Benefits of enhanced expectancies through temporal-comparative feedback for motor learning in older adults

Article *in* International journal of sport psychology · December 2018

DOI: 10.7352/IJSP.2018.49.521

Helena Thofehrn Lessa
Universidade Federal de Pelotas

Suzete Chiviacowsky
Universidade Federal de Pelotas

Int. J. Sport Psychol., 2018; 49: 521-530
doi: 10.7352/IJSP.2018.49.521

Benefits of enhanced expectancies through temporal-comparative feedback for motor learning in older adults

HELENA THOFEHRN LESSA*, GO TANI**, SUZETE CHIVIACOWSKY*

(*) *Universidade Federal De Pelotas, Brazil*
(**) *Universidade De São Paulo, Brazil*

The present study investigated the effects of positive temporal-comparative feedback on the learning of a timing walk task in older adults. Thirty-four older adults practiced a task in which they were required to learn how to walk for a distance of 4 m using 50% of their maximal speed. Participants were divided into a positive temporal-comparative feedback (PTC) group and a control group, both of which received feedback about timing accuracy after every other trial during practice. In addition, after each block of 10 trials, participants in the PTC group were informed that their average temporal errors in the block were lower than the average error of the previous block. Retention and transfer tests were performed 24 hours after the practice phase. A customized questionnaire was also applied, which focused on verifying perceived competence, enjoinment, and nervousness levels. The results showed enhanced learning and lower levels of nervousness while adapting to the transfer task for the PTC group relative to the control group. These results provide evidence that positive temporal-comparative feedback can facilitate motor learning in older adults, and further support the motivational role of feedback in motor learning.

KEY WORDS: Aging, Knowledge of results, Motivation.

Introduction

The motivational role of feedback in motor learning have recently been more directly investigated through different lines of research (Ávila, Chiviacowsky, Wulf, & Lewthwaite, 2012; Badami, Vaezmousavi, Wulf, & Namazizadeh, 2012; Chiviacowsky & Harter, 2015; Chiviacowsky & Wulf, 2002; 2007; Chiviacowsky, Wulf, Wally, & Borges, 2009; Clark & Ste-Marie, 2007;

Correspondence to: Suzete Chiviacowsky, Ph.D., Escola Superior de Educação Física, Universidade Federal de Pelotas, Rua Luís de Camões, 625 - CEP 96055-630 Pelotas - RS, Brazil (e-mail: suzete@ufpel.edu.br)

Lewthwaite & Wulf, 2010; Navaee, Farsi, & Abdoli, 2016; Saemi, Porter, Ghotbi-Varzaneh, Zarghami, & Maleki, 2012; Wulf, Chiviacowsky, & Lewthwaite, 2012). In general, these studies indicate that practice conditions in which participants can build positive mindsets and expectancies for successful performance through the use of positive feedback may generate better motor performance and learning.

One of these research lines involves comparative feedback, a type of feedback that provides the learner with information related to improvements on performance at different points in time (temporal-comparative feedback) or related to the performance of peers in similar practice conditions (social-comparative feedback) (Albert, 1977; Brown & Middendorf, 1996; Festinger, 1954; Zell & Alicke, 2009; Wilson & Ross, 2000). Social-comparative feedback has been consistently demonstrated to facilitate the learning of motor skills in diverse kinds of tasks. Wulf, Chiviacowsky and Lewthwaite (2012) observed not only higher learning, but also reduced nervousness and concerns related to own ability in older adults receiving feedback who indicated above-average performance during practice. Similar results were found in other populations, for example in young adults learning balance tasks (Lewthwaite & Wulf, 2010b), sequential timing tasks (Wulf, Chiviacowsky, & Lewthwaite, 2010), or throwing tasks (Pascua, Wulf, & Lewthwaite, 2015; Wulf, Chiviacowsky, & Cardozo, 2014), or in children learning the throwing of beanbags (Ávila et al., 2012) or basketballs (Gonçalves, Cardozo, Valentini, & Chiviacowsky, 2018).

