

# Task-relevant and task-irrelevant choices made during practice influence on motor learning

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## Background and Rationale

- Allowing learners to exercise control or choice while learning a new motor skill, termed self-controlled practice, has been shown to enhance skill retention and transfer compared to no-choice yoked groups [1].
- Lewthwaite et al. [2] recently extended the benefits of self-controlled practice conditions to exercising choice over features not directly related to the skill being learned.
  - Exp. 1: Colour of golf balls
  - Exp. 2: Which of 2 paintings the researchers should hang in the laboratory and which of 2 tasks to perform after completing Day 2 of the experimental protocol
- Lewthwaite et al. concluded that the learning benefits of control or choice, whether unrelated or related to the task being learning, are predominantly motivational because choice is intrinsically rewarding and satisfies fundamental autonomy needs [2].
- However, this conclusion is problematic due to the fact the authors failed to include a group that made task-relevant choices.

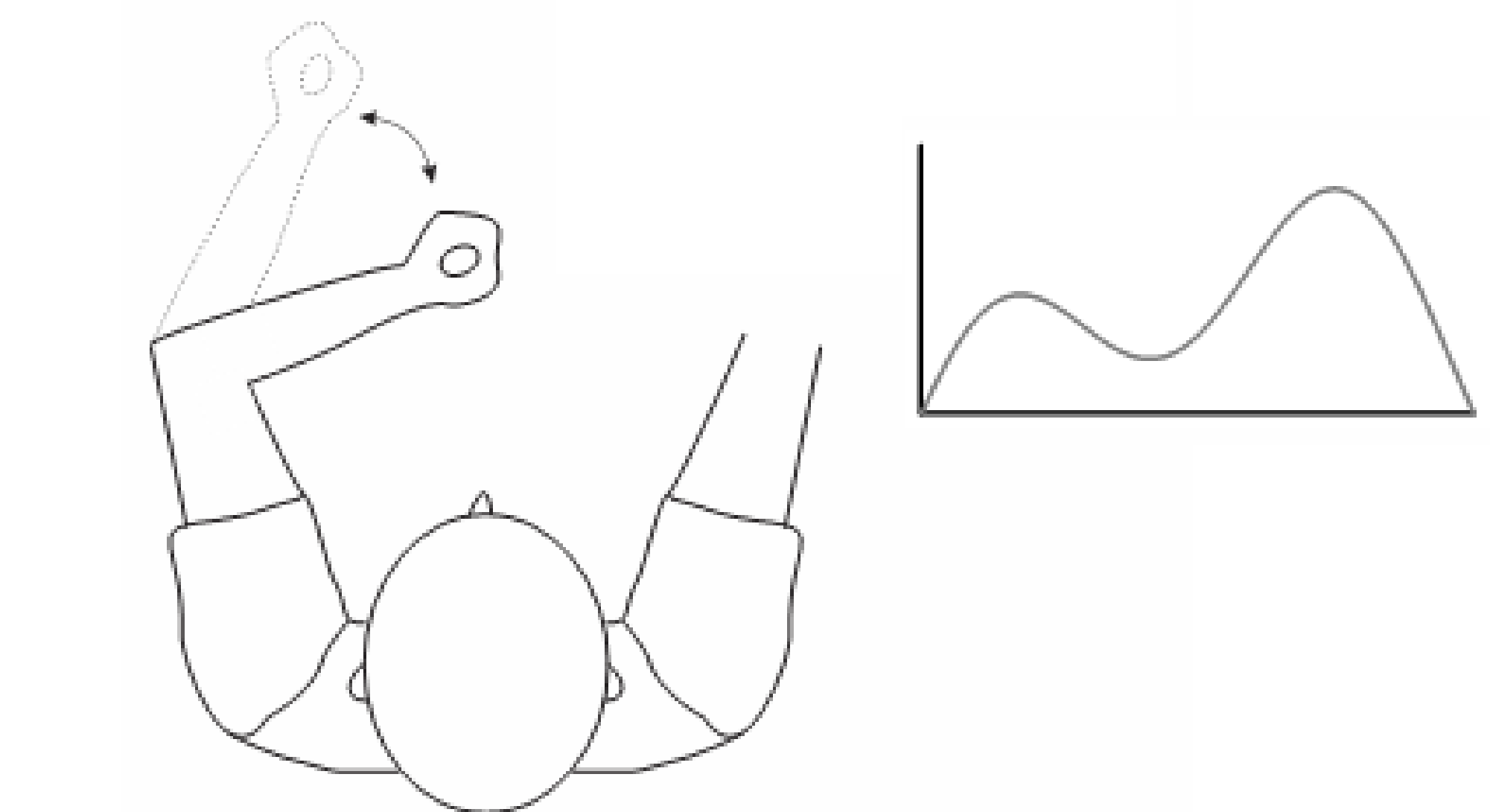
*Research question: Do task-irrelevant and task-relevant choices differentially impact motor learning?*

