COMPUTER INPUT DEVICES: GENDER AND STATURE BASED DIFFERENCE IN EXPOSURE

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Aims

Computer input devices represent a set of tools where a one size fits all paradigm has been applied. There is a developing body of evidence which demonstrates that there are exposure differences when men and women use "standard-sized" computer input devices. Anthropometric data on differences between genders in hand/finger length, finger strength and finger mass may assist in determining the whether designing gender specific input devices may be of benefit. Through recent research and a systematic analysis of anthropometric data we will demonstrate why there may be mismatches between the design of computer input devices and the men and women using them.

Methods

In a lab based study, fifteen men and fifteen women completed five standardized computer tasks: touch-typing, completing a form, editing text, sorting and resizing graphical objects and navigating intranet pages. Surface electromyography measured muscle activity; electrogoniometric and magnetic motion analysis system measured wrist, forearm and upper arm postures; load-cells measured typing forces; and a force-sensing mouse measured applied forces. In order to identify anthropometric differences that may impact exposures and the design of computer input devices, a systematic evaluation of male and female anthropometry was carried using the CHILDATA (DTI, 1995) and ADULTDATA (DTI, 1998) anthropometric databases. Finger length, finger strength and finger mass were compared between males and females and as a function of age.

Results

Relative forces applied to the keyboard and mouse, normalized muscle activity of two forearm muscles, range of motion for the wrist and shoulder joints and external rotation of the shoulder were higher for women ($p<0.05$). When subjects were dichotomized into groups based on either shoulder width or arm length (body stature/size rather than gender) the differences in forces, muscle activity of the shoulder and wrist posture and shoulder posture were greater. The results from the anthropometric study corroborated many of the laboratory findings. When comparing adult male and female populations, the 50th percentile female has only 67% of the force producing capacity of the 50th percentile male and the 50^{th} percentile females finger mass is only two-thirds that of the 50^{th} percentile male. When comparing percentiles, the mass of the 50th percentile adults female's finger was less than the mass of the 5th percentile adult male's, indicating only a small degree of overlap between the adult male and female populations. In contrast, differences in hand length were small with the 50th percentile adult female's hand being 94% of the length of the adult male's. When assessing gender differences as a function of age, little differences were seen between the ages of 5 – 11, after that the genders differences increased, reaching a maximum at adulthood.

Conclusion

The lab based study indicated that women and smaller stature subjects had greater exposure to physical risk factors during identical computer tasks. Future studies may want to compare risks between genders but also compare risks as a function of stature. Finger length, mass and strength measures are one set relevant measures which may be used to determine the size of input devices and appropriate activation forces. The relative differences between male and female populations in finger length are much smaller compared to the relative differences in finger mass and strength. To make a computer input device gender proportional, the anthropometric data indicate that differences in activation forces should be larger than the proportional differences in device size. Not only does the device have to be sized proportionally, but even more critical, due to the greater range of finger strength and mass differences, is to correctly and proportionally scale the activation forces. Future studies should be conducted to further evaluate differences in exposures based on gender and stature and the viability and user preference for computer input devices with differing activation forces and sizes based on gender and/or stature differences in finger/hand size, finger mass and finger strength.