

Anticipatory grasping behavior in a drawer opening task.

Christian Seegelke, Christoph Schütz, Andreas Knoblauch, Thomas Schack

2011

Preprint:

This is an accepted article published in Sport vereint: Psychologie und Bewegung in Gesellschaft. 43.Jahrestagung der Arbeitsgemeinschaft für Sportpsychologie (asp). The final authenticated version is available online at: [https://doi.org/\[DOI not available\]](https://doi.org/[DOI not available])

Anticipatory grasping behavior in a drawer opening task

Christian Seegelke^{1,2}, Christoph Schütz¹, Andreas Knoblauch³ & Thomas Schack^{1,2}

¹Neurocognition & Action, Bielefeld University, ²CoR-Lab, Bielefeld University, ³HRI Offenbach

Schlüsselwörter: motor planning, end-state comfort effect, action sequences

Introduction

In object manipulation tasks, the tendency to initially adopt an awkward grip in order to end in a more comfortable posture (end-state comfort effect) has been taken as evidence that humans are able to represent future posture states and select appropriate grasps in anticipation of these postures. Most studies have only examined movements that require two sequential movements (e.g., grasping and placing), and evaluate end-state comfort using a binary grip choice (e.g. Rosenbaum & Jorgensen, 1992). In the present study, we examined how grasping postures are influenced by the anticipation of specific object end orientations during a three-step action sequence task in which a continuous range of postures could be adopted.

Method

20 participants performed a drawer opening task with their dominant right hand. Participants opened a drawer by its knob, grasped a cylindrical object from inside the drawer, and placed the object on a table in one of three target orientations (0°, 90°, or 180° object rotation required). Joint angles were calculated using a 7-DoF arm model. Initial and intermediate grasp postures were compared using repeated measures ANOVAs.

Results and discussion

Participants adopted different intermediate grips depending on the target orientation (as expressed through differences in six out of seven joint angles). Interestingly, only 65% of the participants showed a preference for comfortable end postures. However, this effect was only apparent for the 180° target orientation. Thus, we further analyzed the data using a 2 (Group: End-Staters vs Non-end-staters) x 3 (Target orientation: 0°, 90°, or 180°) ANOVA to examine potential differences. Analysis revealed significant interactions in 5 joint angles and post-hoc t-tests confirmed that the group differences were significant for target orientation 180° only. Furthermore, there were no differences in the initial grasping postures based on target orientation.

The results indicate that intermediate, but not initial grasp postures are influenced by object end-orientation. Specifically, participants adopted different strategies when 180° object rotation was required. We entertain two possible explanations for these findings. First, it is possible that inter-individual differences in upper limb joint flexibility influence the weighting of the biomechanical costs. That is, participants with more flexible joints are less likely to satisfy end-state comfort. Second, mentally rotating the object may have increased the cognitive load and interfered with efficient motor planning.

References

Rosenbaum, D.A. & Jorgensen, M.J. (1992). Planning macroscopic aspects of manual control. *Human Movement Science*, 11, 61-69.