## Methods

**Task:** Waveform matching task that involved two rapid extension-flexion movements about the elbow joint (see Fig. 1).

### Procedure

- Participants were randomly assigned to one of three groups ( $n = 18$  per group): Task-Relevant Choice, Task-Irrelevant Choice, and No-Choice
- The Task-Relevant group had choice over which trials to receive feedback for during practice but had no choice over the colour of ProWrap placed on their arm.
- The Task-Irrelevant group had choice over the colour of ProWrap placed on their arm and which of 2 games they would want to play after Day 2 of data collection was completed. They did not have choice over feedback schedule.
- The No-Choice group expressed no choices over colour of ProWrap, which game would be played at the end of Day 2, or over their feedback schedule.
- Both the Task-Irrelevant and No-Choice groups were matched to a Task-Relevant counterpart and replicated their feedback schedule without any choice; thus, all participants received an identical feedback schedule (33% of trials).



**Fig. 1.** A schematic representation of the experimental task and the target waveform. The overall movement time goal was 900 ms during Practice and Retention, and was 1150 ms during Transfer.

### Procedure continued

- Participants completed 60 practice trials on Day 1 and feedback was provided after 20 of them.
- Learning was assessed using delayed (~24 hours) retention and transfer tests. Both tests consisted of 10 no feedback trials.

### Measurement

- Performance accuracy was assessed using root mean squared error (RMSE). RMSE captures both spatial and temporal errors and was calculated over the participant's movement time after synchronizing movement onset with target onset.

## Results

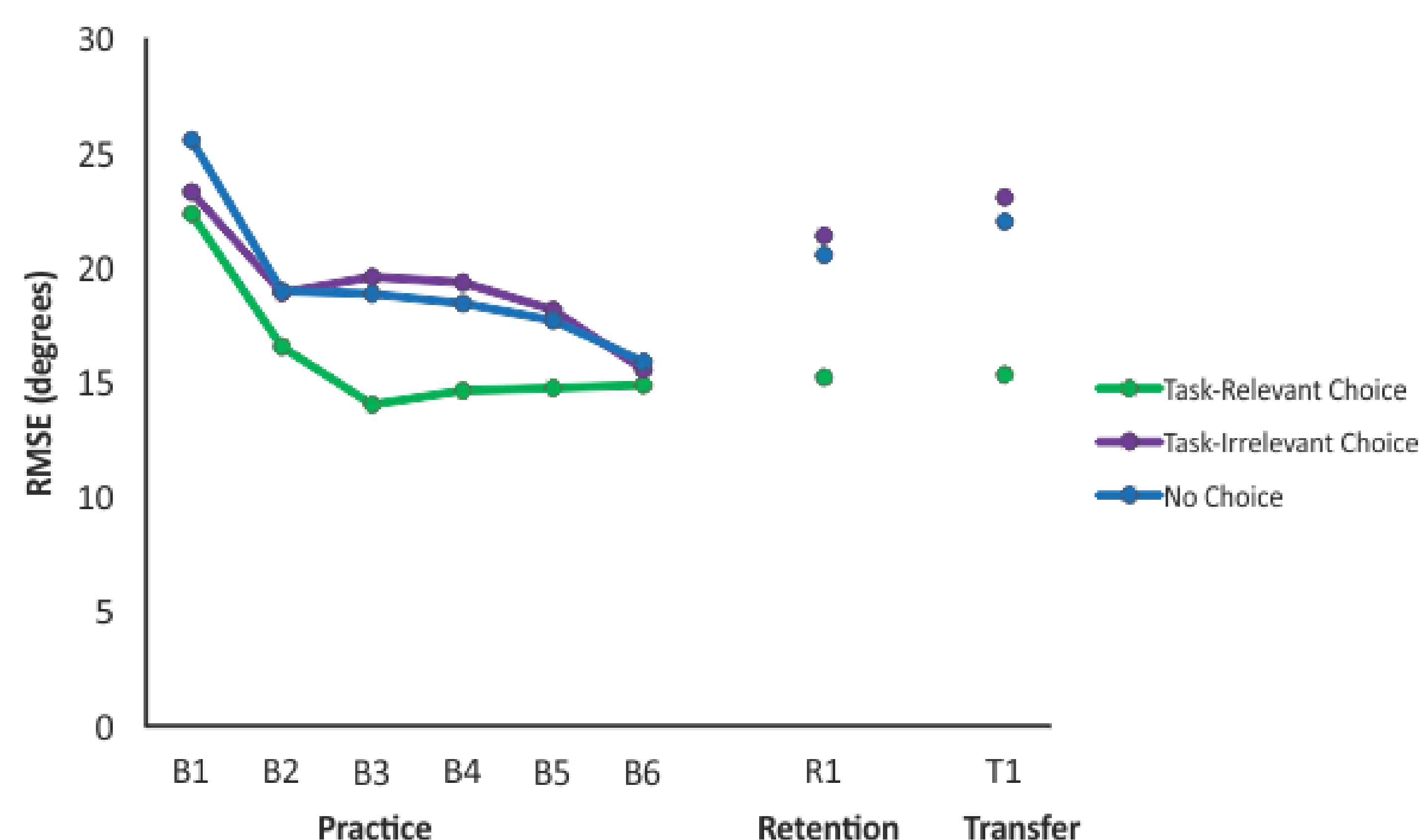
The results for RMSE are displayed in Figure 2.

