Influence of Instructions on Learning to Operate a Simulated Hydraulic Excavator: Internal versus External Focus of Attention

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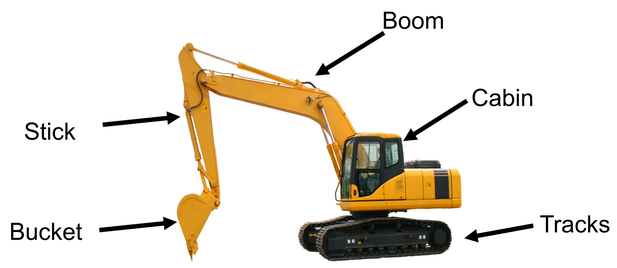
Background

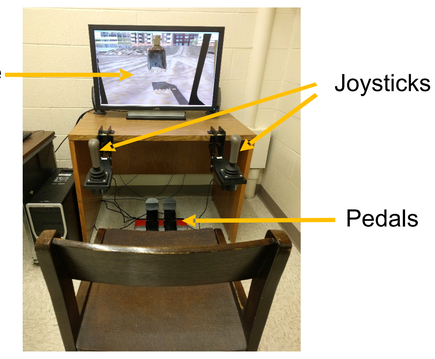
- Using computer-based virtual training systems to train people can reduce risks and training time and allow flexibility in the training environment (So, Proctor, & Dunston, 2014).
- One issue in training is whether the focus of attention should be ***internal*** or ***external*** (Wulf & Lewthwaite, 2016).
  - The external focus of attention is to focus on the intended outcome, such as an implement's position.
  - The internal focus of attention is to focus on body movements.
- Previous studies showed that an external focus of attention facilitates coordination on a larger scale compared to an internal focus.
- The present study used a simulated hydraulic excavator to compare external focus on the each implement (***bucket***) to the internal focus on ***joystick*** movement directions – forward, backward, left, and right – to control the various operating components of the machine.

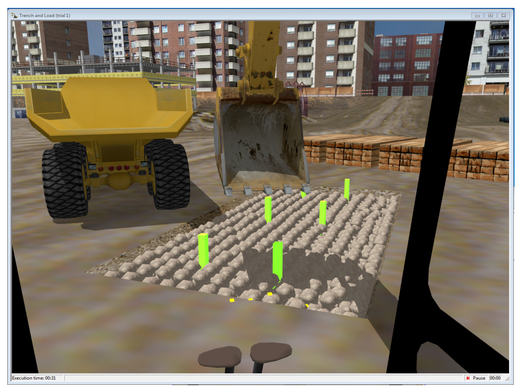


- The main question was whether the two attention emphases result in differences in performance.

Method

- The study used Simlog Hydraulic Excavator Personal Simulator software for the simulator control.

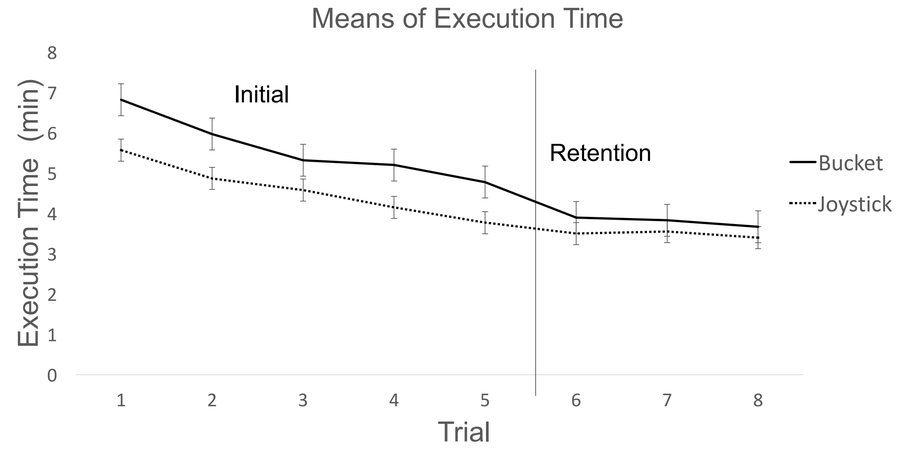




- Participants
  - 40 students from PSY 120 subject pool
    - 20 Internal focus group (13 Males)
    - 20 External focus group (14 Males)
- Procedure
  - Phase 1
    - Filled out a preliminary questionnaire obtaining demographic information and viewed an introductory lesson introducing the parts and basic control functions of the machine
  - Phase 2
    - Sat at the simulator and performed a Controls Familiarization task for training
    - Performed a Trench-and-Load task, 5 *initial* trials and 3 *retention* trials after a 5-minute intervening activity. Trench-and-Load task is comprised of digging a trench and turning to transfer each bucketful of soil into a waiting dumping truck
  - Phase 3
    - Filled out post-experience questionnaire

Results

- Average execution time (minutes)
  - Both groups demonstrated a trend of improvement across trials
  - The external group (bucket) had a significantly longer execution time than the internal group (joystick) in the first five trials
  - There was no difference in execution time for retention trials



- Productivity (m^3/h)
  - Both groups demonstrated improvement in productivity (m^3/h) across trials
  - Non-significant tendency of internal (joystick) group to perform better than the external (bucket) group

- Post-session questionnaire

  Only two questions showed a significant difference between the groups.
  1. Over the number of repetitions I performed, I developed a more smooth activation and integrated management of the joysticks.
     - The external group showed more agreement with this statement
  2. What percentage of time during the digging and dumping would you estimate that you spent on the joystick controls verses the bucket?
     - Internal group estimated spending more time on the joystick and external group more time on the bucket

Discussion

- The internal focus group had shorter execution time and a tendency to have more productivity than the external focus group, which suggests that instructions with internal focus led to better performance.
- There was no interaction with trials of the two focus group, suggesting that learning across trials did not depend on whether the instructions had an internal and external focus.
- The little difference in the post-test questionnaire and the reversed answer for the second question could be due to design of the questionnaire or the instructions.

Reference:

So, J. C., Proctor, R. W., & Dunston, P. S. (2014). Training on perceptual-motor tasks using simulated construction equipment. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 58, pp. 2360-2364). Thousand Oaks, CA: Sage.

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.