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Feedback on More Accurate Trials Enhances Learning of Sport Skills

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Abstract: Recent studies have shown that feedback can be more effective for learning a beanbag-toss task if it was provided for the most accurate trials compared to the least accurate trials. Our purpose in this experiment was to examine the generalizability of the benefits of feedback about the most accurate trials compared with feedback about the least accurate trials to the learning of a sport skill. Participants performed 48 trials on a volleyball "tennis" serves task under one of two conditions in acquisition phase: After each block of six trials, one group received feedback on the three most accurate trials, whereas another group received feedback on the three least accurate trials. One Day 2, participants performed a retention test without feedback. The results indicated that feedback on more accurate trials resulted in more effective learning. The findings are interpreted as evidence for a motivational function of feedback.

Key words: Type of feedback · Motor learning · Volleyball · Motivation

INTRODUCTION

Feedback (knowledge of results, (KR); knowledge of performance, (KP)) plays an important role in the learning of motor skills [1]. Some recent findings indicate that providing KR after trials with relatively small errors is more effective for learning than providing KR after trials with larger errors [2, 3]. Studies examining self-controlled KR first showed that learners prefer to receive KR after they believe they had a "good" trial rather than a "poor" trial. This was evident from post experimental interviews of self-controlled learners. Furthermore, self-controlled learners had, on average, smaller errors on those trials on which they requested feedback relative to trials on which they did not ask for feedback [4, 5]. Chiviacowsky and Wulf [2] followed up on those findings by directly examining the effectiveness of KR after relatively good (i.e., summary feedback on accurate trials) versus poor (i.e., summary feedback on inaccurate trials) trials. They found that providing KR after "good" trials resulted in more effective learning compared to KR provided after "poor" trials. In their study, young adults practiced a task that required them to throw beanbags at a target with their non-dominant arms, with vision being occluded. After each six-trial block, KR was provided for the three most accurate trials in that block, or the three least accurate trials. The group who received KR for the three most accurate trials demonstrated superior retention compared to the group that received KR for the three least accurate trials. In other study, Chiviacowsky and Wulf [3] examined whether previous findings of learning advantages of feedback for the most accurate trials compared with the least accurate trials would generalize to older adults. So, they replicated the experiment by Chiviacowsky and Wulf [2], using same experimental design, but used 65-year-old adults as participants. The finding were replicated with older adults, group who was provided KR for the most accurate trials demonstrated more effective retention performance than the group who received KR for the three least accurate trials [3]. Our main purpose in this experiment was to examine whether previous findings of learning advantages of feedback after good trials versus poor trials [2, 3] would generalize to more complex sport skills. For the beanbag-toss task used in those studies, even though those were performed with the non-dominant arm, adult participants can presumably use a wealth of previous experiences with similar tasks to judge the movement outcome. This might be different for other tasks for which participants lack experience. Participants in the present study practiced volleyball "tennis" serve and different groups received feedback for the most accurate trials, or the least accurate trials [2, 3]. We hypothesized that feedback about the most accurate trials, relative to the least accurate trials, would be enhanced learning.

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MATERIALS AND METHODS

Participants were 26 female students with a mean age of 14 years (SD =.3). All participants provided informed consent. They had no prior experience with the experimental task and were not aware of our specific study purpose. The experimental protocol was reviewed and approved by the university's Advising Committee of Science and Research.

Apparatus and Task: The experiment took place on a regular indoor-volleyball court. A standard height (2.33 m) was used for all participants. In the center of the "opponents" side of the court, a 3 × 3 m target area was marked with tape. A 4×4 m and a 5×5 m area were marked around the target area. If the center of the target area was hit, then 4 points were awarded. A score of 3, 2, or 1 was awarded if one of the three larger target areas or any other area on the opponents' side of the court, respectively, was hit. For balls that were out of bounds or hit the net, 0 points were recorded [6]. The serves were always performed from the right side of the court. Before each session, we checked and adjusted the pressure of the balls, if needed, to ensure identical conditions for all participants.

Procedure: Participants were randomly assigned to groups receiving KR either on more accurate trials (MA group) or less accurate trials (LA group). After each block of six trials, participants in the MA group received KR on their three most accurate (i.e., best) services in that block, whereas those in the LA group received KR on their three least accurate services [2, 3]. Participants in both groups were informed that, at the end of each block of 6 trials, they would receive KR on 3 of those trials. However, they were not informed for which trials they would be given KR.