Research looking at the effects of temporal-comparative feedback on motor learning, however, is significantly more limited. Chiviacowsky and Drews (2016) observed that younger adult participants receiving false feedback that suggested that their average performance on practice blocks was better than in previous blocks presented higher levels of self-efficacy and greater learning of a coincident timing task than participants who were informed that their performance across blocks had decreased. In another study using the same population, the learning of a sport motor task, golf putting, was enhanced when participants received positive comparative feedback relative to a control group that did not receive such information (Chiviacowsky, Harter, Gonçalves, Cardozo, 2019).

Experiments observing the effects of positive temporal-comparative feedback in older adults are, however, still lacking. This subject is important for several reasons. For example, Brown and Middendorf (1996) observed that temporal comparison was preferred in different age groups relative to social comparison, with its importance being increased throughout life, while the importance of social comparison remained constant. In addition, the performance of older adults is considered to be frequently negatively affected by the adults' mindsets. In the aging process, negative stereotypes related to the advancement of age can be incorporated and assimilated unconsciously, reflected as loss of competence and impaired self-esteem (Levy, 2009).

The negative effects of age stereotypes on motor learning have recently been confirmed (Chiviacowsky, Cardozo, & Chalabaev, 2018). While older adults may indeed present a natural physical and cognitive decline that may compromise their daily activities (Ren, Wu, Chan, & Yan, 2013), such negative psychological perspectives may contribute to the level of observed age-related changes. Thus, there is a possibility that positive temporal-comparative feedback may benefit the acquisition of motor skills in older adults, and the purpose of the present study was to investigate this effect.

Two groups of participants (a positive temporal-comparative feedback group and a control group) practiced a gait task involving speed precision. While both groups received equal feedback about temporal accuracy after every other trial during the practice phase, only the positive temporal-comparative feedback group received (false) feedback suggesting that their performance in a determined block was better on average than the performance in the previous block. Retention and transfer tests, without any kind of feedback, were applied the next day, in order to assess relatively permanent effects on performance, that is, task learning. In addition, to assess whether and how positive temporal-comparative feedback influenced participants' perceptions of enjoyment, competence and nervousness, participants completed a customized questionnaire at the end of each day. We hypothesized that older adults receiving the positive comparative feedback would demonstrate superior performance in the learning tests, and higher motivational levels in the customized questionnaire, relative to participants of the control group.

Methods

Participants

Thirty-four older adults (30 women and 4 men) with a mean age of 66.14 ± 5.06 years (positive temporal comparative group: mean = 66.06, standard deviation [SD] = 4.63; control group: mean = 66.24, SD = 5.63) participated in this experiment. The participants were healthy and were recruited from a physical activity group of a university in the southern Brazil. Participants indicated their voluntary participation by informed consent, but were not aware of the specific purpose of the study and had no prior experience with the experimental task. The university's institutional review board approved the study.

Task And Procedure

The participants were required to learn an indoor 4-meter walking speed task, on a flat floor, using 50% of their maximal speed. Two marks were placed on the floor indicating the beginning and end of the straight path, and a stopwatch was used to record the time (in seconds) to complete the trials. Before practice, all participants were asked to complete the path once as fast as possible, in order to establish their maximal speed. Each trial began with the participants standing on the first mark. The timer was initiated when the participants' feet left the mark and stopped when the participant first touched the end mark.

The participants were randomly assigned to the positive temporal-comparative feedback group (PTC) or the control (C) group, matched according to sex and age, and received general task instructions. Next, they received the specific target time (50% of their maximal speed) to complete each trial, and performed one trial as a pre-test. During practice, both groups received feedback about the time used to complete the path after every other trial. In addition, participants in the PTC group received positive comparative feedback indicating their progress across the blocks. More specifically, at the end of the second, third, and fourth block of trials, and similar to the findings of Chiviacowsky and Drews (2016), these participants were informed that their average errors were 10%, 15%, and 20% lower than the average error of the previous block, respectively. The practice phase consisted of 40 trials. In order to assess learning, participants performed retention and transfer tests the next day, with both tests consisting of ten trials without any feedback. In the transfer test, the target time for each participant was increased by 2 seconds.

