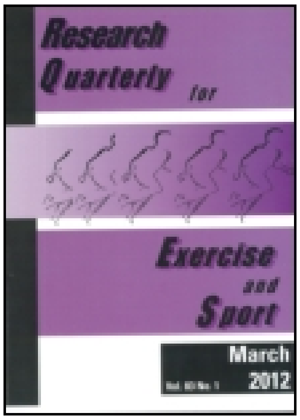
This article was downloaded by: [Suzete Chiviacowsky]
On: 22 May 2014, At: 06:35
Publisher: Routledge
Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Research Quarterly for Exercise and Sport
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/urqe20

Knowledge of Results After Good Trials Enhances Learning in Older Adults

Suzete Chiviacowsky [a] , Gabriele Wulf [b] , Raquel Wally [a] & Thiago Borges [a]
[a] Department of Physical Education , Federal University of Pelotas
[b] Department of Kinesiology and Nutrition Sciences , University of Nevada-Las Vegas

Published online: 23 Jan 2009.

To cite this article: Suzete Chiviacowsky , Gabriele Wulf , Raquel Wally & Thiago Borges (2009) Knowledge of Results After Good Trials Enhances Learning in Older Adults, Research Quarterly for Exercise and Sport, 80:3, 663-668

To link to this article: http://dx.doi.org/10.1080/02701367.2009.10599606

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the “Content”) contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at http://www.tandfonline.com/page/terms-and-conditions

Research Quarterly for Exercise and Sport
©2009 by the American Alliance for Health,
Physical Education, Recreation and Dance
Vol. 80, No. 3, pp. 663–668

Knowledge of Results After Good Trials Enhances Learning in Older Adults

Suzete Chiviacowsky, Gabriele Wulf, Raquel Wally, and Thiago Borges

Key words: feedback, motivation, motor learning, throwing

In recent years, some researchers have examined motor learning in older adults (e.g., Carnahan, Vandervoort, & Swanson, 1996; Daselaar, Rombouts, Veltman, Raaijmakers, & Jonker, 2003); Smith et al., 2005; Wishart & Lee, 1997). Some of these studies have specifically looked at the effectiveness of different manipulations of extrinsic feedback, or knowledge of results (KR). While in young adults decreasing the "usefulness" of feedback often enhances learning (for reviews, see Schmidt, 1991; Swinnen, 1996; Wulf & Shea, 2004), this evidence appears to be somewhat mixed for older adults. While some studies found similar effects of different KR manipulations for younger and older adults (e.g., Carnahan et al., 1996; Swanson & Lee, 1992), others did not find unqualified benefits of making KR more difficult to use for learning in older adults (e.g., Behrman, Vander Linden, & Cauraugh, 1992; Wishart & Lee, 1997; Wishart, Lee, Cunningham, & Murdoch, 2002). In the study by Carnahan et al. (1996), for example, older adults (average age: 75.0 years) practiced a computer-key-pressing task with a specified goal time. KR was provided either in a summary format, where KR about each trial was provided only after the completion of a given block of trials, or after every single trial. Similar to what studies with younger adults have shown (e.g., Gable, Shea, & Wright, 1991; Schmidt, Young, Swinnen, & Shapiro, 1989; Schmidt, Lange, & Young, 1990; Yao, Fischman, & Wang, 1994), summary KR resulted in more effective retention performance than did KR provided after every trial.

