

Expecting to teach promotes motor learning of a golf putting task in children

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Abstract

Introduction. Researchers have shown that the learners achieve higher levels of learning when they learn with the aim and expectation of teaching their content to others. Recently some motor behavior researchers have also examined this learning method, and have indicated that expecting to teach others improves motor learning in adults. The purpose of the present study was to examine the effect of expecting to teach others on the learning of a golf-putting task in children. **Material and Methods.** Participants consisted of 24 children (all males; $M_{age} = 9.58$; $SD = 0.50$ years) who were randomly assigned into two experimental groups. Participants in the group expecting to teach others were instructed as follows: “given that you have to teach golf putting to some people the day after the acquisition phase, you have the opportunity to practice this skill carefully today and tomorrow”. Participants in the group expecting to be tested received the following instructions; “you have the opportunity to practice this skill carefully today and tomorrow expecting to be tested in this skill”. **Results.** The results showed that the children in the group expecting to teach others had better accuracy scores relative to children in the group expecting to be tested in the retention phase ($p \leq 0.05$). **Conclusions.** The findings of this study suggest that promoting the expectation to teach others would improve motor learning in children.

KEYWORDS: expecting to teach, golf putting task, motor learning, children.

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Introduction

When you try to learn new information, you usually set a specific goal to use that information in the future. For example, learners often learn with the goal of increasing their future performance; in contrast, educators (teachers and coaches) learn primarily with the goal of enabling themselves to convey educational material more effectively to learners [13]. One of the new ways to learn is to combine these two goals.

Researchers have shown that the learner achieves higher levels of learning when he/she learns with the aim and expectation of teaching his/her content to others [2, 3, 5, 10, 11]. As one of the first studies in this field, Bargh and Schul [2] introduced three main and important components in the teaching process: preparing to teach, providing the teaching material, and receiving the feedback while answering learners' questions. They believed that engaging in the first stage of the teaching process, i.e. preparing to teach, is an important element in the teaching process. In other words, the results of their pioneering study showed that a person achieves higher learning outcomes when he/she prepares him/herself to teach that material to others. This finding has been confirmed by further studies [3, 13].

For example, Nestojko et al. [13] in another study found similar results. They had two groups of participants in their experiment. The first group was told, “you will study the text and material and immediately after that, you should teach what you have learned to another group of learners without access to the material”. In contrast, there was a second group who were told “you will study the text and material and immediately

after that, you would take an exam". The results showed that the participants in the group expecting to teach group had a better recall of the text and answered more questions concerning the text than the other group. Those researchers believed that when learners think they should teach what they are learning to others, they engage in more effective processes and strategies of learning and therefore achieve higher learning outcomes. Benware and Deci [3] also reported similar findings.

However, some findings have shown that this learning approach may not necessarily achieve high levels of learning efficacy for all individuals [11, 14]. For example, Renkl [14] found that people who studied with an expectation to teach others were not superior to those, who studied with an expectation to be tested. The researcher attributed the probable reason for this lack of superiority to the stress and anxiety of people in the first group. Fiorella and Mayer [11] also reported that learning by expecting to teach can only improve learning in the short term. In a study conducted by the researchers, participants learned a lesson concerning the Doppler effect under two conditions of expecting to teach it to others (without real teaching) or expecting to be tested. Individuals who were instructed to expect to teach others performed better than the other group in short-term learning. However, these individuals did not perform better in the long-term learning that occurred the previous week.

Major research in this field has focused on cognitive learning and academic information. Academic information is based on declarative knowledge, while learning motor skills and motor perceptual skills are more based on procedural knowledge that has a different mechanism [4]. Therefore, the expectation of teaching effects can be different in motor skill learning, so examining this new practice method in motor skill learning can be important.

Recently, Daou et al. [6] in one of the first studies in the field of motor skills learning directly examined the effect of learning by expecting to teach in a golf putting task compared to the learning by expecting to be tested. In their study there were two groups of adults, one group practiced a golf putting task expecting to teach it to others (the teaching group) and the other group practiced the golf putting task expecting to be tested (the test group). The purpose was to determine whether learning by expecting to teach improves motor learning. Their results showed that learning by expecting to teach directly improves motor skill learning. In other words, these practice methods had the ability to improve procedural knowledge.

