

Practice organization beyond memory processes: the Schöllhorn (2022) comments on generalization

GUILHERME M. LAGE¹ | LIDIANE A. FERNANDES² | TÉRCIO APOLINÁRIO-SOUZA³ | NATHÁLYA G. H. M. NOGUEIRA¹
| BÁRBARA DE PAULA FERREIRA¹

¹ Universidade Federal de Minas Gerais – UFMG, Brasil.

² Universidade Federal de Juiz de Fora – Campus Avançado de Governador Valadares – UFJF-GV, Brasil.

³ Instituto Metodista Izabela Hendrix, Brasil.

Correspondence to: Guilherme Menezes Lage. Department of Physical Education, Universidade Federal de Minas Gerais, Av. Pres. Antônio Carlos, 6627 Campus Pampulha, Belo Horizonte, CEP 31270-901, Brasil.

email: menezeslage@gmail.com

<https://doi.org/10.20338/bjmb.v16i2.306>

ABBREVIATIONS

CI Contextual interference
VP Variability of practice

PUBLICATION DATA

Received 20 05 2022

Accepted 30 05 2022

Published 01 06 2022

Professor Schöllhorn ¹ brings an interesting and insightful viewpoint to our narrative review, in which we aimed to discuss recent findings of a specific area of study: the practice organization. We have reflected on Schöllhorn ¹ comments and decided to reply on three specific points: (1) the role of narrative literature reviews, (2) the different interpretations of Lage et al. ² and Schöllhorn ¹, and (3) the maintenance or not of our main conclusions.

The roles of narrative and systematic literature reviews are different. The mini-review, as a narrative review, serves in the BJMB as a forum to present a specific topic from an author's point of view. It is impossible to eliminate some bias and risks in terms of conclusions in narrative reviews. Updates are usually observed over time. In our opinion, the main narrative review published on practice organization ³ exemplifies this assertion. The main hypothesis, which claims that contextual interference is observed only when variations of generalized motor programs are applied ³, was refuted by subsequent studies ^{4,5}. The Schöllhorn ¹ comments have the role of challenging our viewpoint. However, a list of interpretations extrapolates our ideas and propositions.

At any point, we claimed that we intended to redirect research in the field of Motor Learning. Far from it, we asserted that the findings of the studies analyzed “have the potential to redirect the research efforts in this field” ². The field was delimited in the study of practice organization. In conjunction, the results speak for themselves. All behavioral hypotheses proposed in the variability of practice (VP) and contextual interference (CI) paradigms focused on memory processes. The analyzed articles showed, among other findings, differentiated results in relation to perceptual processes involved in more repetitive and variable practices. Therefore, we, at any point, extrapolate these findings as general principles to the “field of motor learning”.

In the same rationale, Schöllhorn ¹ wrote that our “increased generalization” suggests certainties about the predictability of interventions. Despite our disagreement with his conclusion of “increased generalization”, we would like to take advantage of this opportunity to clarify to the BJMB’s readers the limitations of findings in the Motor Learning area, mainly in practice organization. The Motor Learning field produces knowledge about the acquisition of motor skills ⁶ and essentially seeks to understand “how one learns”. The area responsible to investigate “how one teaches” is usually called Movement Pedagogy or Sport Pedagogy. The knowledge produced about learning factors, such as practice organization and provision of extrinsic feedback, has a strong practical appeal ⁷, but cautions should be taken because the teaching of motor skills in physical education and rehabilitation settings is much more complex than the controlled lab environment in which the tasks are learned in motor learning research, mainly when are investigated neurobiological processes. The focus of these studies is on the mechanisms that underlie the changes in behavior. Teaching movements involve decisions concerning the planning, carrying out, and evaluation of instruction of motor skills. Motor learning findings in the behavioral level of analysis provide information that the instructors can use to develop an operative basis for making these decisions ⁸.

According to Schöllhorn ¹, the analysis of the references listed reveals a very narrow field of motor learning research, which shows a bias. Yes, we agree, it is an inherent characteristic of the narrative reviews. However, we disagree that it was “done without explicitly stating these boundaries” ¹. Our rationale describes that in this narrow field of study well defined as practice organization, both behavioral and neurophysiological studies published until 2015-2016 focused on memory processes and neurobiological aspects associated with the motor output. Thus, the short period of analysis, and consequently, the few studies published, is biased by the exceptionality of research investigating sensory input and perceptual process in practice organization only after 2015-2016. Again, we would like to take advantage of this opportunity to highlight to the BJMB’s readers that the references used by Lage et al. ² are representative of a specific group of recent findings ^{9,10,11,12,13,14}. This is the reason why we proposed that the findings have latent qualities (potential) that may be developed and lead to future changes in the research on practice organization.

