Observational Learning
Tell Them What They Are about to Watch and They Will Learn Better

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1 OBJECTIVES

Observing a model performing a motor skill improves the learning of that skill by naïve observers (see Ste-Marie et al. 2012 for a recent review on observation learning). Research indicates that observation enables one to identify the key spatial and/or temporal features of the task, thereby obviating the need to create a cognitive representation of the action pattern through trial and error (Blandin et al. 1994; Buchanan and Dean 2010; Carroll and Bandura 1982). This finding is supported by neurophysiological studies showing that the observation and production of an action share a common neural network known as the “action observation network”, which is activated both when individuals perform a given motor task and when they observe others performing that same motor task (Buccino et al. 2001; Cisek and Kalaska 2004; 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).

Considering the advances in video capture technology, it is very easy to film both expert and novice athletes and use these films to teach novel motor skills to children and adults. In the present study, we assessed whether learning is optimized when the learner knows beforehand whether he or she would be observing an expert, an intermediate, or a novice performance. Advance knowledge of this information might guide one’s observation (observe for something to reproduce or for something to correct/avoid) and improve learning. However, being uncertain of whether the next demonstration would be that of a novice or of an expert might activate more elaborate cognitive processes, thereby leading to improved learning.

The task that we chose required that the participants changed the relative timing pattern that naturally emerged from the task constraints to a new imposed pattern of relative timing. This is much like changing one’s tempo when executing a serve in tennis or a drive in golf (see Rohbanfard and Proteau, 2011).

2 METHODS

Sixty right-handed university undergraduate students (30 males and 30 females; mean age = 20.8 years; SD = 1.7 years) participated in the experiment. Participants were naive as the purpose of the study and 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 in hitting successively four targets of equal size in a clockwise motion. The distances between each barrier were 15 cm, 32, 18, and 29 cm, respectively. 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.

The participants were randomly assigned to one of the three groups of 20 participants (10 females per group): control (C), variable observation + feedforward (VO+FW) and variable observation + feedback (VO+FB). All groups performed four experimental phases.

All participants received verbal instructions regarding the goal TMT and IT before the first experimental phase. This first experimental phase was a pre-test in which all participants performed 20 trials without knowledge of the results (KR) on their TMT and the ITs. It was immediately followed by an acquisition phase of 60 trials. In this phase, participants in the two observation groups (VO+FW, VO+FB) individually watched a video presentation of two models performing the experimental task and for which they were informed of the models performance (both TMT and ITs) in ms, either before the demonstration for the VO+FW group or

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after the demonstration for the VO+FB. The model was alternated every 5 trials (i.e., model 1: trials 1–5 and model 2: trials 6–10, and so on). For each model we showed video clips that illustrated performances in each one five subcategories going from that of an expert to that of someone who had never practiced the task before. The resulting 60 trials (2 models x 5 levels of performance x 6 repetitions) were randomized so that the five levels of performance were presented once into each consecutive set of five trials. Participants in the control group did not take part in the observation protocol and rather read a provided magazine for the same duration as the observation phase for the other groups. All participants completed the third and fourth experimental phases: 10-min and 24-hour retention phases, similar in all points to the pre-test.

The data from the pre-test and the two retention phases were regrouped into blocks of five trials. For each block, we computed the absolute value of each participant's constant error for TMT (|CE|, the constant error indicates whether a participant undershot [negative value] or overshot [positive value] TMT) and the variable error of TMT (VE, or within-participant variability) to determine the accuracy and consistency of TMT, respectively. For IT, we computed a root mean square error (RMSE), which indicates in a single score how much each participant deviated from the prescribed relative timing pattern. For each trial,

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

where ITi represents the intermediate time for segment "i", and target represents the goal movement time for each segment of the task (i.e., 300 ms). The data for each dependent variable were submitted independently to an ANOVA contrasting three groups (C, VO+FW, VO+FB) x three phases (pretest, 10-min retention, 24-hour retention) x four blocks of trials (1-5, 6-10, 11-15, and 16-20) with repeated measures on the last two factors.

3 RESULTS

The ANOVA computed for the |CE| (Figure 1, upper panel) and VE of TMT (not illustrated) revealed that the three groups did not differ significantly in the pre-test. Both observation groups significantly outperformed the control group, but only in the 10-min retention test: |CE|, $F(4, 114) = 3.4$, $p = .01$, VE, $F(4, 114) = 2.48$, $p = .05$). Concerning the relative timing data, the ANOVA computed for the RMSE revealed that the three groups did not differ significantly from one another in the pre-test. In addition, in both the 10-min and 24-hour retention tests, although the VO+FB group significantly outperformed the control group, it was, in turn, significantly outperformed by the VO+FW group, $F(4, 114) = 7.48$, $p < .001$.