In contrast, other studies did not find learning advantages of more "difficult" KR manipulations, such as reduced KR frequencies, for motor skill learning in older adults (e.g., Behrman et al., 1992; Wishart & Lee, 1997; Wishart, Lee, Cunningham, & Murdoch, 2002). Behrman et al. (1992) used a task that required participants (average age: 69 years) to reproduce a force-time curve, presented on an oscilloscope, by modulating isometric force production of their right elbow extensors. Similar to what Vander Linden, Cauraugh, and Greene (1993) found for young adults using a similar task, concurrent knowledge of performance (KP) was not beneficial to learning, compared to terminal KP (100% or 50%). However, the 50% KP condition did not result in more effective learning than the 100% condition, contrary to Vander Linden et al.'s (1993) findings. Furthermore, Wishart and Lee (1997) did not find differential learning effects as a function of different KR frequencies (100% versus 67%) for older adults (average age: 66.2 years) on a task that required participants to produce a continuous movement comprising three distinct spatial segments with specific timing requirements (although no KR frequency effects were found for younger participants [average age: 19.8 years] either). In the Wishart et al. (2002) study, younger (19–27 years) and older (65–70 years) participants practiced a bimanual coordination task under concurrent or reduced feedback conditions. Older participants not only performed generally less effectively than younger participants, but they also benefited more from concurrent feedback relative to terminal feedback. Finally, in Van Dijk and Hermens' study (2006), younger adults (20–35 years) were able to utilize myofeedback (i.e., display of electromyographic signal) in a task requiring them to lower trapezius muscle activity, whereas older adults (55–70 years) were not.

Submitted: October 10, 2007
Accepted: July 29, 2008

Suzete Chiviacowsky, Raquel Wally, and Thiago Borges are with the Department of Physical Education at the Federal University of Pelotas. Gabriele Wulf is with the Department of Kinesiology and Nutrition Sciences at the University of Nevada–Las Vegas.

In general, the learning benefits of providing summary KR or reducing KR frequency have been explained with more effective information-processing activities (i.e., guidance hypothesis; e.g., Salmoni, Schmidt, & Walter, 1984; Schmidt, 1991). According to this view, reducing the availability of KR during practice encourages learners to process their own intrinsic feedback to a greater extent, compared to when KR is provided frequently and immediately. As a consequence, learners develop less of a dependency on the KR. In addition, excessive variability in movement execution (so-called maladaptive short-term corrections), due to frequent error information, tends to be avoided. Thus, at least in young adults, learning is typically enhanced if KR is more difficult to use (but see the review by Wulf & Shea, 2004).

In contrast, it appears that the advantages, if any, of reducing the usefulness of KR are not as clear-cut in older adults. Potential reasons for this lack of effect may be related to differences in the capabilities of younger and older adults to process information and learn new motor skills (e.g., Grouios, 1991; Santos, Corrêa, & Freudenheim, 2003; Spirduso, 1995). For example, Grouios (1991) showed that reaction time increased in adults 50 years and older. Similarly, movement time has been demonstrated to increase with age (Pohl, Winstein, & Fisher, 1996; Smith et al., 1999). According to Spirduso (1995), reduction in the capability to process information, rather than a decrease in the cognitive structures involved, increases reaction and movement times. Age-related changes in information processing refer to factors such as attention, information comparison, recognition, use of strategies, selection, and planning of responses in accordance with the task objective. To explain older adults' lack of improvement in their study, Van Dijk and Hermens (2006) argued that "…the provided information about the muscle activity (myofeedback)…was too complicated for older adults to interpret. The age-related changes in cognitive processing possibly hindered them to comprehend this specific information and use it to improve their performance" (p. 153).

Considering the limitations in information processing in older adults, learning motor skills may be generally more demanding than for younger adults. Similar to learning complex skills—with high attention, memory, or motor control demands—in younger individuals, older adults may not necessarily benefit from manipulations that make practice more difficult or challenging for the learner (e.g., by reducing the feedback frequency; Wulf & Shea, 2002, 2004). This pattern of results is in line with Wulf and Shea's (2002) conclusion based on their review of the literature on simple versus complex skill learning:

> The differential effectiveness of various practice variables depending on the task and experience of the learner suggests that judging difficulty based on external characteristics may not be as productive as characterizing task situations in terms of their demands (cognitive, attentional, motor). Under a scheme based on the demands the task places on the cognitive motor system, difficulty would be considered a relative task characteristic depending on the degree to which resources are loaded or overloaded. This perspective is consistent with the notion that motor skills with low demands benefit from practice conditions that increase the load and challenge the performer…; however, the acquisition of skills that place extremely high loads on the performer should benefit from conditions that reduce the load to more manageable levels (physical assistance, increased feedback….(Wulf & Shea, 2002, pp. 206–207).