A very interesting analysis of the tasks applied in VP and CI is presented by Schöllhorn ¹. However, this analysis is accurate only if Schöllhorn ¹ has discussed the restricted group of studies analyzed by Lage et al. ². The selected visuomotor manual skills in this group of studies are clearly associated with the search by an increased internal validity. Using neurobiological measures, researchers need to be confident that a cause-and-effect relationship established in a study cannot be explained by other factors, and the benefits of more variable practice on motor learning are consistently found in visuomotor manual skills ^{4,15,16}. On the contrary, whether Schöllhorn ¹ has provided a general analysis of the tasks applied in VP and CI studies, his analysis is not exact enough. There are a great number of studies on practice organization applying gross motor movements involving many degrees of freedom, and suffering the influence of gravity and inertial forces ^{17,18,19,20}.

The main critique of Schöllhorn ¹ is maybe the divergence of results pointed out by Lage et al. ² in the study of Henz et al. ¹³. We agree only in part with this critique. From many interesting findings of Henz et al. ¹³, Lage et al. ² focused only on those associated with perceptual processes. The main results described are aligned with the logic in which

practice that is more variable is associated with higher perceptual demand. The emphasis was on the result showing that differential learning induces more integration from different sensory modalities compared to the random variation of tasks and repetitive practice. When comparing specifically the results from CI, it was highlighted that random variable practice did not show a difference in perceptual processing compared to the constant practice. Lage et al.² speculated that the variation of motor patterns could produce this result since this is the only study described that varied motor patterns. We agree with Schöllhorn¹ that we could do this analysis more profoundly. First, Henz et al.¹³ did not examine brain activity during practice as in other studies, but in the subsequent resting state mode. Second, this was the unique study to apply a more complex task. We would have analyzed these particularities. We would like to emphasize that Schöllhorn¹ wrote, "...these findings were not an isolated case or exception but confirmed findings from previous studies where a broader understanding of variable training was suggested, specifically the differential learning model". At any point, we affirmed that the findings differed from the other studies analyzed. We only described that one finding was different. Now, we revised our viewpoint due to the exceptionality of the neurobiological analysis and the characteristic of the task applied by Henz et al.¹³.

Finally, we would like to say thank you to Professor Schöllhorn, who gave us a new opportunity to rethink and review our manuscript published in 2021. Within the scientific community, critique articles should be seen as an essential component of academic advances. Lage et al.² concluded that the second half of the 2010s can be considered a watershed in the practice organization research. We would like to maintain this conclusion, keeping in mind that our decision is based only on a group of recent studies and that we never have generalized these findings as general principles to the "field of motor learning".

REFERENCES

1. Schöllhorn WI. Studies of specific movements and their stabilization do not allow general inferences on motor learning, even at the neurophysiological level - comment on Lage et al (2021). *Braz J Mot Behav.* 2022;16:8-10. doi: 10.20338/bjmb.v16i1.295
2. Lage GM, Fernandes LA, Apolinário-Souza T, Nogueira NGHM, Ferreira BP. Mini-Review: practice organization beyond memory processes. *Braz J Mot Behav.* 2021;15:333-341. doi: 10.20338/bjmb.v15i5.259
3. Magill RA, Hall KG. A review of the contextual interference effect in motor skill acquisition. *Hum Mov Sci.* 1990;9:241-289. doi: 10.1016/0167-9457(90)90005-X
4. Sekiya H, Magill RA, Sidaway B, Anderson DI. The contextual interference effect for skill variations from the same and different generalized motor programs. *Res Q Exerc Sport.* 1994;65:330-338. doi: 10.1080/02701367.1994.10607637
5. Sekiya H, Magill RA, Anderson DI. The contextual interference effect in parameter modifications of the same generalized motor program. *Res Q Exerc Sport.* 1996;67:59-68. doi: 10.1080/02701367.1996.10607926
6. Schmidt RA, Lee TD. *Motor control and learning: A behavioral emphasis.* 4 ed.: Human Kinetics; 2005.

