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Enhancing performance expectancies through positive comparative feedback facilitates the learning of basketball free throw in children

Gisele Severo Gonçalves[a], Priscila Lopes Cardozo[a], Nadia Cristina Valentini[b], Suzete Chiviacowsky[a,*]

[a] Federal University of Pelotas, Pelotas, Brazil
[b] Federal University of Rio Grande do Sul, Porto Alegre, Brazil

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ABSTRACT

The present study examined the influence of enhancing performance expectancies through comparative feedback on the learning of a sport motor skill, the basketball free throw, in children. Two groups of participants, a positive comparative feedback group (PF) and a control group, practiced 40 basketball free throws. All children received feedback regarding their punctuation scores after each block of practice. Participants in the PF group also received positive social-comparative feedback suggesting that their own punctuation score was better than that of a peer group's on the block. Learning effects were observed through a transfer test performed one day after practice. Participants in the PF group demonstrated higher learning of the task, showing greater punctuation scores on the transfer test than participants in the control group. Questionnaire results also showed higher levels of perceived competence, importance of doing well, and persistence related to the task among the PF group relative to the control participants. These findings provide the first evidence that enhancing performance expectancies through positive comparative feedback enhances the learning of sport motor skills in children. They also demonstrate the important motivational role of feedback on children's learning of motor skills.

1. Introduction

In recent years, a growing number of studies have been conducted to verify the effects of motivational factors on the learning of motor skills. For instance, studies have provided evidence that the provision of autonomy (Carter, Carlsen, & Ste-Marie, 2014; Chiviacowsky & Wulf, 2002; Fairbrother, Laughlin, & Nguyen, 2012; Lewthwaite, Chiviacowsky, Drews, & Wulf, 2015; Wu & Magill, 2011; Wulf & Toole, 1999), relatedness (Gonzalez & Chiviacowsky, 2016), and competence (Chiviacowsky & Wulf, 2007; Clark & Ste-Marie, 2007; Lewthwaite & Wulf, 2010; Trempe, Sabourin, & Proteau, 2012) support for learners during practice has a direct and positive impact on motor learning. Autonomy, relatedness, and competence are considered basic psychological needs and important sources of human motivation (Deci & Ryan, 2000, 2008). In the present study, we examined whether enhancing children's perceived competence or expectancies for successful performance, through positive comparative feedback, would facilitate the learning of a sport motor skill.

Competence implies the need to feel oneself as confident, rather than feeling incapable, of skillfully mastering challenges in one's environment (Ryan, 1995). It has long been argued that individual's performance, choice, effort, and persistence can be explained by their efficacy expectancies or beliefs about how well they will do on a determined task or activity (Bandura, 1982; Deci & Ryan, 2000, 2008; Wigfield & Eccles, 2000). In the OPTIMAL theory of motor learning (Wulf & Lewthwaite, 2016), enhancing learners' expectancies for future performance is also considered an important motivational factor.

Augmented feedback is considered as information provided by an agent (e.g., teacher, coach) related to aspects of one's understanding or performance (Hattie & Timperley, 2007) and one of the most powerful factors affecting motor learning (Schmidt & Lee, 2011). Several studies have demonstrated a strong relationship between augmented feedback, competence, and motor learning. For example, learners usually prefer to receive feedback after good rather than poor trials (Chiviacowsky & Wulf, 2002, 2005; Fairbrother et al., 2012; Grand et al., 2015; Patterson & Carter, 2010; Patterson, Carter, & Sanli, 2011). Feedback deliberately provided after good trials (Badami, VaezMousavi, Wulf, & Namazizadeh, 2012; Chiviacowsky & Wulf, 2007; Clark & Ste-Marie, 2007; Ste-Marie, Vertes, Rymal, & Martini, 2011) or indicating successful performance through the establishment of relatively easy

* Corresponding author. Escola Superior de Educação Física, Universidade Federal de Pelotas, Rua Luís de Camões, 625, CEP 96055-630, Pelotas, RS, Brazil.
E-mail address: suzete@ufpel.edu.br (S. Chiviacowsky).

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criteria of good performance (Chiviacowsky & Harter, 2015; Chiviacowsky, Wulf, & Lewthwaite, 2012; Palmer, Chiviacowsky, & Wulf, 2016; Trempe et al., 2012) has been demonstrated to enhance motor learning. Likewise, feedback statements designating performance a result of malleable rather than fixed capacities positively affects performance and learning of motor skills (Chiviacowsky & Drews, 2016).

