The Effect of Visual and Auditory Models in Self Regulated and External Controlled Environment on Learning a Timing Task

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Abstract: The purpose of the present study was to compare motor skill acquisition between two learning environments; an environment in which learners determined the type of model or time of receiving it and one which was controlled by the researcher. Ninety male college aged participants were randomly divided into 5 groups; 4 groups of 15 participants and one of 30. Participants' conditions in terms of the type of model used (visual or auditory model) and control environment (external control, self control in selecting model, self control in time of receiving model) was different from other groups. Participants practiced 60 trails of a sequential timing task. The result indicated that auditory model led to better learning of the timing task than visual model. In addition, for both visual and auditory modeling, providing self-controlled conditions led to an enhanced performance in the overall and absolute timing error in retention test compared to externally controlled conditions, but in relative timing no significant difference was observed between self controlled and external controlled conditions.

Key words: Motor learning % Absolute timing % Relative timing % Modeling % Self control

INTRODUCTION

Social learning theorists suggested that information acquired through the observation of a model can provide a powerful means of establishing a cognitive representation of motor responses. This cognitive representation guides response production and provides a standard against which performance feedback is compared for corrective adjustments [1]. Applied to the use of models and demonstrations as a learning strategy, McCullagh, Weiss and Ross [2] suggested that the visual modality, though typically presumed when presenting demonstrations, is not the optimum mode for all tasks. Although visual information may be superior to auditory information if the task requires positional, spatial, or qualitative aspects, audition may be a more important modality for timing [3]. On the other hand, the studies in learning styles domain had shown that people may be visual or auditory learners. Singer [4] suggested that visual perception is probably the most important source of information when performing sport skills. Visual learners' primary source of information is received through their eyes. The visual learner learns best by watching a demonstration or model. An athlete who is an auditory learner focuses on sounds and rhythms to learn movement patterns along with verbal description of the movement. Auditory learners learn best through the use of language including lectures, group discussions and audiotapes [5]. More recently, a different empirical method that was employed in motor learning study is giving learners some control over their practice activities. There have been numerous exercise and sport science studies that demonstrate the effectiveness of practice regiments that incorporated some form of self-control during motor skill acquisition and performance [6]. One of the facts about model-giving not yet examined is allowing the learners to choose their own model. Since people have different styles of learning, the type of task assigned might not determine a suitable model for doing that particular task. It is rather the inherent characteristics of

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the individuals such as their learning style which is the main factor for effectiveness of different audio and visual models.

Since the introduction of Schmidt's schema theory, researches have been trying to identify the effectiveness of various practice conditions on learning the generalized motor program and parameter. One of the tasks employed in researches to distinguish the effective practice conditions on generalized motor program learning and its parameter has been the sequential timing task. In these tasks, relative timing performance is considered as a measure of the underlying movement structure, or generalized motor program (GMP), whereas absolute timing performance is seen as a measure of the capability to parameterize an action appropriately. This study, generally speaking, has some distinctive features. Firstly, no investigation has been done so far about the effectiveness of the choosing of the model by learners on their learning. Second, Studies about observational learning indicate that allowing the learners to choose their own time of watching the model enhances their learning. For example, Wulf *et al*. [7] demonstrated that self-control method at the time of receiving the model increases precision scores and the form of performing basketball jump shoot compared to the paired group. Although these researches have pointed out the advantages of employing self-control method, they have not shown how self-control in time of receiving model affects the generalized motor program and parameter. Thus in the present study we wanted to address how the self controlled conditions influenced relative versus absolute timing.

MATERIALS AND METHODS

Subjects: Ninety undergraduate students (all men; Mage = 22.9 years) participated in this experiment. All participants provided informed consent. None had prior experience with the experimental task, nor were they aware of our specific purpose in the study.

Equipment and Tools: We used the same sequential timing task used in the Chiviacowsky and Wulf [7,8]. A computer, color monitor and keyboard were placed on a standard table. Participants were asked to sit on a chair and keep their arms unsupported while executing the task. The task required them to depress four keys (2, 4, 8 and 6) sequentially on the numeric keypad portion of the keyboard, using the index finger of their right hand. The goals MTs for the three segments were 400, 800 and 600 ms (total MT: 1800 ms). Thus, the relative timing (in percentages) for the three segments in all phases of the experiment was 22.2-44.4-33.3.The measure of interest was overall, relative and absolute timing errors.