7. Tani G, Corrêa UC. Da aprendizagem motora a pedagogia do movimento: novos insights acerca da prática de habilidades motoras. In: Lebre E, Bento JO (eds). *Professor de educação física: ofícios da profissão*. Porto: Universidade do Porto; 2004:pp.76-92.
8. Magill RA. Motor Learning is Meaningful for Physical Educators. *Quest*. 1990;42:126-133. doi: 10.1080/00336297.1990.10483984
9. Lelis-Torres N, Ugrinowitsch H, Apolinario-Souza T, Benda RN, Lage GM. Task engagement and mental workload involved in variation and repetition of a motor skill. *Sci Rep*. 2017;7:14764. doi: 10.1038/s41598-017-15343-3
10. Thurer B, Stockinger C, Putze F, Schultz T, Stein T. Mechanisms within the Parietal Cortex Correlate with the Benefits of Random Practice in Motor Adaptation. *Front Hum Neurosci*. 2017;11:403. doi: 10.3389/fnhum.2017.00403
11. Pauwels L, Chalavi S, Gooijers J, Maes C, Albouy G, Sunaert S, et al. Challenge to Promote Change: The Neural Basis of the Contextual Interference Effect in Young and Older Adults. *J Neurosci*. 2018;38:3333-3345. doi: 10.1523/JNEUROSCI.2640-17.2018
12. Chalavi S, Pauwels L, Heise KF, Zivari Adab H, Maes C, Puts NaJ, et al. The neurochemical basis of the contextual interference effect. *Neurobiol Aging*. 2018;66:85-96. doi: 10.1016/j.neurobiolaging.2018.02.014
13. Henz D, John A, Merz C, Schollhorn WI. Post-task Effects on EEG Brain Activity Differ for Various Differential Learning and Contextual Interference Protocols. *Front Hum Neurosci*. 2018;12:19. doi: 10.3389/fnhum.2018.00019
14. Bicalho LEA, Albuquerque MR, Ugrinowitsch H, Da Costa VT, Parma JO, Dos Santos Ribeiro T, et al. Oculomotor behavior and the level of repetition in motor practice: Effects on pupil dilation, eyeblinks and visual scanning. *Hum Mov Sci*. 2019;64:142-152. doi: 10.1016/j.humov.2019.02.001
15. Lage GM, Apolinário-Souza T, Albuquerque MR, Portes LL, Januário MDS, Vieira MM, et al. The effect of constant practice in transfer tests. *Motriz*. 2017;23:22-32. doi: 10.1590/S1980-6574201700010004
16. Lai Q, Shea CH, Wulf G, Wright DL. Optimizing generalized motor program and parameter learning. *Res Q Exerc Sport*. 2000;71:10-24. doi: 10.1080/02701367.2000.10608876
17. Hall KG, Domingues DA, Cavazos R. Contextual interference effects with skilled baseball players. *Percept Mot Skills*. 1994;78:835-841. doi: 10.2466/pms.1994.78.3.835
18. Goode S, Magill RA. Contextual Interference Effects in Learning Three Badminton Serves. *Res Q Exerc Sport*. 1986;57:308-314. doi: 10.1080/02701367.1986.10608091
19. Buszard T, Reid M, Krause L, Kovalchik S, Farrow D. Quantifying Contextual Interference and Its Effect on Skill Transfer in Skilled Youth Tennis Players. *Front Psychol*. 2017;8:1931. doi: 10.3389/fpsyg.2017.01931
20. Krstulovic S, De Giorgio A, Delcastillo Andres O, Franchini E, Kuvacic G. Effects of Contextual Interference on Learning of Falling Techniques. *Motor control*. 2020;25:117-135. doi: 10.1123/mc.2020-0066

Citation: Lage GM, Fernandes LA, Apolinário-Souza T, Nogueira NGHM, Ferreira BP. (2022). Practice organization beyond memory processes: the Schöllhorn (2022) comments on generalization. *Brazilian Journal of Motor Behavior*, 16(2):100-104.

Editors: Dr Fabio Augusto Barbieri - São Paulo State University (UNESP), Bauru, SP, Brazil; Dr José Angelo Barela - São Paulo State University (UNESP), Rio Claro, SP, Brazil; Dr Natalia Madalena Rinaldi - Federal University of Espírito Santo (UFES), Vitória, ES, Brazil.

Copyright:© 2022 Lage, Fernandes, Apolinário-Souza, Nogueira and Ferreira and BJMB. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interests: The authors have declared that no competing interests exist.

DOI: <https://doi.org/10.20338/bjmb.v16i2.306>