EFFECT OF LIFTING CONDITIONS ON THE BOX TRAJECTORY

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INTRODUCTION

The shortes pathway of lifting is the straight line between the origin and the destination. In the other aspect, the further the box located from the body, the greater mechanical load stresses the lumbar spine with increased moment arm. There should be a negotiation process to decide the optimal pathway between these two physical principles. It is important to investigate the effect of environmental features of lifting task on this pathway determination process. Movement speed significantly affected the maximal deviation in a finger pointing study [1]. There has been lack of study performed on the actual trajectory of the lifted object in the manual lifting study.

The aim of this study is to explore how the environmental features of lifting task, such as lifting pace, box weight and target size, influence the lifting trajectory.

METHODS

Thirty nine healthy participants performed a total of 24 lifts (2 lifting paces/2 box weights/2 target sizes/3 lifting trials per condition) from their waist to shoulder level. Preferred and maximal lifting paces were tested. Kinematic data of the box was collected. The effects of lifting conditions on the box trajectory (Figure 1) were analyzed using repeated-measures MANOVA

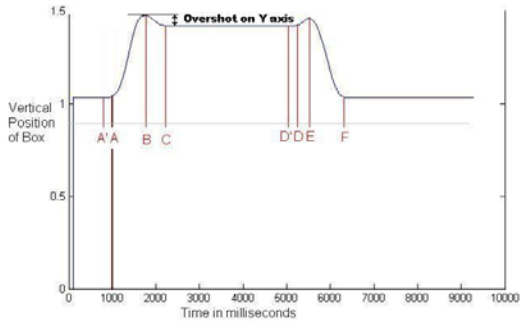

Figure 1: A sample plotting to show the trajectory of the box and the overshot.

RESULTS AND DISCUSSION

Both of the vertical overshot (Figure 2) and the peak trajectory deviation from the straight line (Figure 3) were significantly ($p<0.001$) decreased at maximal lifting pace. The effect of target size was different ($p<0.001$, interaction effect) based on the lifting pace. The overshot and the peak trajectory deviation increased toward the larger target at the preferred pace, but they decreased at the maximal pace of lifting. The effect of box weight was not significant.

The lifting strategies at the preferred and maximal lifting paces seem to be completely different because of the difference in their goals. At the preferred lifting pace, the moment arm between the body and the box seems to be the priority to minimize torque on the body, while the trajectory deviation from the virtual straight line seems to be more considered at the maximal lifting pace.

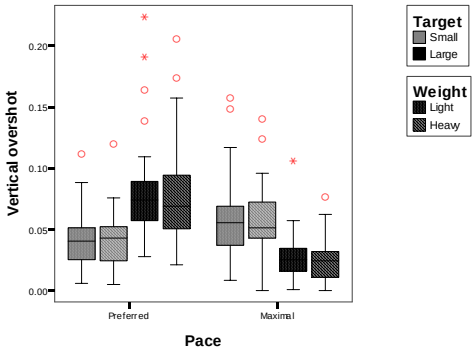

Figure 2: Box plot of the vertical overshot by lifting pace, box weight and target size.

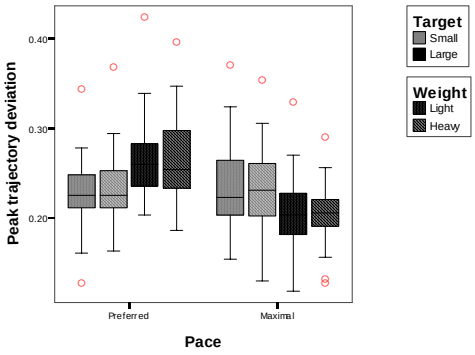

Figure 3: Box plot of the peak trajectory deviation by lifting pace, box weight and target size.

CONCLUSIONS

The trajectory of the lifting object was influenced by the environmental features of lifting task. It seems that the lifting performance is controlled by a feed-forward process rather than a feedback process. For future study, it would be interesting to explore what the experienced workers learn from their experience in terms of lifting strategy.

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