A related line of research supporting this "feedback/competence/learning" relationship involves individuals' competence evaluation amid social or temporal comparison. For instance, participants who received general feedback informing them that their performance had gradually improved across blocks of practice showed higher learning and motivation relative to participants who were informed that their performance had slightly degraded over time (Chiviacowsky & Drews, 2016). Similar effects on motor learning were found in individuals receiving social-comparative feedback during practice, where their outcomes were compared with those of others (Lewthwaite & Wulf, 2010; Navaee, Farsi, & Abdoli, 2016; Pascua, Wulf, & Lewthwaite, 2015; Wulf, Chiviacowsky, & Cardozo, 2014; Wulf, Chiviacowsky, & Lewthwaite, 2010, 2012).

To date, however, only one experiment has observed the effects of enhancing learners' expectancies through positive comparative feedback on motor learning in typical children (Ávila, Chiviacowsky, Wulf, & Lewthwaite, 2012). Motivation after practice was higher and the retention of a simple beanbag-throwing task was facilitated in 10-year-old participants receiving positive social-comparative feedback relative to a control group. Nevertheless, it is still largely unknown if this factor would facilitate the learning of more complex motor skills, such as most of the sport skills. The objective of the present experiment was, therefore, to observe the influence of positive social-comparative feedback on the learning of a sport motor skill. Considering that there is a dearth of research on sport skills learning in children, and the acquisition of new skills is considered to be significantly more effective up until early adolescence than later in life (Janacsek, Fiser, & Nemeth, 2012), the potential benefits of positive comparative feedback on the acquisition of sport skills in children were therefore deemed an important driver of this research.

Two groups of 10-year-old children were asked to practice the free-throw basketball task. Similar to the study of Ávila et al. (2012), the positive feedback (PF) group received socio-comparative information after each given block of trials in addition to veridical feedback suggesting that their average performance was better than that of a peer group's on that block. Participants in the control group received veridical feedback but were not provided with social-comparative feedback. The learning of sport skills usually involves task transfer (Schmidt & Lee, 2011) from simple or easy conditions of practice to more difficult or complex environments, normally involving well-established rules of competition. Thus, in order to examine skill-learning effects as a function of positive feedback, a transfer test was performed one day later. A customized questionnaire to assess the potential influence on participants' level of perceived competence, enjoyment, importance of doing well, and persistence related to the task as a function of practice condition was applied at the end of practice. We hypothesized that the positive comparative feedback group would demonstrate higher learning of the task than the control group. We also expected that these participants would report higher levels of enjoyment, satisfaction with performance, importance of doing well, and perhaps greater persistence related to the task after practice, relative to participants in the control group.

2. Methods

2.1. Participants

Twenty-six children (PF group, M = 9.65; SD = 0.91; control group, M = 9.60, SD = 0.92; range age 9–12 years-old) participated in the experiment. Participants provided their assent, and informed consent was obtained from the school and the parents/guardians. The university's institutional review board approved the study. Calculation of the sample size was carried out using G × Power 3.1, with an α level of 5%, effect size (*f*) of 0.58, and a power of 80% for the two groups, based on effect sizes previously reported using similar study designs (e.g., $\eta_p^2 = 0.78$ in Chiviacowsky, 2014; $\eta_p^2 = 0.16$ in Ávila et al., 2012). Participants were not aware of the specific purpose of the study and had no prior experience with the experimental task.

2.2. Apparatus and task

The task involved the basketball free throw. A private gymnasium with a basketball court was used for data collection. The free throw line for practice was located at a distance of 3 m from the backboard, which was at a height of 2.60 m from the floor, and an official youth ball (number 5) was used. Scores were established in relation to shot accuracy: specifically, 4 points for a converted ball, 3 points for balls that touched both the backboard and the hoop; 2 points for balls that touched only the hoop; 1 point for balls that touched only the backboard; and 0 points for missed shots.

2.3. Procedure

After completing the consent form, all participants were randomly assigned to the PF group and control group, with an equal number of males and females (9 boys and 4 girls) in each group, and introduced to the task. Data were collected individually and one of the researchers for the present study was responsible for instructing all children. Participants were informed about the goal of the task and observed two demonstrations of how to perform it. They were instructed to throw the basketball overhand with both hands, keeping their feet behind a line on the floor. The participants were also informed about the punctuation score system and that they would receive feedback after each block of 10 trials in relation to the sum of points in the specific block. Participants in the PF group were informed that they would also receive comparative feedback on their performance in relation to the performance of another group of children of the same age. More specifically, these participants were informed about (false) peer's average scores in the block, which were always calculated as 20% less than the participants' own scores. Thus, participants in the PF group received veridical feedback and (false) positive social-comparative feedback after each block of practice, while the control group received only veridical feedback after each block.

