Human Movement Science 38 (2014) 235–240

Contents lists available at ScienceDirect

Human Movement Science

journal homepage: www.elsevier.com/locate/humov

Small choices can enhance balance learning

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A R T I C L E   I N F O

Article history:

PsycINFO classification:
2330
2343
3720

Keywords:
Autonomy support
Exercise
Fundamental psychological needs
Self-controlled practice
Motivation

A B S T R A C T

The present study examined whether the learning of exercise routines would be enhanced by giving participants an incidental choice (i.e., exercise order). Two groups of participants were asked to perform three balance exercises. After watching a demonstration of each exercise, a choice group was allowed to choose the order of exercises, while yoked control group participants performed them in the same order as their choice group counterparts. To assess learning, a retention test was conducted 1 day later. The choice group had a significantly smaller number of errors (i.e., contacting the ground with the free leg to regain balance) than the control group. This finding indicates that performers' need for autonomy can be supported by giving them small choices – which in turn can positively affect the learning of balance exercises.

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1. Introduction

Supporting people's fundamental need for autonomy (Deci & Ryan, 2000, 2008) has been shown to have positive consequences for motivation, general well-being, quality of life (e.g., Langer & Rodin, 1976), and learning (e.g., Chiviacowsky, Wulf, Lewthwaite, & Campos, 2012; Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997). The benefits of providing autonomy support – or giving individuals a sense of choice and allowing them to determine their own behavior – also extend to the exercise domain (for a review, see Teixeira, Carraca, Markland, Silva, & Ryan, 2012). For instance, exercisers'

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http://dx.doi.org/10.1016/j.humov.2014.10.007
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perceptions of autonomy have been found to be affected by fitness instructors' perceived interacting style (Puente & Anshel, 2010). Furthermore, individuals' motivation and adherence to exercise or rehabilitation programs has been shown to be related to the degree of autonomy support they experienced (Chan, Lonsdale, Ho, Yung, & Chan, 2009; Standage, Gillison, Ntoumanis, & Treasure, 2012). Interestingly, it is apparently sufficient for participant to *believe* that their preferences (for certain exercises) are being taken into account to increase their exercise adherence (Thompson & Wankel, 1980). Even a small and incidental choice can increase individuals' motivation to exercise. In a recent study (Wulf, Freitas, & Tandy, 2014), participants who were allowed to choose the order in which they wanted to complete four different exercises (e.g., jumping jacks, lunges) subsequently chose to do significantly more repetitions of each exercise than did control group participants who were asked to complete those exercises in a pre-determined order. Thus, giving participants a relatively trivial choice increased their exercise engagement.

In the present study, we followed up on that finding. We asked whether giving performers an incidental choice would also result in more effective learning of exercise routines. In the motor learning domain, self-controlled (i.e., learner-controlled) practice has consistently been found to lead to more effective learning than prescribed practice conditions. For example, if performers are given the opportunity to make decisions about the delivery of feedback (e.g., Chiviacowsky, Wulf, Laroque de Medeiros, Kaefer, & Tani, 2008; Janelle et al., 1997; Patterson & Carter, 2010), the use of assistive devices (e.g., Hartman, 2007; Wulf & Toole, 1999), or frequency of skill demonstrations (Wulf, Raupach, & Pfeiffer, 2005), learning is usually superior compared with yoked control groups (for reviews, see Sanli, Patterson, Bray, & Lee, 2013; Wulf, 2007). But in those studies, participants' choices are typically related to a task-relevant aspect (e.g., specific task information, performance feedback), or practice conditions such as the amount of practice (Post, Fairbrother, Barros, & Kulpa, 2014) or order of different tasks to be learned (Hodges, Edwards, Luttin, & Bowock, 2011). In contrast, in the current study, we gave participants one incidental choice. We asked them to perform three different balance exercises and, similar to Wulf et al. (2014), one group was allowed to choose the order of those exercises while another group was not. In contrast to the previous study, in which that choice positively influenced participants' willingness to exercise, we asked whether the *learning* of exercise routines might also be enhanced by having a choice. In a few previous studies (Hodges et al., 2011; Keetch & Lee, 2007), participants were able to decide in which order they wanted to practice different tasks. However, in those studies numerous practice trials were performed on each task, and choices about the task to be performed next – presumably as a function of previous performance – were made throughout the practice phase. In the present case, participants chose the order of three exercises only once, namely, before the beginning of practice. Subsequently, they completed five consecutive repetitions of each exercise in either the chosen order (choice group) or in a prescribed order (yoked group). To assess whether giving performers this relatively minor choice would affect their task learning, both groups performed a retention test 1 day after the practice phase.