Given that many motor tasks may already be more challenging for older adults compared to younger adults, making KR more difficult to use has not always been effective for learning in older adults. The purpose of our study was to examine the effectiveness of another KR manipulation that has recently been demonstrated to enhance learning in younger adults—one that presumably does not tax the information-processing system. Chiviacowsky and Wulf (2007) found that providing KR after "good" trials resulted in more effective learning compared to KR provided after "poor" trials. In their study, younger adults (21 years) practiced a throwing task. 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 after the three best trials demonstrated superior retention compared to the group that received KR after the three poorest trials. Chiviacowsky and Wulf (2007) argued that motivational factors might be largely responsible for the learning benefits of KR provided after relatively successful trials. In our study, we wanted to determine whether similar learning advantages could be seen in older adults. As providing KR after good, as opposed to poor trials, does not involve an increase in the "difficulty" of using KR, or in the information-processing requirements, we expected similar learning advantages as seen in younger adults. We replicated the experiment by Chiviacowsky and Wulf (2007), using the same task and experimental design, but used 65-year-old adults as participants. Two groups practiced a beanbag-throwing task with their nondominant arms and were provided KR after the three most accurate or three least accurate trials in each six-trial block, respectively. We assessed learning in a retention test 3 days after the practice phase.

Method

Participants

Twenty-two adults (all women) with a mean age of 65.9 years participated in this experiment. We recruited participants from the Physical Activity Oriented Program at the Federal University of Pelotas. Participants had no prior experience with the experimental task, and they were not aware of our study's specific purpose. All participants provided informed consent.

Apparatus, Task, and Procedure

The apparatus, task, and procedure were similar to those used in previous studies (Chiviacowsky & Wulf, 2007; Chiviacowsky, Wulf, Laroque de Medeiros, Kaefer, & Wally, 2008). Participants were required to toss beanbags (100 g) with their nondominant arms at a target on the floor (see Figure 1). The target had a radius of 100 cm and was placed at a distance 3 m from the participants. Concentric circles with radii of 20–100 cm (in 10-cm increments) served as zones to assess the accuracy of the throws. If the beanbag landed on the target, 100 points were awarded. If it landed in one of the other zones, or outside the circles, 90 down to 0 points were awarded. The target area was divided into four quadrants for the provision of KR.

Participants were randomly assigned to the KR good and KR poor groups, with 11 participants in each group. All participants were informed that, at the end of each six-trial block, they would receive KR on three of those trials but not told which ones. Participants in the KR good group were provided KR on the three most accurate trials in a block, whereas participants in the KR poor group were given KR on the three least accurate trials.[1] Participants were allowed to look at the target before each set of six trials. During those six trials, they were required to wear opaque swimming goggles to prevent them from viewing the outcome. To control the timing of the trials and KR presentation a digital timer was used. Participants had 6 s to complete each trial. KR was written on a board and presented for 15 s. KR was provided in terms of the direction and the extent of the deviation from the target (Chiviacowsky et al., 2008). Specifically, it consisted of the trial number and the respective score, as well as directional information (e.g., "right +50"; see Figure 1). All participants performed 60 practice trials. A retention test consisting of 10 trials without KR was conducted 72 hr after the practice phase.

Data Analysis

Accuracy scores for the practice phase were averaged across blocks of six trials and analyzed in a 2 (group) x 10 (blocks) analysis of variance (ANOVA) with repeated measures on the last factor. In addition, we compared performances on the first and last practice block in a 2 (group) x 2 (blocks) ANOVA. The retention test scores were averaged across all 10 trials and analyzed in a one-way ANOVA.