Immediately after the practice phase (day 1) and the transfer test (day 2), the participants were asked to complete a customized questionnaire adapted from the Intrinsic Motivation Inventory (IMI) (Mcauley, Duncan, & Tammen, 1989), with questions related to the enjoyment, competence, and nervousness scales. They were asked to indicate the intensity of which they felt such aspects in relation to the task on a scale of 1 ("nothing") to 10 ("extremely").

Data Analysis

Accuracy scores for each trial were analyzed in a 2 (groups: PTC, control) × 4 (trial blocks) analyses of variance (ANOVA) with repeated measures on the last factor. Retention, transfer, and the questionnaire data were analyzed by separated one-way ANOVA. Partial eta-squared values were used to indicate effect sizes. The alpha level for significance was set at .05 for all analyses.

Results

Temporal Accuracy

Pre-test

There was no significant difference observed between groups on the pre-test, $F\ (1, 34) = 1.71$, $p = .682$, $\eta p^2 = .005$.

Practice

The groups increased their temporal accuracy across the practice trials (see Figure 1). The main effect of trial was significant, F (3, 96) = 41.789, p < .001, ηp^2 = .566. The main effect of group was not significant, F (1, 32) = 3.266, p = .080, ηp^2 = .093, indicating that performance during practice did not differ across groups. The interaction of group and trial was also not significant, F (3, 96) = 0.120, p = .948, ηp^2 = .004.

Retention

The main effect of group was not significant, F (1, 34) = 1.754, p = .195, ηp^2 = .052 (Figure 1).

Transfer

The main effect of group was significant, F (1, 32) = 6.036, p = .020, ηp^2 = .159, confirming that the PTC group had higher temporal accuracy then the control group (Figure 1).

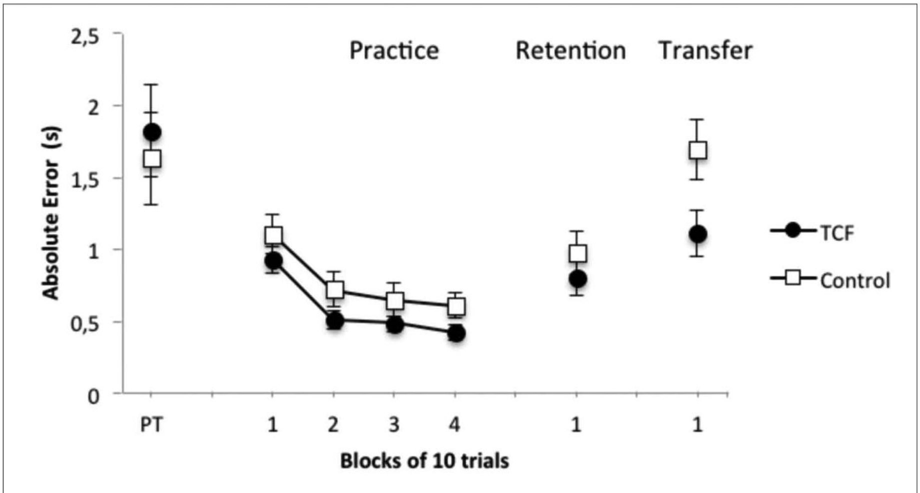

Figure 1. Absolute error scores of the PTC and Control groups in the pre-test, practice, retention, and transfer phases. Error bars represent SE.

QUESTIONNAIRE

After the practice phase, no differences were observed between the PTC and the control groups regarding perceived enjoyment, F (1, 32) = 1.078, p = 0.307, $\eta p^2 = .033$; competence, F (1, 32) = 0.059, $p = .810$, $\eta p^2 = .002$; or nervousness, F (1, 32) = 2.298, $p = .139$, $\eta p^2 = .067$. After the transfer test, there was a significant difference observed between the groups, with the PTC group presenting lower scores in the nervousness levels relative to the control group, F (1, 32) = 6.152, $p = .019$, $\eta p^2 = .161$. Differences in the reported enjoyment, F (1, 32) = 1.078, $p = .307$, $\eta p^2 = .033$, and competence, F (1, 32) = 0.000, $p = 1.000$, $\eta p^2 = .000$, levels were not found. The means and SD of the assessed questionnaire subscales are presented in Table I.