2. Method

2.1. Participants

Twenty individuals (4 males) with an average age of 34.7 years ($SD = 14.05$) participated in this study. Half of the volunteers were university students, who were recruited from an undergraduate kinesiology class. The other half of the participants were recruited from a gym at which the experimenter worked as a personal trainer. Eighteen participants were right-foot dominant, and two were left-foot dominant. The study was approved by the university's institutional review board. All participants gave their informed consent, and they were unaware of the specific purpose of the study and their assignment to a certain group.

2.2. Apparatus, task, and procedure

Participants were randomly assigned to either a choice or control group in the order of their appearance in the laboratory. In both groups, participants performed 3 balance exercises (see below) with each foot. Foot dominance was determined by asking participants with which foot they would kick a ball. Each exercise was performed with the dominant foot first. Choice group participants were able to choose the order of those exercises after a demonstration but before the beginning of the practice phase. Control group participants were each yoked to a participant in the choice group and were simply informed about the order in which they would perform the exercises. The exercises were as follows: (1) Toe touch: Standing on one leg and reaching down to touch the toes with the ipsilateral arm (continuously for 30 s); (2) Head turn: Standing on one leg, rotating the head to the left for 3 s, returning head to normal (i.e., straight forward), rotating the head to the right for 3 s, returning the head to normal, looking down for 3 s, and returning the head to normal (with verbal guidance); (3) Ball pass: Standing on one leg and catching a medicine ball 10 times. Each exercise was performed 5 times with the dominant leg first. Subsequently, participants performed the same exercises 5 times with the other leg. The experimenter counted the number of errors (i.e., contacting the ground with the free leg to regain balance) each participant made on each set. One day later, participants returned to the lab and completed a retention test, which consisted of 2 sets of each exercise with each leg, in the same order as during practice.

2.3. Data analysis

Errors during the practice phase were analyzed in a 2 (group: choice, control) $\times$ 3 (exercise: toe touch, head turn, ball pass) $\times$ 2 (leg: right, left) $\times$ 5 (set) analysis of variance (ANOVA) with repeated measures on the last factor. The retention data were analyzed in a 2 (group) $\times$ 3 (exercise) $\times$ 2 (leg) $\times$ 2 (set) ANOVA.

3. Results

3.1. Practice

Fig. 1 shows each group's average errors on the three exercises during practice and retention, and Fig. 2 shows errors for each exercise and leg. Errors generally decreased across sets, and the choice