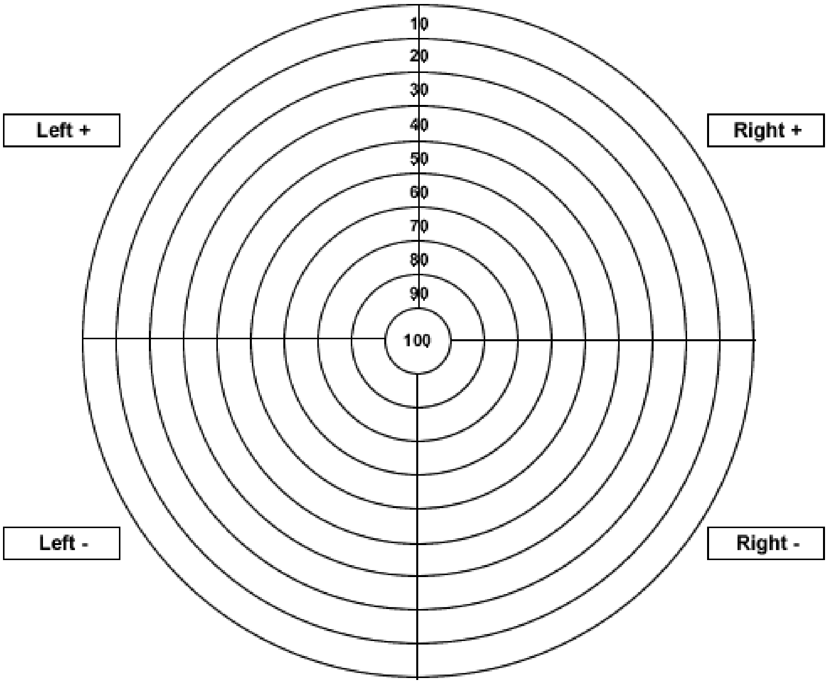


Figure 1. Schematic of the target and areas used for providing feedback.

Results

Practice

Both groups tended to increase their accuracy scores across the practice phase, with the KR good group showing a somewhat more systematic increase from the beginning to the end of practice (see Figure 2, left). Neither the main effects of group, $F(1, 20) < 1$, or block, $F(9, 180) = 1.44$, $p > .05$, nor the Group x Block interaction, $F(9, 180) = 1.53$, $p > .05$, were significant. The lack of block effect may have been due to the somewhat erratic performance of the KR poor group. Therefore, we compared accuracy scores on the first and last practice block in a separate ANOVA. The main effect of block was significant, $F(1, 20) = 4.46$, $p < .05$, $\eta^2 = .18$. In addition, the group effect was significant, $F(1, 20) = 5.15$, $p < .05$, $\eta^2 = .21$. The Group x Block interaction was not significant, $F(1, 20) < 1$.

Retention

On the retention test without KR, performed 3 days after the practice phase, the KR good group had higher accuracy scores than the KR poor group (see Figure 2, right). This group difference was significant, $F(1, 20) = 4.36$, $p < .05$, $\eta^2 = .18$. Thus, in line with Chiviacowsky and Wulf's (2007) results, providing KR after more accurate trials during practice resulted in more effective learning than providing KR after less accurate trials.

Discussion

There appears to be converging evidence that providing KR after trials with relatively small errors is more effective for learning than providing KR after trials with larger errors. Studies examining learner-controlled (self-controlled) KR first showed that learners prefer to receive KR after they believe they had a "good" trial rather than a "poor" trial (Chiviacowsky & Wulf, 2002, 2005). Chiviacowsky and Wulf (2007) followed up on those findings by directly examining the effectiveness of KR after relatively good versus poor trials and found that KR after good trials indeed resulted in superior learning in young adults. Our study demonstrated that motor learning in older adults benefited from this type of KR as well. Although the 65-year-olds in our study tended to be generally less proficient relative to the 21-year-olds in Chiviacowsky and Wulf's (2007) study, the group who was provided KR after good trials demonstrated more effective retention performance than the group who received KR after poor trials.

There may be various reasons for the learning benefits of KR after good trials. For example, KR that indicates a movement was relatively successful might have a *reinforcing* role. That is, it might encourage learners to try to repeat that movement. In addition, the learning advantages of KR after good trials are likely to be *motivational*. Providing KR after successful trials (and ignoring poor trials) might create a greater success experience for learners than providing KR after poor trials (and ignoring good trials), which, in turn, enhances the learning process.