### Practice

- Performance improved over practice blocks, which was supported by a significant main effect of Block ( $F[5, 255] = 19.441, p < .001, \eta_p^2 = .276$ ).
- Both the main effect of Group and the Group x Block interaction failed to reach statistical significance ( $p$  values  $> .05$ ).

### Retention & Transfer

- The Task-Relevant Choice group performed with greater accuracy in retention and transfer than both the Task-Irrelevant Choice and No-Choice groups.
- There was a significant main effect of Group in both retention ( $F[2, 51] = 4.091, p = .022, \eta_p^2 = .138$ ) and transfer ( $F[2, 51] = 6.295, p = .004, \eta_p^2 = .198$ ).
- Post hoc comparisons revealed that the Task-Relevant group was significantly more accurate than the two other groups in both retention and transfer. The Task-Irrelevant and No-Choice groups did not differ significantly on either test.



**Fig. 2.** The group mean RMSE (degrees) for the Task-relevant choice, Task-irrelevant choice, and No-choice groups as a function of the practice, retention, and transfer blocks.

## Discussion and Conclusion

- These results indicate that having the opportunity to make Task-Relevant choices was most effective for motor learning compared to making Task-Irrelevant choices or not making any choices at all.
- Contrary to the findings of Lewthwaite et al., we did not replicate a learning advantage of Task-Irrelevant choices over a No-Choice group.
- These findings do not support Lewthwaite et al.'s [2] prediction of a common motivational learning mechanism underlying relevant and irrelevant choices in self-controlled practice conditions.
- Our results suggest that self-controlled practice conditions are most optimal if the feature that learners are permitted to exercise control or choice over is relevant to the task they are trying to learn.
- We suggest that task-relevant choices are more effective due to information-processing benefits wherein the learner is able to structure their feedback schedule in a way that maximizes the informational value of the feedback received on that particular trial [3].
- This may in turn optimize independent error detection and correction mechanisms [3, 4] which are important for performance when feedback is not available (i.e., during retention and transfer).

## References

- [1] Sanli, E., Patterson, J., Bray, S., & Lee, T. (2013). Understanding self-controlled motor learning protocols through the self determination theory. *Front. Psychol.*, 3(611), doi: 10.3389/fpsyg.2012.00611
- [2] Lewthwaite, R., Chiviacowsky, S., Drews, R., & Wulf, G. (2015). Choose to move: The motivational impact of autonomy support on motor learning. *Psychonomic Bulletin & Review*, 22(5), 1383-1388.
- [3] Carter, M.J., Ste-Marie, D.M., & Carlsen, A.N. (2014). Self-controlled feedback is effective if it is based on the learner's performance: a replication and extension of Chiviacowsky and Wulf (2005). *Front. Psychol.*, 5(1325), doi: 10.3389/fpsyg.2014.01325
- [4] Carter, M.J. & Ste-Marie, D.M. (2016). An interpolated activity during the knowledge-of-results delay interval eliminates the learning advantages of self controlled feedback schedules. *Psychological Research*. doi: 10.1007/s00426-016-0757-2

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