Discussion

In the present experiment, we investigated whether positive temporal comparative feedback, confirming improvements in performance across blocks of practice, would benefit motor learning in older adults. The results showed that participants receiving the positive comparative feedback had similar performance during practice and retention, but enhanced performance in the transfer test, relative to participants in the control group. Thus, more effective learning of the task was observed in the positive feedback group. Questionnaire results also demonstrated reduced nervousness in these participants compared with the control group on the second day. Positive temporal comparative feedback can therefore play a role in decreasing levels of nervousness related to task performance among older adults, subsequently benefiting motor learning.

The findings of the present study add to a growing literature showing that a person's mindset can affect motor learning. These findings are in line,

TABLE I
Questionnaire Subscale Results Of The PTC And Control Groups After Practice And Transfer.

Subscales	After practice phase		After transfer test	
	PTC	Control	PTC	Control
Enjoyment	8.94 (1.06)	8.41 (1.54)	8.78 (0.94)	8.53 (1.33)
Competence	9.33 (1.33)	9.18 (1.47)	9.39 (1.29)	9.35 (0.93)
Nervousness	1.72 (2.37)	3.41 (3.59)	1.0 (1.78)*	3.47 (3.57)

* Significant statistical ($p < .05$) difference between groups.

for example, with evidence showing the benefits of providing temporal comparative feedback in young adults (Chiviacowsky, Harter, Gonçalves, & Cardozo, 2019). They also corroborate previous findings (Wulf et al., 2012) in which elderly women receiving social comparative feedback demonstrated higher motor learning and lower levels of nervousness and ability-related concerns relative to control groups.

While the aging process is reflected in behavioral changes resulting from functional decline, it can also be influenced by age-related negative stereotypes internalized throughout life, such as reduced memory performance, reduced balance, slower gait speed, and decreased auditory capacity (Levy, 1996; Levy, 2009). Such stereotypes are capable of influencing cognitive, physical, and motor outcomes, being associated, for example, with an intensified cardiovascular response (Levy, Hausdorff, Hencke, & Wei, 2000), worse gait performance (Hausdorff, Levy, & Wei, 1999), and motor learning (Chiviacowsky, Cardozo, & Chalabaev, 2018). However, it seems that the simple reduction of negative beliefs by enhancing older adults' expectancies for performance, or perceptions of ability, through different kinds of positive feedback can benefit motor learning in this population (Chiviacowsky et al., 2009; Wulf et al., 2012; present study).

Practice conditions that enhance expectancies for performance may contribute to motor learning by strengthening the coupling of goals to actions, reading the motor system for task execution, and helping to consolidate memories (Wulf & Lewthwaite, 2016). In this process, a dual role for goal-action coupling is indicated: maintaining focus on the task goal and preventing or reducing self-focus. Individuals showing increased task-related nervousness may present higher concerns about their own competence on the task, probably occupying themselves with self-directed intrusive thoughts, which is considered counterproductive to motor learning (Bandura, 1982; Bandura & Wood, 1989; McKay, Wulf, Lewthwaite, & Nordin, 2015; Sarason, 1984; Wine, 1971; Wulf et al., 2012). Confidence (or self-efficacy) has, in fact, been shown to enhance task-relevant attentional control during practice (Themanson & Rosen, 2015), and is demonstrated to be a predictor of motor performance and learning (e.g., Chiviacowsky, 2014; Chiviacowsky, Wulf, & Lewthwaite, 2012; Moritz, Feltz, Fahrbach, & Mack, 2000; Stevens, Anderson, O'Dwyer, & Williams, 2012).

Taken together, the results of the present study and previous literature support the conclusion that positive temporal-comparative feedback probably affects older adults by reducing age-related negative self-focus. The findings advance the results of previous feedback experiments, providing the first evidence that positive temporal-comparative feedback can enhance the learning of motor skills in older adults. The results have implications in practical settings that can be easily implemented in teaching situations, since the provision of positive temporal-comparative feedback can generate conditions for optimal motor learning. Considering the worldwide phenomenon of aging populations and the evidence strongly supporting the positive association between increased levels of physical activity, exercise participation, and improved health in older adults (Taylor, 2014), it is a challenge for health professionals to increase the participation of older adults in physical activity. Practice contexts supporting the individual's motivation for better learning of motor skills may play an important role in promoting higher engagement in physical activity, contributing to the improvement of health in this population. Future research could further explore the specific mechanisms mediating the relationship between temporal-comparative feedback and the learning of motor skills in older adults.