The practice phase consisted of 40 trials, and one day later a transfer test was performed, consisting of 10 trials without any augmented feedback. In this transfer test, the free throw line was located at a distance of 4 m from the backboard, according to Mini Basketball official rules. In order to assess the subjective experience related to the task, after the practice phase, all children filled out a customized questionnaire. For each of the four statements (enjoyment, competence, importance and persistence-related), there were four possible responses, ranging for example from "not competent/not important" to "very competent/very important", and with appropriate "smiley" or "frowny" faces accompanying each response (adapted from Ávila et al., 2012). The responses to each statement were assigned 1, 2, 3, or 4 points, respectively, for analysis purposes.

2.4. Data analysis

The Shapiro-Wilk test was used to confirm the normality of the data. Punctuation scores were analyzed in 2 (group: PF versus control) × 4 (blocks of 10 trials) analysis of variance (ANOVA) with repeated measures of the last factor for the practice phase, while separated one-way ANOVAs were used for the transfer test and questionnaire responses. Bonferroni test was used for follow-up analysis. Partial eta-squared

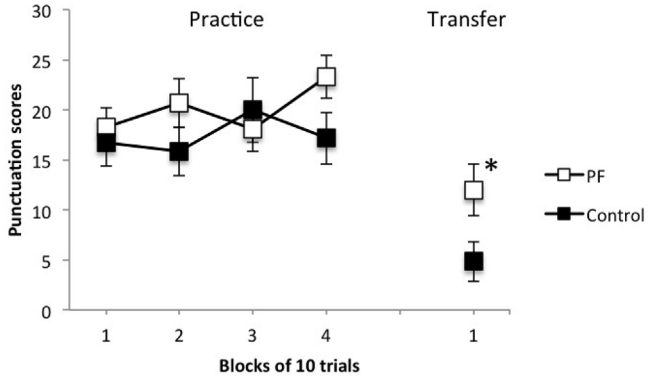

Fig. 1. Punctuation scores of the PF group and control group during practice and transfer. Error bars indicate standard errors. Asterisk denotes significant difference between PF versus Control group.

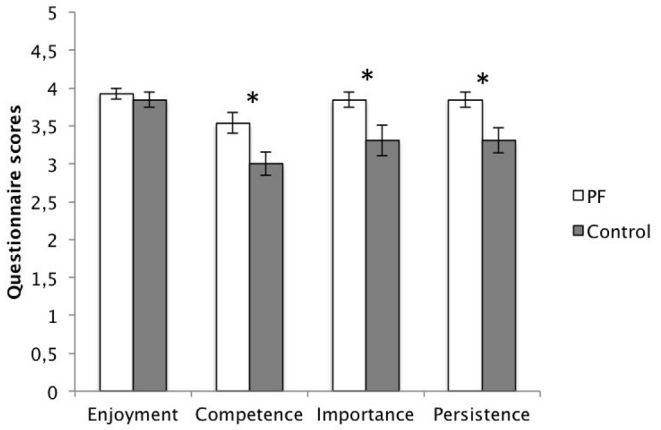

Fig. 2. Questionnaire scores, after practice, of the PF and control groups. Error bars indicate standard errors. Asterisks denote significant differences between PF versus Control group.

values were used to indicate effect sizes (η_p^2), considering 0.01, 0.06, and 0.14 for a small, moderate, or large effect, respectively (Larson-Hall, 2009), and for all analysis the alpha was set at 0.05.

3. Results

3.1. Throwing accuracy

3.1.1. Practice

During the practice phase, participants in both groups improved their punctuation scores across blocks (Fig. 1). While the main effect of group, F (1, 24) = 0.72, p = .401, η_p^2 = 0.029; and block, F (3, 72) = 1.72, p = .169, η_p^2 = 0.067 were not significant, the group × block interaction, F (3, 72) = 4.06, p = .010, η_p^2 = 0.145 was significant. Follow-up analysis showed that participants in the PF group significantly improved across blocks, F (3, 36) = 3.34, p = .030, η_p^2 = 0.281, while improvement in control group participants failed to reach significance, F (3, 36) = 2.31, p = .092, η_p^2 = 0.162.