In another study, Daou et al. [9] examined this effect using a similar method. In their study they sought to find basic mechanisms that provide the advantage of learning by expecting to teach others and examined the key concepts related to movement in a free recall test. However, motivation and anxiety have nothing to do with the benefit of learning with the expectation to teach, but due to the improvement of declarative knowledge during this new method the recall of key skill-related concepts was improved. This group of researchers in several studies indicated benefits of learning by expecting to teach compared to other test groups [6-9]. However, some studies have shown that learning by expecting to teach will not be effective in situations under high psychological pressure. For example, Daou et al. [7] in another study examined the effectiveness of learning by expecting to teach in stressful situations. They sought to examine whether the advantage created by the expectation to teach is sustainable in certain situations, such as high psychological pressure, and concluded that the motor skill learning efficacy deteriorated in the situations when people practice in a group with expectation to teach. Since this method enhances the learner's declarative knowledge in accordance with the reinvestment theory [12], it causes a decline in performance in certain situations such as stress and high psychological pressure. Of course, this decline in performance is manifested in a way that they perform similarly to someone who has practiced the skill without expecting to teach [7]. Given that this research topic in the field of motor learning is relatively new, there are still many ambiguities in this area. For example, can this new practice method improve children's motor learning in the same way as adults? Since children follow different patterns in the process of motor skill learning than adults and in order to generalize and examine the findings of the above-mentioned studies in other age groups as well, the present study seeks to investigate the effect of this new practice method on learning of a golf putting task in children.

Material and Methods

Participants

The present study was a quasi-experimental study and was conducted in two experimental groups over three days. Participants included 24 children (all males; $M_{age} = 9.58$; $SD = 0.50$ years) who were recruited and randomly assigned to one of two experimental groups: motor skills practice by expecting to teach versus skills practice by expecting to be tested in it. The criterion for

estimating the sample size was according to the previous studies in this area [15]. The inclusion criteria for participation in the study were as follows: 1. not having any previous experience in performing the golf putting task, 2. being in good health, 3. being right-handed. The criteria for exclusion from the study were as follows: 1. lack of desire to continue cooperation in research, 2. having any skeletal and neurological disorders and problems. The participants were unaware of the purpose of the study. Informed consent forms were completed by parents of the participants based on the conscious consent to participate in the research and being able to leave the study freely. All experimental methods were approved by a university Institutional Review Board.

Task

The target was an artificial putting mat with the dimensions of 400-cm length and 100-cm width, a hole at the center of a target. The putting task required children with the right-hand dominance to put a standard golf ball towards a hole at the center of the target. The starting line was placed 200 cm away from the hole at the center of the target. The dimensions of the ground, the ball, and the target point were selected based on previous researches [1]. The task goal was to stop the ball as close as to the center of the target as possible. The distance between the target center and the edge of the ball was used as a radical error (RE) index after each trial to measure the accuracy of golf putting.

Procedure

All the participants completed the experiment individually. After consenting to participate, they completed a demographic questionnaire. They also completed the Edinburgh Handedness Inventory to determine their handedness. The experiment took place during a free time activity in an elementary school. Participants then completed 10 practice trials of the golf putting skill for an initial assessment of their motor function. In particular, in the present study, based on previous research [6], the participants were randomly assigned into two experimental groups in the acquisition phase of golf putting and performed 6 blocks of 10 trials per day with a 5-minute break between blocks for two days. One group practiced the skill by expecting to teach it to others, so the participants received instructions prior to starting each practice block: “given that you have to teach golf putting to some people the day after the acquisition phase, you have the opportunity to practice this skill carefully today and tomorrow” (the teach group), while the other group received instructions

prior to starting each practice block: “you have the opportunity to practice this skill carefully today and tomorrow expecting to be tested in this skill” (the test group). These instructions were approximately similar with previous research in this area [6, 9]. As soon as the third day of the test started, participants in the teach group were told “the participants who you were going to teach did not show up today, so you will actually be tested on your putting instead”. In this way, both the teaching and testing groups performed retention tests (10 trials). The groups performed a transfer test (10 trials) from the starting line, which was placed 300 cm away from the hole.

Data analysis

Parametric tests such as an independent t-test, mixed ANOVA, one-way ANOVA and the Bonferroni post hoc test were used to compare the groups at the acquisition phase, retention and transfer tests, respectively. Alpha levels were set to 0.05 for all the tests using the SPSS software, version 24. To calculate the strength of the results, partial-eta-squared was applied. These effect-sizes were defined as follows: $\eta_p^2 = 0.01$ as small, $\eta_p^2 = 0.06$ as medium and $\eta_p^2 = 0.14$ as large [4].

Results

Table 1 shows the mean and standard deviations of some of the individual variables of participants in the experimental groups at the beginning of the study. The results of the t-test indicated that the outcome performance was not significant between the groups in the pretest ($p = 0.53$).

Table 1. Demographic characteristics of group participants

Characteristics	Groups (Mean ± SD)		p-value*
	Teach	Test	
Age (year)	9.58 ± 0.51	9.50 ± 0.52	0.69
Height (cm)	138.00 ± 7.27	136.83 ± 6.75	0.68
Weight (kg)	38.25 ± 7.59	38.92 ± 7.05	0.82
Golf putting task (pretest [cm])	55.33 ± 18.59	50.50 ± 19.13	0.53
Gender	Male	Male	

* The significance level was set as $p \leq 0.05$

Motor performance

Acquisition

The results of 2 (two experimental groups) by 6 (the number of practice blocks) mixed ANOVA on the

accuracy of golf putts in the acquisition phase showed that although the main effect of the acquisition block was significant ($F(5,110) = 4.72$, $p = 0.001$, $\eta_p^2 = 0.17$), the main effects of the group ($F(1,22) = 0.002$, $p = 0.96$, $\eta_p^2 = 0.001$) and the interaction effect ($F(5,110) = 0.81$, $p = 0.53$, $\eta_p^2 = 0.003$) was not significant. In other words, it was found that participants in both experimental groups experienced significant improvements during the practice trials, but no significant difference was observed between the two groups (Figure 1).