Procedure: First, participants were divided randomly into 5 groups; 4 groups of 15 participants and one of 30. Using a graphic representation, the task was explained to all participants. Participants' conditions in terms of the type of model used and control environment was different from other groups. The model used in the first group was auditory which was determined by the test administrator, but the time of receiving the model was self-controlled and decided by the learner, which means the participants of this group were free to use an auditory model whenever they wished. The model used in the second group was visual determined by the administrator, but like the first group, the time of receiving the model was self-controlled and was decided by the learner. Participants in first and second groups were asked to request only 3 models per 10 trials so that the two self-controlling groups could be equal in terms of receiving models in order to have a fair comparison.

The participants of the third and the fourth group were also given visual or auditory model but regarding model receiving time, each of the participants of these groups were yoked with one of the first or second group and the individual was given visual or auditory model in the same trials the counterpart had requested. Participants of the fifth group chose visual or auditory models in a self-controlled manner; they did this by choosing one model after observing the correct way of performing the timing task using auditory or visual model (each model, 3 times) to employ later in the practice stage. From the 30 participant of group 5, 17 people chose the auditory and 13 people chose the visual model and each of the participants of these two groups were paired with one counterpart from first or second group regarding the model receiving time. Specifically, the conditions were as follows: auditory model with self-controlled condition in selecting time of receiving model (AM-SCST); auditory model with self-controlled condition in selecting model (AM-SCSM); visual model with self-controlled condition in selecting time of receiving model (VM-SCST); visual model with self-controlled condition in selecting model (VM-SCSM); auditory model with external controlled condition (AM-EC); and visual model with external controlled condition (VM-EC). All participants performed 60 trials during the practice phase and feedback concerning relative- and absolute-timing errors provided for all trails in this phase. 1 day after practice they performed a retention test consisting of 10 trials on the practice task version (400-800-600 ms).

RESULTS AND DISCUSSION

All groups showed a consistent reduction in overall, relative and absolute timing errors during practice. (Figure 1). in term of Overall Timing Errors, the analyses of variance (ANOVAs) indicated main effects of model, $F(1, 720) = 5.72$, $p<.05$, environment, $F(2, 720) = 37.77$, $p<.05$ and the interaction of model and environment, $F(2, 720) = 3.44$, $p<.05$ in retention. Overall Timing Errors were lower for the auditory model (M = 311.8) than for the Visual model (M =303.6). in addition Duncan's new multiple range test indicated that overall timing errors were greater for AM- EC (M = 362.8) and VM- EC (M = 436.9) than for AM-SCCM (M=293.3), VM- SCSM (M = 297.1), AM- SCST(M = 277.7) and VM- SCST(M = 286) groups, which were not different from each other.

In addition, in term of Relative Timing Errors, the main effect of model, $F(1, 714) = 1.17$, $p>.05$,environmen, $F(2, 714) = 0.69$, $p>.05$ and the interaction of model and environment were not significant, $F(2, 714) < 1$ in retention test. In relation to Absolute Timing Errors, The main effect of model was significant, $F(1, 720) = 10.21$, $p<.05$, environment, $F(2, 720) = 33.43$, $p<.05$ and the interaction of model and environment, $F(2, 720) = 5.47$ were significant. Absolute Timing Errors were lower for the auditory model (M = 311.8) than for the Visual model (M =303.6). in addition Duncan's new multiple range test indicated that absolute timing errors were greater for AM- EC (M = 139.6) and VM - EC (M = 179.6) than for AM- SCSM (M = 119.6), VM-SCSM(M = 120.1), AM-SCST(M = 118.7) and VM- SCST(M = 110.6) groups, which were not different from each other.

In relation to compare effectiveness of visual and auditory model, the result indicated that auditory model led to better learning of the timing task than visual model. Auditory modeling has been reported to facilitate the ability to successfully develop a memory representation to use as a reference for evaluating and subsequently correcting performance in timing task [9]. Glenberg *et al*. [10] argued that timing intervals are best processed and coded through auditory events, because they appear to have direct access to a temporal coding mechanism. On the other hand, visual events, visual depictions, or verbal descriptions of temporal events provided less salient temporal information and, thus, were coded in a less efficient manner than auditory cues. Previous research has indicated that auditory models, like visual models, enhanced relative timing learning to a greater extent than absolute timing learning [11].