REFERENCES

Albert, S. (1977). Temporal comparison theory. *Psychological Review, 84*, 485-503.

Ávila, L., Chiviacowsky, S., Wulf, G., & Lewthwaite, R. (2012). Positive social-comparative feedback enhances motor learning in children. *Psychology of Sport and Exercise*, *13*, 849-853.

Badami, R., Vaezmousavi, M., Wulf, G., & Namazizadeh, M. (2012). Feedback about more accurate versus less accurate trials: Differential effects on self-confidence and activation. *Research Quarterly for Exercise and Sport*, *83*, 196-203.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*, 122-147.

Bandura, A., & Wood, R. (1989). Effect of perceived controllability and performance standards on self-regulation of complex decision making. *Journal of Personality and Social Psychology, 56*, 805-814.

Brown, R., & Middendorf, J. (1996). The underestimated role of temporal comparison: A test of the life-span model. *The Journal of Social Psychology, 136*, 325-331.

Chiviacowsky, S. (2014). Self-controlled practice: autonomy protects perceptions of competence and enhances motor learning. *Psychology of Sport and Exercise, 15*, 505-510.

Chiviacowsky, S., Cardozo, P., & Chalabaev, A. (2018). Age stereotypes' effects on motor learning in older adults: The impact may not be immediate, but instead delayed. *Psychology of Sport and Exercise,* doi: 10.1016/j.psychsport.2018.02.012.

Chiviacowsky, S., & Drews, R. (2016). Temporal-comparative feedback affects motor learning. *Journal of Motor Learning and Development, 4*, 208-218.

Chiviacowsky, S., Harter, N., Gonçalves, G. and Cardozo, P. (2019). Temporal-Comparative Feedback Facilitates Golf Putting. *Frontiers in Psychology, 9*: 2691. doi: 10.3389/fpsyg.2018.02691.

Chiviacowsky, S., & Wulf, G. (2007). Feedback after good trials enhances learning. *Research Quarterly for Exercise and Sport, 78*, 40-47.

Chiviacowsky, S., & Wulf, G. (2002). Self-controlled feedback: does it enhance learning because performers get feedback when they need it?. *Research Quarterly for Exercise and Sport, 73*, 408-415.

Chiviacowsky, S., Wulf, G., & Lewthwaite, R. (2012). Self-controlled learning: The importance of protecting perceptions of competence. *Frontiers in Movement Science and Sport Psychology, 3*, 458, 1-8.

Chiviacowsky, S., Wulf, G., Wally, R., & Borges, T. (2009). Knowledge of results after good trials enhances learning in older adults. *Research Quarterly of Exercise and Sport, 80*, 663-668.

Clark, S., & Ste-Marie, D. (2007). The impact of self-as-a-model interventions on children's self-regulation of learning and swimming performance. *Journal of Sports Sciences*, *25*, 577-586.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, 7, 117-140.

Gonçalves, G., Cardozo, P., Valentini, N., & Chiviacowsky, S. (2018). Enhancing performance expectancies through positive comparative feedback 3 facilitates the learning of basketball free throw in children. *Psychology of Sport and Exercise,* doi: 10.1016/j.psychsport.2018.03.001.

Hausdorff, J., Levy, B., & Wei, J. (1999). The power of ageism on physical function of older persons: reversibility of age-related gait changes. *Journal of the American Geriatrics Society, 47*, 1346-9.

Levy, B. (1996). Improving memory in old age by implicit self-stereotyping. *Journal of Personality and Social Psychology, 71*, 1092-1107.

Levy, B. (2009). Stereotype Embodiment: A Psychosocial Approach to Aging. *Current Directions in Psychological Science, 18*, 332-336.