The motivational role of KR for learning (e.g., Thorndike, 1927) has been downplayed somewhat in recent years (e.g., Schmidt & Lee, 2005). In fact, according to the predominant theoretical view of feedback—the guidance hypothesis (e.g., Salmoni, Schmidt, & Walter, 1984; Schmidt, 1991), which focuses on the *informational* properties of KR (Schmidt & Lee, 2005)—feedback should be particularly important after poor trials when it is assumed

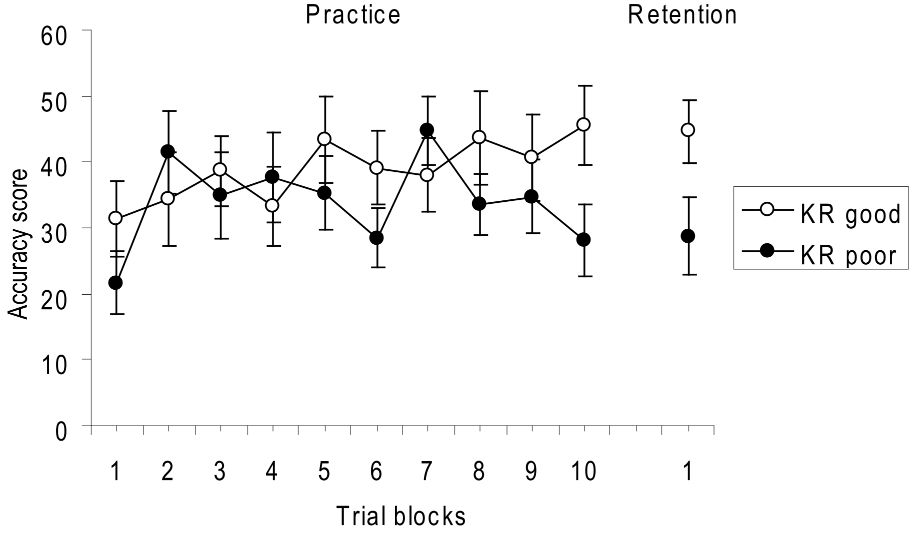


Figure 2. Accuracy scores for the knowledge of results (KR) good and KR poor groups during practice (10 blocks of 6 trials) and retention (1 block of 10 trials).

to guide learners to the correct response. After good trials, feedback is seen as less important. Our findings, as well as those of Chiviacowsky and Wulf (2007), seem to contrast with this view by showing that KR after good trials can, in fact, be more important than KR after poor trials—presumably because of its motivational effects. Other findings also point to the motivational influence of feedback on performance and learning, including studies on normative feedback, in which norms such as a peer group's average performance scores are provided in addition to participants' actual scores. Decreased motivation in response to negative (normative) feedback was found in a number of studies (e.g., Johnson, Turban, Pieper, & Ng, 1996). Lack of motivation or interest in the task, in turn, was associated with reduced improvement in motor performance, compared to high motivation (e.g., Jourden, Bandura, & Banfield, 1991). Moreover, in recent studies (Lewthwaite and Wulf, in press; Wulf, Chiviacowsky, & Lewthwaite, in press), the feedback provided to participants about their actual motor performance was supplemented by fake average scores, indicating to different groups that they were performing above or below the norm, respectively. Individuals who believed they performed "better" than average found the normative feedback more useful and demonstrated more effective learning than those who believed they were "worse" than average. Thus, although participants had veridical information about their performance, the positive or negative connotations of the feedback had differential effects on learning. Together, these findings suggest the motivational (or reinforcing) effects of feedback should perhaps be considered to a greater extent than they have been in recent years to get a better understanding of how feedback functions in the learning process.