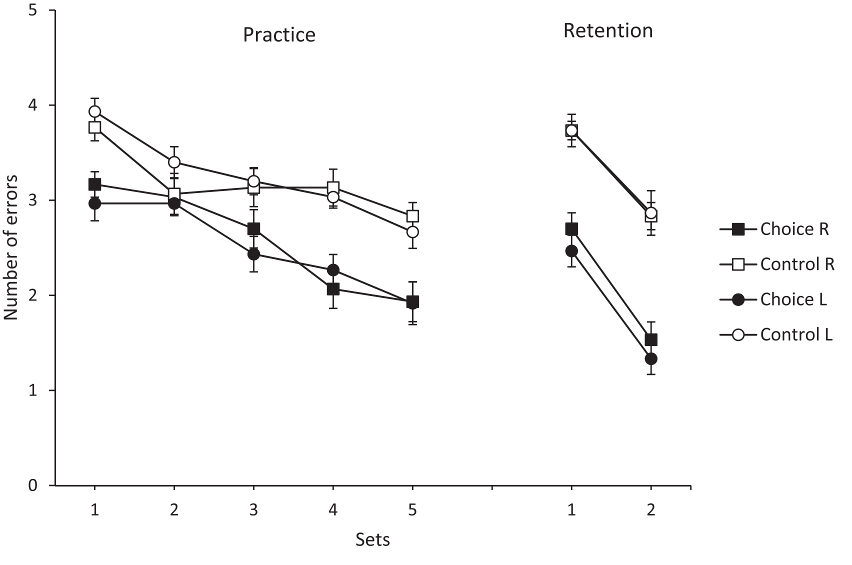

Fig. 1. Average number of errors on all three exercises with the right foot (R) and left foot (L) during practice and retention. Error bars represent standard errors.

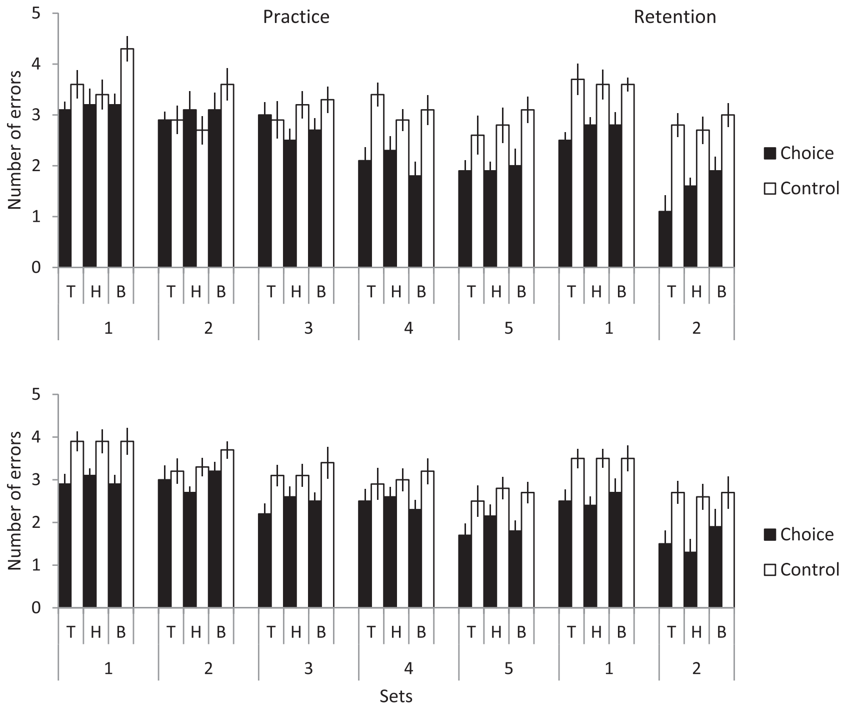

Fig. 2. Number of errors on each exercise (T: toe touch; H: head turn; B: ball toss) with the right foot (top) and left foot (bottom) during practice and retention. Error bars represent standard errors.

group had smaller errors than the control group throughout most of the practice phase. Also, there were no differences between right and left legs. The main effects of group, $F(1,18) = 13.70$, $p < .01$, $\eta_p^2 = .432$, and set, $F(4,72) = 39.20$, $p < .001$, $\eta_p^2 = .685$, were significant. Also, the interaction of group and set, $F(4,72) = 3.46$, $p < .05$, $\eta_p^2 = .161$, was significant. Post hoc tests indicated that the two groups differed on Sets 1, 4, and 5, *ps* < .01. Furthermore, the interaction of group, set, and leg, $F(4,72) = 2.79$, $p < .05$, $\eta_p^2 = .134$, was significant, but post hoc test did not identify the source of the interaction. Neither the main effects of exercise, $F(2,36) < 1$, or leg, $F(1,18) < 1$, nor any of the other interactions were significant.

