we rank ordered the participants as a function of their initial performance and made two subgroups that included the 40 participants that had a “better” initial performance and the 40 participants that had a “poorer” initial performance. The data of each subgroup were individually subjected to an ANOVA comparing five groups (PP, EGO, ESO, SO and C) × three phases (pretest, 10-min retention, and 24-hour retention) × four blocks of trials (1-5, 6-10, 11-15, and 16-20), with repeated measures for the last two factors.

3 RESULTS

For the participants who had a “better” initial performance, (Figure 1, top panel) the ANOVA revealed a significant group × phase interaction (F [8, 70] = 4.06, p = 0.001). The breakdown of this interaction did not reveal any difference in RMSE proceeding from the pre-test to both the 10-min and the 24-hour retention tests for the C, EGO, and ESO groups (F [2, 34] = 0.38, 1.20, and 1.10, p > 0.25, respectively). However, although we noted a significant decrease in RMSE for the PP group proceeding from the pre-test to either retention tests (F [2, 34] = 5.27, p = 0.01), we noted a significant increase in RMSE for the SO group (F [2, 34] = 6.12, p = 0.005). For the participants who had a “poorer” initial performance (Figure 1, bottom panel), the ANOVA revealed a significant group × phase interaction (F [8, 70] = 4.67, p < 0.001). The breakdown of this interaction did not reveal any difference in RMSE proceeding from the pre-test to both the 10-min and the 24-hour retention tests for the C group (F [2, 34] < 1). However, for the EGO, ESO, SO and PP groups, there was a significant decrease in RMSE proceeding from the pre-test to either retention tests (F [2, 34] = 8.71, 4.67, 24.16, and 3.62, p < 0.05, respectively).

4 DISCUSSION

The live or video observation (Rohbanfard and Proteau, 2012) of a model practicing a motor skill favors the learning of that skill by the observers. One goal of our laboratory is to determine the conditions of observation that would optimize learning.

The results of the present study confirm previous findings indicating that one can learn a new relative timing pattern through observation (Andrieux and Proteau, 2013; Rohbanfard and Proteau, 2011). However, although physical practice resulted in a significant reduction in the RMSE of relative timing regardless of the initial level of performance, this was not the case for the observation groups. In this regard, our results indicate that if physical practice is not possible (e.g., because of lack of material or injury) or not advisable (e.g., when there is an element of danger), observation is a powerful learning tool with novices whose performance largely departs from the desired relative timing pattern. Our results also suggest that mixed observation of either oneself or a generic novice model combined with that of an expert model provides better learning than self-observation. We suggest that the comparison of expert and novice performance in a mixed observation protocol helps the observer to both detect his or her errors and to develop a good representation of what to do.

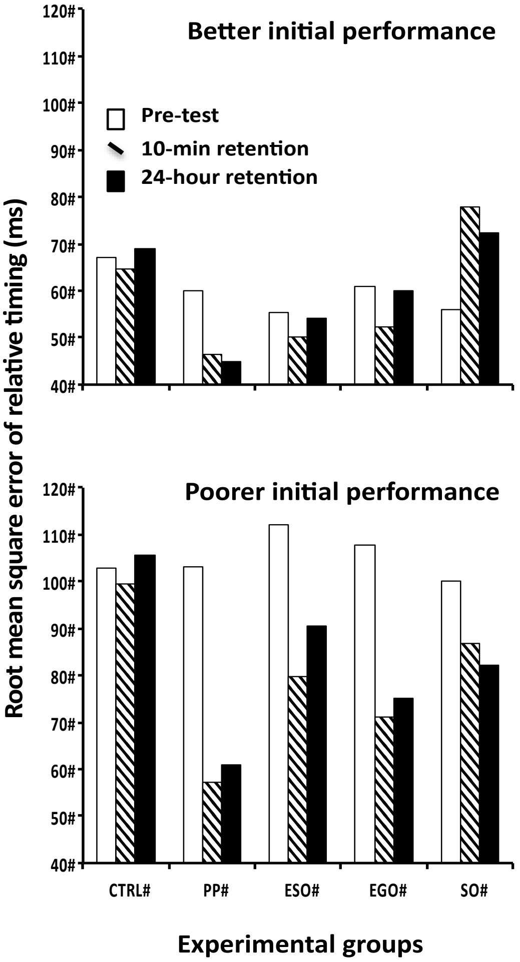

Figure 1: The root mean square error of relative timing as a function of the initial performance, the experimental phases and the experimental groups.

However, when a novice's initial performance is relatively good, our results indicate that self-observation could be detrimental to learning a new relative timing pattern. We suggest that this could be the case because self-observation (a) does not underline the technical aspect on which to focus and/or (b) encourages the learner to try to correct errors that are beyond his or her actual level of performance (or to perform maladaptive corrections, as previously termed by Schmidt and Bjork [1992]). A mixed observation protocol apparently alleviates these problems, which should encourage the practitioner to use an EGO or an ESO protocol rather than only self-observation.

In conclusion, observation is a powerful learning tool that is available to anyone with a minimal equipment requirement. Self-observation does not appear to be optimal for the learning of new relative timing patterns and could even be detrimental in some cases. Therefore, it appears that a mixed protocol of observation, which allows one to compare and contrast the performance of a novice to that of an expert, should be favored.

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