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Thumb Performance and Movement Coverage on Smartphone Touchscreens

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Abstract of Dissertation

This study aimed to investigate the relationships between thumb muscle activity and touch button size, thumb moving orientations and circling directions on a smartphone touchscreen, as well as the relationships between thumb covering area and position on smartphone touchscreens and other relevant factors that could affect the thumb performance.

Through the measurements of electromyography, fatigue time, tapping speed and perceived exertion in the six thumb muscles, namely, adductor pollicis (AP), flexor pollicis brevis (FPB), abductor pollicis brevis (APB), abductor pollicis longus (APL), first dorsal interosseous (FDI), and extensor digitorum (ED), it was found that small size touch button and flexion-extension of thumb moving orientation tend to affect the thumb performance on smartphone touchscreens. The reasons were considered as small size touch buttons are likely to increase the effort-related demands on FDI, and flexion-extension of thumb moving orientation increases that on APL. As a result, the thumb becomes less susceptible to fatigue, and the thumb performance is reduced. Furthermore, this research also found that when the thumb moves in an adduction-abduction orientation on smartphone touchscreens, the thumb covering area and position tend to be affected by the user age, thumb length and touchscreen size. That is, elderly leaves more space unreachable at the right side of the touchscreen than the young ones, and longer thumbs are able to reach larger area whereas leave more unreachable space at the right side and bottom of the touchscreen compared with the shorter thumbs. In addition, this study also found that increasing the touchscreen size does not necessarily increase the thumb covering area in a same ratio.

Take all into account, these studies draw out three suggestions for the designs of user interface in hand held touchscreens. First of all, the small touch buttons should be minimised in order to reduce the effort-related demands on FDI, which could cause the thumb to be less susceptible to fatigue. Secondly, not only small touch buttons but also flexion-extension movements should be minimised, in order to reduce the effort-related demands on FDI and APL, especially for aged users. Thirdly, the design of handheld touchscreen interface shall comprehensively consider the overall effects of age, thumb length and screen size.