Levy, B., Hausdorff, J., Hencke, R., & Wei, J. (2000). Reducing cardiovascular stress with positive self-stereotypes of aging. *Journal of Gerontology: Psychological Sciences, 55B*, 205-2013.

Lewthwaite, R., & Wulf, G. (2010). Grand challenge for movement science and sport psychology: embracing the social-cognitive–affective–motor nature of motor behavior. *Frontiers on Psychology, 1*, 42, 1-3.

Lewthwaite, R., & Wulf, G. (2010b). Social-comparative feedback affects motor skill learning. *Quarterly Journal of Experimental Psychology, 63*, 738-749.

Mcauley, E., Duncan, T., & Tammen, V. (1989). Psychometric properties of the intrinsic motivation inventory in a competitive sport setting: a confirmatory factor analysis. *Research Quarterly for Exercise and Sport, 60*, 48-58.

McKay, B., Wulf, G., Lewthwaite, R., & Nordin, A. (2015). The self: Your own worst enemy? A test of the self-invoking trigger hypothesis. *The Quarterly Journal of Experimental Psychology, 68,* 1910-1919.

Moritz, S., Feltz, D., Fahrbach, K., & Mack, D. (2000). The relation of self-efficacy measures to sport performance: a meta-analytic review. *Research Quarterly for Exercise and Sport, 71*, 280-294.

Navaee, S. A., Farsi, A., & Abdoli, B. (2016). The effect of normative feedback on stability and efficacy of some selected muscles in a balancing task. *International Journal of Applied Exercise Physiology*, *5,* 1, 43-52.

Pascua, L., Wulf, G., & Lewthwaite, R. (2015). Additive benefits of external focus and enhanced performance expectancy for motor learning. *Journal of Sports Sciences, 33*, 58–66.

Ren J., Wu Y., Chan, J., & Yan, J. (2013). Cognitive aging affects motor performance and learning. *Geriatrics & Gerontology International, 13*, 19-27.

Saemi, E., Porter, J., Ghotbi-Varzaneh, A., Zarghami, M., & Maleki, F. (2012). Knowledge of results after relatively good trials enhances self-efficacy and motor learning. *Psychology of Sport and Exercise, 13*, 378-382.

Sarason, I. (1984). Stress, anxiety, and cognitive interference: reactions to tests. *Journal of Personality and Social Psychology, 46,* 929.
Stevens, D., Anderson, D., O'Dwyer, N., & Williams, A. (2012). Does self-efficacy mediate transfer effects in the learning of easy and difficult motor skills? *Consciousness and Cognition, 21*, 1122–1128.
Taylor, D. (2014). Physical activity is medicine for older adults. *Postgraduate Medical Journal, 90*, 26-32.
Themanson, J. R., & Rosen, P. J. (2015). Examining the relationships between self-efficacy, task-relevant attentional control, and task performance: Evidence from event-related brain potentials. *British Journal of Psychology*, *106,* 2, 253-271.
Watson, D., Clark, L., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative: the PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063-1070.
Wine, J. (1971). Test anxiety and direction of attention. *Psychological Bulletin, 76,* 92-104.
Wilson, A., & Ross, M. (2000). The frequency of temporal-self and social comparisons in people's personal appraisals. *Journal of Personality and Social Psychology, 78*, 928-942.
Wulf, G., Chiviacowsky, S., & Cardozo, P. (2014). Additive benefits of autonomy support and enhanced expectancies for motor learning. *Human Movement Science, 37*, 12-20.
Wulf, G., Chiviacowsky, S., & Lewthwaite, R. (2012). Altering mindset can enhance motor learning in older adults. *Psychology and Aging, 27*, 14-21.
Wulf, G., Chiviacowsky, S., & Lewthwaite, R. (2010). Normative feedback effects on learning a timing task. *Research Quarterly for Exercise and Sport, 81*, 425-431.
Wulf, G., & Lewthwaite, R. (2016). Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning. *Psychonomic Bulletin & Review, 23,* 1382-1414.
Zell, E., & Alicke, M. (2009). Self-evaluative effects of temporal and social comparison. *Journal of Experimental Social Psychology, 45*, 223-227.

Manuscript submitted April 2018. Accepted for publication November 2018.