These findings may be particularly relevant for motor learning in older adults. Previous studies with older adults have not been able to provide convincing evidence that increasing the difficulty of using KR (e.g., by providing summary KR or reducing the relative KR frequency) is beneficial for learning in older adults (e.g., Behrman et al., 1992; Carnahan et al., 1996; Wishart & Lee, 1997). Similarly, there is no clear evidence that KR manipulations can enhance learning in individuals with impairments, such as stroke (for a review, see Van Vliet & Wulf, 2006). Limitations in the information-processing capabilities of older (e.g., Spirduso, 1995) or impaired adults are likely a mediating factor in this context. The identification of KR manipulations that enhance learning in older adults—such as feedback after successful, rather than unsuccessful trials—has theoretical and practical importance.

The assumption that feedback should be given primarily after poor trials seems to be prevalent in the minds of practitioners as well. Our findings may have implications for practical settings, such as exercise groups for older adults or physical or occupational therapy. Given that learners often have a relatively good feel for how they perform, prefer feedback after good trials (Chiviacowsky & Wulf, 2002, 2005), and show more effective learning with "good" feedback (see also Chiviacowsky & Wulf, 2007), instructors may want to consider withholding feedback after less successful movement executions, while reinforcing successful ones.

References

Behrman, A. L., Vander Linden, D. W., & Cauraugh, J. H. (1992). Relative frequency knowledge of results: Older adults learning a force-time modulation task. *Journal of Human Movement Studies, 23,* 233–250.

Carnahan, H., Vandervoort, A. A., & Swanson, L. R. (1996). The influence of summary knowledge of results and aging on motor learning. *Research Quarterly for Exercise and Sport, 67,* 280–287.

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. (2005). Self-controlled feedback is effective if it is based on the learner's performance. *Research Quarterly for Exercise and Sport, 76,* 42–48.

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

Chiviacowsky, S., Wulf, G., Laroque de Medeiros, F., Kaefer, A., & Wally, R. (2008). Self-controlled feedback in children: Higher feedback frequencies enhance learning. *Research Quarterly for Exercise and Sport, 79,* 122–127.

Daselaar, S. M., Rombouts, S. A. R. B., Veltman, D. J., Raaijmakers, J. G. W. & Jonker, C. (2003). Similar network activated by young and old adults during the acquisition of a motor sequence. *Neurobiology of Aging, 24,* 1013–1019.

Gable, C. D, Shea, C. H., & Wright, D. L. (1991). Summary knowledge of results. *Research Quarterly for Exercise and Sport, 62,* 285–292.

Grouios, G. (1991). Aging effects on reaction time. *International Journal of Physical Education, 2,* 18–22.

Johnson, D. S., Turban, D. B., Pieper, K. F., & Ng, Y. M. (1996). Exploring the role of normative- and performance-based feedback in motivational processes. *Journal of Applied Social Psychology, 26,* 973–992.

Jourden, F. J., Bandura, A., & Banfield, J. T. (1991). The impact of conceptions of ability on self-regulatory factors and motor skill acquisition. *Journal of Sport & Exercise Psychology, 8,* 213–226.

Lewthwaite, R., & Wulf, G. (in press). Social-comparative feedback affects motor skill learning. *Quarterly Journal of Experimental Psychology.*

Pohl, P. S., Winstein, C. J., & Fisher, B. E. (1996). The locus of age-related movement slowing: Sensory processing in continuous goal-directed aiming. *Journal of Gerontology: Psychological Sciences 51B,* 94–102.

Salmoni, A., Schmidt, R. A., & Walter, C. B. (1984). Knowledge of results and motor learning: A review and critical reappraisal. *Psychological Bulletin, 95,* 355–386.

Santos, S., Corrêa, U. C., & Freudenheim, A. M. (2003). Variability of performance in an anticipatory timing task with individuals of different ages. *Brazilian Journal of Physical Education and Sport, 17,* 154–162.

Schmidt, R. A. (1991). Frequent augmented feedback can degrade learning: Evidence and interpretations. In J. Requin & G. E. Stelmach (Eds.), *Tutorials in motor neuroscience* (pp. 59–75). Dordrecht, The Netherlands: Kluwer Academic.

Schmidt, R. A., Lange, C., & Young, D. E. (1990). Optimizing summary knowledge of results for skill learning. *Human Movement Science, 9,* 325–348.

