VISUAL AND PRECISION DEMANDS AFFECT HAND KINEMATICS DURING COMPUTER WORK

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INTRODUCTION

Little attention is paid among computer users to the option of adjusting the relation between computer mouse and cursor movement also called sensitivity or "mouse motion". In recent mouse software versions both motion speed and acceleration is adjustable via the "control panel". Programs are delivered with a setting of medium speed and acceleration and these are rarely changed. Similarly little awareness seems to be on icon size among those developing software for man-computer interaction interfaces. Our hypothesis was that working with small icons to be marked with the cursor via mouse motion more smooth hand movements would occur when large hand displacements are allowed per distance of cursor displacement. This would correspond to a mouse motion setting of low speed and no acceleration.

METHODS

Ten subjects performed a standardized computer task with repeated mouse clicking on icons. Icons had to be hit correctly to be successful and to proceed with the computer task. The design of the study was a 2 x 3 factor experiment. Icon sizes varied between 10 mm (large) and 1 mm (small) in diameter on the screen and "mouse motion" (Logitech MouseWare®9.1 Windows) was set at 3 levels: medium (default speed + acceleration), low, and high (i.e. lowest and highest motion settings, respectively). Low "mouse motion" resulted in a small cursor displacement relative to a given displacement of the hand with the mouse as compared with high "mouse motion". Reflective markers were attached to anatomical landmarks of the hand and video recordings (50Hz) were taken from above with a camera pointing vertical downwards onto the horizontal table. The video recordings were digitized for 30 s per session and analyzed in the Peak Motus System. Data presented here are on displacement, velocity and acceleration of the index finger in the horizontal plane. Dissociation between changes in accumulated displacement and acceleration was taken to indicate a change in smoothness of the movement (Laursen et al 1998).

RESULTS AND DISCUSSION

In general the accumulated displacement of the index finger of the hand moving the mouse was largest during sessions with the largest icon size (Tab 1). This was due to the largest production (number of mouse clicks) that was attained because with large icons it was easiest to attain successful icon hits. Also, accumulated displacement was largest during the sessions with low mouse motion. Since production was similar in sessions with different mouse motion this was a logical consequence of a larger mouse displacement being requested at the setting with low "mouse motion". Corresponding patterns were seen for the differences in velocity (tabel 1) and acceleration (Fig. 1) among sessions.

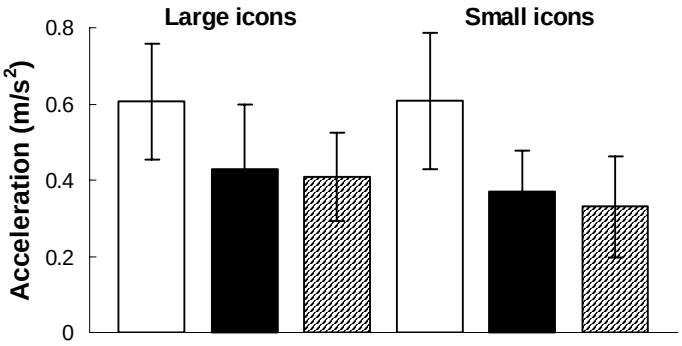

Figure 1: Mean values of acceleration for each of the six sessions (bars indicating 1SD). Within each series with large and small icons the order is low, med, and high mouse motion (same overall order as in Table 1).

SUMMARY

The adjustment of "mouse motion" did not qualitatively affect the motion of the hand moving the mouse as evaluated from accumulated displacement of the index finger, its velocity or acceleration when working with computer programs with small and large icon sizes, respectively. However, productivity was larger working with large icon sizes; this increased the accumulated hand displacement and in correspondence up-scaled its velocity and acceleration. In particular increases in acceleration have been shown to increase muscle tension (Laursen et al 1998) that remains to be shown for the present experiment.

REFERENCES

Laursen, B., et al. (1998). *Eur. J. Appl. Physiol.* **78**: 544-548.

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Table 1: Data on total displacement and mean velocity per 30 s analyzed for each of the six sessions (mean ± SD)

Icon size	10 mm	10 mm	10 mm	1 mm	1 mm	1 mm
Mouse motion	low	med	high	low	med	high
Displacement (mm)	1,349 (±251)	549 (±142)	447 (±96)	961 (±290)	446 (±176)	351 (±137)
Velocity (mm/s)	43.5 (±8.3)	16.4 (±3.8)	12.6 (±2.4)	29.9 (±9.4)	12.4 (±4.2)	9.6 (±3.4)