Before the beginning of each experimental session, participants were asked to warm up sufficiently. Each participant was tested individually. Before the beginning of the first session, the experimenter spent a few minutes with each participant to describe or review the basic technique of the tennis serve. The instructions emphasized important aspects of the technique, such as maintaining a shoulder- wide stance, with the left foot placed in front of the right foot (right-handers) and pointing in the direction of the serve; tossing the ball with the left arm; and hitting the ball with the open right hand [7]. Participants were allowed to look at the target before each set of 6 trials. Yet, during those 6 trials, participants were prevented from viewing the results by wearing opaque swimming goggles. KR was written on a board and presented for 15 seconds. It consisted of the trial number and the respective score, as well as directional information. Participants were aware that scores ranged between 4 and 0. A + or - sign was included with each score to indicated whether the target was overshot or undershot, respectively [2, 3]. Thus, KR provided information not only about the extent of the deviation from the target, but also information about whether the toss was short or long. All participants performed 48 trials during the practice phase, including two sessions of 24 trials and one day after practice they performed a retention test consisting of 10 trials without KR.

Data Analysis: Service accuracy scores were analyzed in a 2 (groups: MA, LA) × 8 (blocks of 6 trials) analysis of variance (ANOVA) with repeated measures on the last factor for the practice phase. An independent t-tests was conducted for service performance on the retention test.

RESULTS

Both groups increased their service scores across practice blocks. The MA group tended to have higher scores than the LA group (Table 1). The main effect of group was not significant, with $F < 1$.

Retention: On the retention test without KR, which was performed one day after the practice phase, the MA group had higher accuracy scores than the LA group (Table 1). This group difference was significant, $t_{(24)} = 4.98$, $p = .0001$. Thus, providing KR after the most effective trials during practice resulted in superior learning compared to providing KR after the least effective trials.

Table 1: Means and standard deviations for accuracy scores in practice and retention

	MA group		LA group	
Groups Variables	Mean	SD	Mean	SD
Practice	0.85	0.53	0.80	0.68
Retention	1.77	0.46	0.90	0.41

DISCUSSION

Our purpose in this experiment was to examine the generalizability of the benefits of feedback about good trials compared with feedback about poor trials found by Chiviacowsky and Wulf [2,3] to the learning of a sport skill. In fact, the results of recent studies by Chiviacowsky and Wulf suggested that feedback can be more effective for learning a beanbag-toss task if it was provided for the most accurate trials compared to the least accurate trials. The present results also showed that feedback about the most accurate trials resulted in more effective learning than feedback about the least accurate trials did in terms of the accuracy of the serves. There appears to be converging evidence that providing KR about trials with relatively small errors is more effective for learning than providing KR about trials with larger errors. These findings challenge a current predominant view (guidance hypothesis) with respect to the role of feedback in motor learning is that feedback is beneficial because it guides the learner to the correct response [8, 9, 10]. If this were the case, feedback about larger errors should be more beneficial than feedback about smaller errors. That is, contrary to what our findings suggest feedback about smaller errors is more beneficial. The present results suggest that a revision of researchers' views regarding the role of feedback might be required.

What are the reasons for the benefits of receiving KR about good trials? Wulf and her colleagues [2, 3] have argued that providing feedback about the most accurate trials (and ignoring poor trials) might create a greater success experience for learners than providing feedback about the least accurate trials (and ignoring good trials), which, in turn, enhances the learning process. In the other words, KR about good trials can, in fact, be more important than KR about poor trials - presumably because of its motivational effects. A couple of recent studies have provided support for that assumption. The study by Amorose and Horn [11] revealed that athletes with higher levels of intrinsic motivation perceived that their coaches provided high frequencies of positive feedback. In other study, Weinberg and Jackson [12] gave participants false success or failure feedback for their balancing ability, success feedback enhanced intrinsic motivation and failure feedback had the opposite effect. Additional evidence comes from a study by Lewthwaite and Wulf [13] that used normative feedback, the feedback provided to participants about their actual motor performance was supplemented by fake average scores, indicating although participants had veridical information about their performance, the positive or negative implications of the feedback had differential effects on learning. Together, these findings suggest that the motivational properties of feedback directly affect learning. In future experiments, it might also be fruitful to examine the possible age differences. Children differ from adults in various ways, including the ability to process information [14, 15] and it was unclear whether children would show the same learning advantages when given feedback about the most accurate trials and ignore poor trials.

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