3.1.2. Transfer

Punctuation scores were significantly higher for the PF group compared with the control group on the transfer test, F (1, 24) = 4.86, p = .037, η_p^2 = 0.168 (Fig. 1).

3.2. Questionnaire results

The groups did not differ in terms of enjoyment of performing the free throws following the practice phase, F (1, 24) = 0.353, p = .558, η_p^2 = 0.014 (Fig. 2). However, they differed regarding how satisfied they were with their performance, with participants in the PF group rating their perceived competence F (1, 24) = 6.25, p = .020, η_p^2 = 0.207, and importance of doing well in the task, F (1, 24) = 5.34, p = .030, η_p^2 = 0.182, significantly higher than control participants. Differences were also found regarding persistence in practicing the task, F (1, 24) = 7.00, p = .014, η_p^2 = 0.226, with participants of the PF group reporting higher willingness to perform more free throws compared with control participants.

4. Discussion

The present experiment was designed to examine whether enhancing performance expectancies through positive social-comparative feedback, suggesting that participants' performance was generally higher than the performance of peers, would enhance the learning of the basketball free throw in children. The findings confirm our hypothesis, showing that the group receiving positive comparative feedback demonstrated higher learning of the basketball free throw, measured in the transfer test, than the control participants. Thus, in line with previous studies that manipulated participants' competence evaluation through social (e.g., Ávila et al., 2012; Lewthwaite & Wulf, 2010; Navaee et al., 2016; Wulf et al., 2010, 2012) or temporal-comparative feedback (Chiviacowsky & Drews, 2016), providing children with general positive feedback, implying that their performance was slightly higher than the performance of peers, led to more effective learning of a sport skill than not giving them such information. The PF group also reported higher perceived competence, importance of doing well, and persistence in practicing the task at the end of practice compared with participants in the control group.

How can the observed effects be explained? The feeling of improving and demonstrating one's abilities or competence is considered fundamentally satisfying and motivating (Deci & Ryan, 2000; White, 1959). Confidence can affect performance expectancies, preparing individuals for further positive experiences, and impacting cognitive, emotional and motor preparatory activity (Schmidt, Braun, Wager, & Shohamy, 2014; Schunk, 1991; Wigfield & Eccles, 2000; Wulf, Chiviacowsky, & Lewthwaite, 2012). According to the OPTIMAL theory of motor learning (Wulf & Lewthwaite, 2016), enhanced expectancies for performance are considered to strengthen the coupling of goals to actions, readying the motor system for task execution and helping to consolidate memories. Performance expectancies can also influence effort tolerance (Hutchinson, Sherman, Martinovic, & Tenenbaum, 2008), positive affect (Stoate, Wulf, & Lewthwaite, 2012), importance of doing well, and persistence in practicing the task (present study).

Furthermore, enhanced expectancies may help learners to set higher performance goals (Bandura & Locke, 2003; Bandura, 1997; Locke & Latham, 2006), potentially affecting effort and attention paid during performance and resulting in performance gains (Bandura & Jourden, 1991; West & Thorn, 2001; West, Dark-Freudeman, & Bagwell, 2009; West, Welch, & Thorn, 2001). In fact, greater self-efficacy has indeed been directly associated with increased task-relevant attentional control during practice (Themanson & Rosen, 2015), and observed to be a predictor of motor performance (for a review, see Moritz, Feltz, Fahrbach, & Mack, 2000) as well as learning (Chiviacowsky, 2014; Chiviacowsky et al., 2012; Stevens et al., 2012; Wulf et al., 2014). Less confident learners, however, tend to occupy themselves with counter-productive self-evaluative concerns, decreasing effort and attention or explicit monitoring activity to important aspects of the task, whereby degrading performance (Bandura & Wood, 1989; Bandura, 1982; Sarason, 1984; Wine, 1971) and motor learning (Cardozo & Chiviacowsky, 2015; Heidrich & Chiviacowsky, 2015; McKay, Wulf, Lewthwaite, & Nordin, 2015).

In conclusion, the findings provide the first evidence that enhancing learners' performance expectancies through positive comparative feedback facilitates the learning of sport motor skills in children. They

also emphasize the important motivational role of augmented feedback in motor learning. Future studies may reveal further comparative feedback effects on the learning of different kinds of sport skills in various populations. Considering practical applications, it is suggested that professionals involved with teaching-learning processes take advantage of enhancing expectancies strategies, for example highlighting positive aspects of performance, or facilitating success experience, in order to benefit sport skills learning.

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