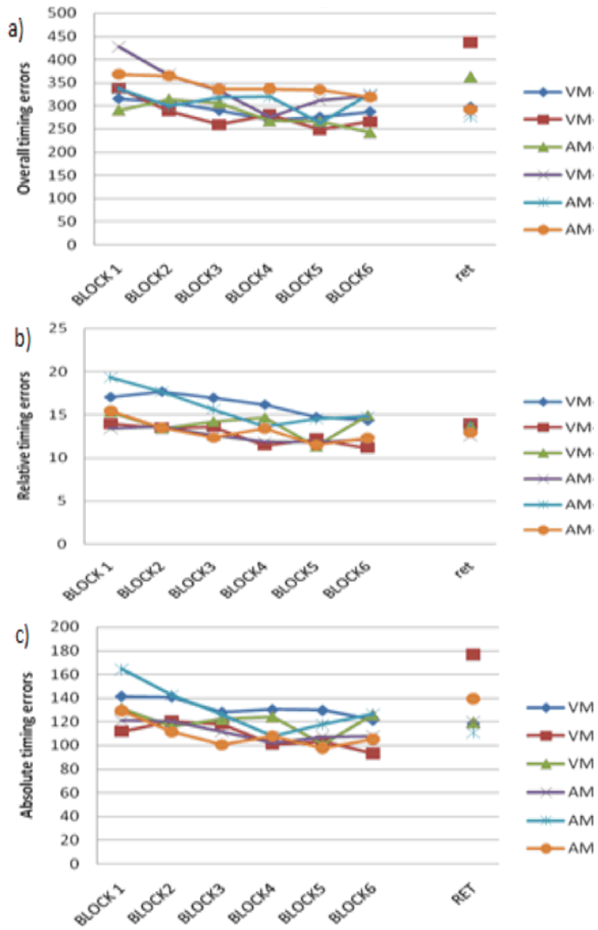

Fig. 1: Overall, relative and absolute timing errors as measured in milliseconds (ms) across trial blocks and retention (RET) for each experimental condition. [auditory model with self-controlled condition in selecting time of receiving model (AM-SCST); auditory model with self-controlled condition in selecting model (AM-SCSM); visual model with self-controlled condition in selecting time of receiving model (VM-SCST); visual model with self-controlled condition in selecting model (VM-SCSM); auditory model with external controlled condition (AM-EC); visual model with external controlled condition (VM-EC)]

The result of present study showed that auditory model led to a more improved overall and absolute timing than visual model, but there was no significant difference between the two groups in relative timing. Thus, manipulating the type of model used for learning a timing task apparently did not affect learning of the fundamental movement structure (or generalized motor program) but affected learning to parameterize the responses.

At large, the results of the research show that allowing the learners to choose their own type of model used and the time they receive the model lead to better learning of sequential timing task than external control conditions. Although self-controlled practice might have beneficial influence on learning, for example through increased motivation and or the consistency of the practice schedule with the learner needs [12], there might be additional benefits more specific to the factor being controlled. For observational learning, this might refer to the amount or type of information learners extract from the model presentation [13]. That is, performers might extract more or more relevant, information from the model when they can request a presentation, as opposed to a situation in which presentation schedule is determined for them. For example, self-control learners might pay particular attention to aspects of the movement pattern they are uncertain about, either to confirm their movements are correct or identify errors. In contrast, yoked participants might be less inclined to engage in such informational processing activities due to unpredictability of the model presentations [13]. Moreover, knowing the fact that self-control method in choosing model type improves learning in comparison with external control, we can state that self-control method enhances learning because it is well-suited to the needs of the learner. Participants of the self-controlled groups in choosing model performed better than groups with external control in retention test by choosing the model which was most suitable for learning the task based on their style of learning [5]. A secondary issue we wanted to address in the present study was how the self controlled conditions influenced relative versus absolute timing. Results showed that both self-control conditions led to a more improved overall and absolute timing than external control conditions, but there was no significant difference between the two groups in relative timing. Thus, adopting the self-control method at the time of watching the model results in improvement of parameter learning and is ineffective on learning generalized motor program. Results from this research are analogous to those found in Wulf *et al*. (2002) in which they showed that adopting the self-control method at the time of receiving feedback results in enhanced absolute timing learning, but does not influence relative timing learning. Further investigations into the reasons for the benefits of self-controlled practice should lead to a better understanding of this intriguing phenomenon and eventually to the design of more effective practice conditions.

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