Retention and transfer

The results of one-way ANOVA in the retention test showed that there is a significant difference between the two experimental groups ($F(1,23) = 5.82$, $p = 0.02$, $\eta_p^2 = 0.20$) and the performance of the teach group is higher than that of the test group. However, the results of one-way ANOVA in the transfer test showed that there is no significant difference between the two experimental groups ($F(1,23) = 0.34$, $p = 0.56$, $\eta_p^2 = 0.01$) and the performance levels of the teach group and the test group were the same.

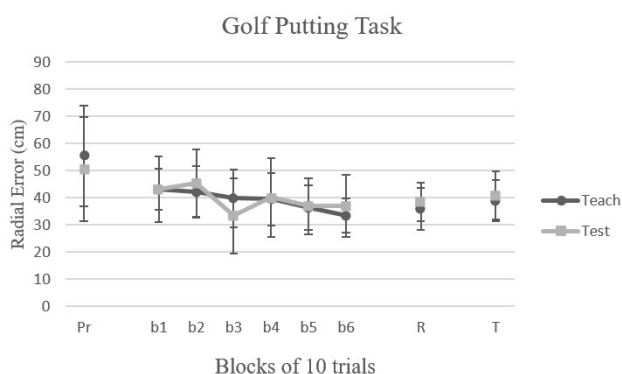


Figure 1. Radial error (RE) during pretest, acquisition, retention and transfer test (all blocks of 10 trials) for two experimental groups

Discussion

The aim of the present study was to compare the effect of two learning methods, i.e. learning by expecting to teach versus learning by expecting to be tested, on motor learning of a golf putting task in children. It was predicted that expecting to teach could increase motor learning. The findings of this study showed the performance of the children that have been practicing a golf putting task for two days by expecting to teach was better than that in the learning by expecting to be tested group in retention tests, but they showed no significant superiority in the acquisition phase or the transfer phase.

To the best of our knowledge, these findings are one of the first findings on the impact of learning by expecting to teach on motor performance and learning in children and they are in line with previous studies in the field [2, 3, 6, 7, 9, 13].

There are several mechanisms to explain the superiority of learning by expecting to teach in research literature. Some researchers in their first explanation of the superiority of learning by expecting to teach versus learning by expecting to be tested attribute to the increase of learners' motivation due to their awareness of how effective they are in improving other people's behavior. For example, some studies have directly shown that learning by expecting to teach increases learner's motivation [11]. One of the limitations of the present study was the lack of a direct measurement of participants' motivation; however, according to the previous proposed mechanisms the superiority of the learning group by expecting to teach can be attributed to the expected improvement of participants' motivation [13].

In the second explanation, especially in learning of academic information, it is stated that the participants in the learning by expecting to teach group identify more key concepts related to skills because teaching requires summarizing important and effective points [13]. In other words, learning by expecting to teach increases free recalling of the main points in the text. Therefore, this mechanism can also explain the superiority of learning in the teaching group with the expectation of learning in the present study.

The findings of the present study are consistent with the major research conducted with respect to the superiority of the learning group by expecting to teach compared to the learning group by expecting to be tested in motor learning in the retention and transfer tests [6, 9]. For example, Daou et al. [9] concluded in a study that the learning method by expecting to teach improves motor learning and also increases information process prior to any practice trial. However, it is not clear what kind of information is processed during the preparation period. Therefore, the reason for a possible superiority of the learning group with the expectation to teach can be interpreted as the fact that participants in the motor preparation may have thought more about the effects of movement on the environment (adopting an external focus of attention) and have focused less on generating movement (adopting an internal focus of attention). It is worth noting that most previous research on the focus of attention has reported the superiority of the external focus of attention over the internal focus of attention [16, 17].

Conclusions

In summary, the findings of the present study showed that teaching golf putting with an expectation to teach others improved the motor learning of children rather than teaching golf putting with an expectation to be tested. Therefore, it is suggested that this new method of practice should be used more in educational environments such as coaching. However, the present study also had some limitations. For example, the number of participants as well as the duration of the skill practice can be considered as a limiting factor for the positive effects of learning with expectation to teach. Therefore, it is recommended that researchers conduct more research in this area by eliminating the above-mentioned limitations. This study involved children and a golf putting task, so it is recommended that future studies should use other age groups such as the elderly as well as other activities.

Conflict of Interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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