3.2. Retention

On the retention test, there was a reduction in errors from Set 1 to Set 2, and the choice group showed fewer errors than the control group (see Fig. 1, right). Errors on each exercise and for each leg can be seen in Fig. 2 (right). The main effects of group, $F(1,18) = 25.35$, $p < .001$, $\eta_p^2 = .585$, and set, $F(1,18) = 111.25$, $p < .001$, $\eta_p^2 = .861$, were significant. There was no main effect of leg, $F(1,18) < 1$, or exercise, $F(2,36) = 1.56$, $p > .05$. The interaction of set and exercise, $F(1,18) = 3.29$, $p = .049$, $\eta_p^2 = .154$, reached significance. However, post hoc tests did not reveal the source of the interaction.

4. Discussion

Giving participants the opportunity to decide in which order they wanted to complete the exercises had an impact on their performance as well as learning of the tasks. Relative to asking participants to perform them in a certain order (yoked control group), the choice group had fewer errors on all tasks during most of the practice phase. More importantly, the choice group demonstrated clearly superior performance when participants returned 1 day later and were not given another choice. Thus, giving participants a single, incidental choice before they began practicing led to significantly more effective learning than not having a choice.

Studies in the motor learning domain have consistently demonstrated learning advantages of self-controlled practice conditions relative to yoked control conditions (see Sanli et al., 2013; Wulf, 2007, for reviews). Yet, in those studies participants typically made a number of task-related choices throughout the practice phase. Also, autonomy-supportive instructional language, implying a certain degree of freedom with respect to task execution and practice, has been found to enhance skill learning relative to controlling-language instructions (Hooyman, Wulf, & Lewthwaite, 2014). In the latter study, the respective instructions were also given repeatedly during practice. In contrast, the present results show that learning can be enhanced by providing performers with relatively innocuous choices. This finding is in line with that of a previous study (Lewthwaite, Chiviacowsky, & Wulf, 2012), in which task-irrelevant choices (e.g., which task to perform in a subsequent experiment) facilitated the learning of a balance task, relative to not having a choice.

In addition to demonstrating that a single choice can be sufficient to produce learning advantages, the present findings suggest a motivational explanation for this effect (Lewthwaite & Wulf, 2012). The learning benefits of self-controlled practice have mostly been explained with enhanced information processing associated with the ability to decide when to receive task information (Patterson & Lee, 2010) or feedback (e.g., Chiviacowsky & Wulf, 2002), use an assistive device (e.g., Hartman, 2007), switch to a different task, or stop practicing (e.g., Post et al., 2014). Even though task-relevant information might indeed be processed more effectively when the learner is in control, the current results – showing enhanced learning with a single, incidental choice – support the idea that the satisfaction of individuals' need for autonomy may be the critical factor underlying the learning effects (Lewthwaite & Wulf, 2012).

This motivational explanation is also consistent with the finding of a previous study (Wulf et al., 2014) in which the same choice (i.e., order of exercises) resulted in a 60% increase in the number of repetitions participants were willing to perform. Evidence seems to suggest that granting performers a freedom of choice may convey a general sense of trust that, in turn, increases their confidence in their abilities. For instance, in a study on reading comprehension (Tafarodi, Milne, & Smith, 1999), having the opportunity to choose names of characters to be used in a story increased participants' confidence in their performance. Autonomy-supportive wording of instructions has also been shown to result in greater perceived competence (Reeve & Tseng, 2011) or self-efficacy (Hooyman, Wulf, & Lewthwaite, 2014). The relation between self-efficacy and motor performance (e.g., Feltz, Chow, & Hepler, 2008; Moritz, Feltz, Fahrbach, & Mack, 2000) and learning (e.g., Stevens, Anderson, O'Dwyer, & Williams, 2012) has been well established.

The picture that is emerging from recent findings, including the present results, is that conditions that are supportive of, or at least do not thwart, performers' fundamental need for autonomy (Deci & Ryan, 2000, 2008) provide various benefits. In practical settings, autonomy support may provide a double advantage for learning – an indirect advantage by increasing practice duration (Wulf et al., 2014) and a direct advantage, perhaps meditated by enhanced self-efficacy. Other possible consequences may include greater adherence to exercise regimens and improved clinical outcomes. In future studies it would be fruitful to examine possible mediating variables (e.g., self-efficacy, positive and negative affect) as well as longer-term effects of exercise programs that include choices.

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