Schmidt, R. A., & Lee, T. D. (2005). Motor control and learning: A behavioral emphasis (4th ed.). Champaign, IL: Human Kinetics.

Schmidt, R. A., Young, D. E., Swinnen, S., & Shapiro, D. E. (1989). Summary knowledge of results for skill acquisition: Support for the guidance hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15,* 352–359.

Smith, C. D, Umberger, G. H, Manning, E. L, Slevin, J. T, Wekstein, D. R., Schmitt, F. A., et al. (1999). Critical decline in fine motor hand movements in human aging. *Neurology, 53,* 1458–1461.

Smith, C. D., Walton, A., Loveland, A. D., Umberger, G. H., Kryscio, R. J., & Gash, D. M. (2005). Memories that last in old age: Motor skill learning and memory preservation. *Neurobiology of Aging, 26,* 883–890.

Spirduso, W. W. (1995). *Physical dimensions of aging.* Champaign, IL: Human Kinetics.

Swanson, L. R., & Lee, T. D. (1992). Effects of aging and schedules of knowledge of results on motor learning. *Journal of Gerontology, 47,* 406–411.

Swinnen, S. P. (1996). Information feedback for motor skill learning: A review. In H. N. Zelaznik (Ed.), *Advances in motor learning and control* (pp. 37–66). Champaign, IL: Human Kinetics.

Thorndike, E. L. (1927). The law of effect. *American Journal of Psychology, 39,* 212–222.

Van Dijk, H., & Hermens, H. J. (2006). Effects of age and timing of augmented feedback on learning muscle relaxation while performing a gross motor task. *American Journal of Physical Medicine & Rehabilitation, 85,* 148–155.

Van Vliet, P., & Wulf, G. (2006). Extrinsic feedback for motor learning after stroke: What is the evidence? *Disability and Rehabilitation, 28,* 831–840.

Vander Linden, D. W., Cauraugh, J. H., & Greene, T. A. (1993). The effect of frequency of kinetic feedback on learning an isometric force production task in nondisabled subjects. *Physical Therapy, 73,* 79–87.

Wishart, L. R., & Lee, T. D. (1997). Effects of aging and reduced relative frequency of knowledge of results on learning a motor skill. *Perceptual and Motor Skills, 84*(Pt. 1), 1107–1022.

Wishart, L. R., Lee, T. D., Cunningham, S. J., & Murdoch, J. E. (2002). Age-related differences and the role of augmented visual feedback in learning a bimanual coordination pattern. *Acta Psychologica, 110,* 247–263.

Wulf, G., Chiviacowsky, S., & Lewthwaite, R. (in press). Normative feedback effects on the learning of a timing task. *Research Quarterly for Exercise and Sport.*

Wulf, G., & Shea, C. H. (2002). Principles derived form the study of simple motor skills do not generalize to complex skill learning. *Psychonomic Bulletin and Review, 9,* 185–211.

Wulf, G., & Shea, C. H. (2004). Understanding the role of augmented feedback: The good, the bad, and the ugly. In A. M. Williams & N. J. Hodges (Eds.), *Skill acquisition in sport: Research, theory and practice* (pp. 121–144). London: Routledge.

Yao, W.-X., Fischman, M. G., & Wang, Y. T. (1994). Motor skill acquisition and retention as a function of average feedback, summary feedback, and performance variability. *Journal of Motor Behavior, 26,* 273–282.

Note

1. Thus, the knowledge of results (KR) schedule was essentially a summary-KR schedule (e.g., Schmidt, Lange, & Young, 1990; Yao, Fischman, & Wang, 1994) in that KR was provided only after a block of trials had been completed; yet, in contrast to typical summary-KR manipulations, KR was only given on half the trials within a given block in both conditions.

Authors' Note

Please address all correspondence concerning this article to Suzete Chiviacowsky, Escola Superior de Educação Física, Universidade Federal de Pelotas, Rua Luís de Camões, 625 - CEP 96055-630, Pelotas - RS – Brazil.

E-mail: schivi@terra.com.br