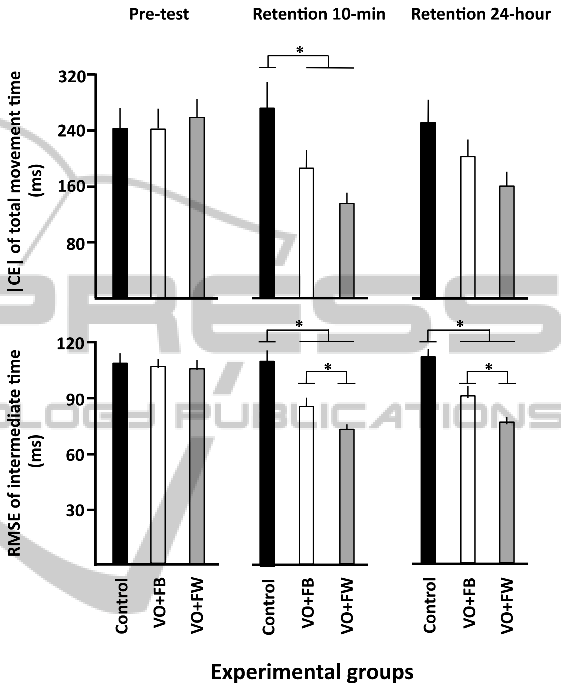

Figure 1: Absolute constant error of TMT and root mean square error of relative timing as a function of the experimental phases and experimental groups.

4 DISCUSSION

Live or video observation (Rohbanfard and Proteau, 2012) of a model practicing a motor skill favours the learning of that skill by the observers. The advance of video capture technology enables coaches and educators to film the performance of a variety of actors/models to help children and adults learn a new skill. One goal of our laboratory is to determine the conditions of observation that would optimize learning.

The results of the present study confirms previous findings indicating that one can learn a new relative timing pattern through observation (Andrieux and Proteau, 2013; Rohbanfard and Proteau, 2011). In that previous work, it was showed that the positive effects of observation for motor learning are significantly larger when one does not only observe either near perfect performance or the usually large errors committed by novice participants. Rather, the results indicated that learning was optimized when one can observe a variety of performances. The most important finding of the present study is that we have showed that the positive effects of varying the quality of the observed performance is optimized when one knows beforehand whether he or she will be watching a very good, an intermediate or rather a poor performance. Decety et al. (1997) have shown that different areas of the brain become more active when one observes to recognize (for example, when observing a novice model/poor or intermediate performance) than when one observes to imitate (fore example, when observing on expert model). We suggest that the benefits of informing the observer of the quality of the performance that will be presented enables her or him to pre-activate the recognition/imitation of the brain as a function of what will be observed, which results in better learning.

In conclusion, observation is a powerful learning tool that is now available to anyone with minimal equipment requirement. The benefits of observation for learning a new motor skill become larger when one has access to a variety of models ranging from novices to experts. These benefits are optimized if the observer knows beforehand the quality of the performance she or he is about to observe.

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REFERENCES

Andrieux, M., Proteau, L., 2013. Observation learning of a motor task: who and when? *Experimental Brain Research,* vol. 229, pp. 125-137.

Blandin, Y., Proteau, L., Alain, C., 1994. On the cognitive processes underlying contextual interference and observational learning. *Journal of Motor Behavior,* vol. 26, pp. 18-26.

Buccino, G., Binkofski, F., Fink, G.R., et al., 2001. Action observation activates premotor and parietal areas in a somatotopic manner: an fMRI study. *European Journal of Neuroscience,* vol. 13, pp. 400-404.

Buchanan, J.J., Dean, N.J., 2010. Specificity in practice benefits learning in novice models and variability in demonstration benefits observational practice. *Psychological Research,* vol. 74, pp. 313-326.

Carroll, W.R., Bandura, A., 1982. The role of visual monitoring in observational learning of action patterns: making the unobservable observable. *Journal of Motor Behavior*,vol. 14, pp. 153-167.

Cisek, P., Kalaska, J.F., 2004. Neural correlates of mental rehearsal in dorsal premotor cortex. *Nature,* vol. 431, pp. 993-996.

Cross, E.S., Kraemer, D.J.M., Hamilton, A.F.D., Kelley, W.M., Grafton, S.T., 2009. Sensitivity of the action observation network to physical and observational learning. *Cerebral Cortex,* vol. 19, pp. 315-326.

Decety, J., Grezes, J., Costes, N., et al., 1997. Brain activity during observation of actions - Influence of action content and subject's strategy. *Brain,* vol. 120, pp. 1763-1777.

Rohbanfard, H., Proteau, L., 2011. Learning through observation: a combination of expert and novice models favors learning. *Experimental Brain Research,* vol. 215, pp. 183-197.

Rohbanfard, H., Proteau, L., 2012. Live vs. video presentation techniques in the observational learning of motor skills. *Trends in Neuroscience and Education,* vol. 2, pp. 27-32.

Ste-Marie, D.M., Law, B., Rymal, A.M., Jenny, O., Hall, C., McCullagh, P., 2012. Observation interventions for motor skill learning and performance: an applied model for the use of observation. *International Review of Sport and Exercise Psychology,* vol. 5, pp. 145-176.