Individual differences in working memory capacity of older adults on use of touch interfaces

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Recently, there are increased opportunities for elderly people to use touch interfaces in touch input devices, because of the increased use of smart phones and tablet PCs. However, touch interfaces introduce a high cognitive load on the elderly with decreased cognitive functions caused by aging, compared to younger adults. It is also possible that cognitive load from touch interfaces does not match the working memory capacity (WMC) of older adults. We examined the effect of WMC of older adult participants on touch interface tasks, by using an extreme-group designs.

Method

Participants
Older adults (N = 163; 51 men and 112 women) recruited near Nagasaki city in Japan participated in this study. Their ages ranged from 60 to 84 years (M = 70.14, SD = 5.13). Participants received ¥2,100 (approximately $20) at the end of the experiment as a payment for their participation in the study.

Procedure
Informed consent was obtained from all patients before they took part in the study. Participants responded to the Hasegawa Dementia Scale Revised (HDS-R), the Subjective Health Scale, which consist of 4 subscales and the PC Usage Frequency Scale, which consist of 4 subscales. Then, they completed a single tapping task and complex span tasks that included verbal, numerical, and spatial tasks, in that order.

Single tapping task
The single tapping task consisted of tapping rectangular buttons (48 x 36 pixel) that were randomly presented on the corner of a rectangular form (1024 x 768 pixel), by using a touch pen, the index finger, or a computer mouse.

Complex span tasks
The complex span tasks consisted of automated reading and operation span task and the revised Japanese version of the symmetry span task (Unsworth et al., 2009). The set size of reading and operation span tasks was from 3 to 7 and that of the symmetry span task was from 2 to 5. There were 3 trials of each set of complex span tasks, resulting in a total of 75 trials of the reading and operation span task and 42 trials of the symmetry span task.

Apparatus
Single tap tasks and complex span tasks were administered using a NEC laptop computer (VY17F/RF-W) connected to a stand-alone touch panel IIYAMA ProLite T1531SR 15inch XGA monitor. These tasks were programmed and run using Microsoft Visual Basic 2010 and Microsoft .NET Framework 4.5.

Result
We targeted one hundred older participants answered rarely using a PC among 163 older participants. Each participant’s score on the HDS-R was higher than 22 (M = 28.6, SD = 1.5, range = 22-30). That is above the cutoff point for the diagnosis of dementia, which is considered as between 20 and 21. Tapping time was defined as the time from the presentation of the rectangular tap button in each condition of the single tapping task. Total correct recall scores on the complex span tasks were transferred to Z-scores. Mean Z-scores of complex span tasks were calculated as a composite score of WMC per participant. We categorized participants that scored above the high 25th percentile of the distribution on the composite score of WMC as high WMC (5 men and 20 women, M = 70.1, SD = 5.1) and those that scored below the low 25th percentile of the distribution as low WMC (6 men and 19 women, M = 72.3, SD = 4.8). We performed a 2 x 2 Analyses of Variance with WMC (high, n = 25 /low, n = 25) as between-subjects factors and tapping interface (touch pen, index finger, or the computer mouse) as within-subject factors. Results indicated a significant interaction between WMC and the touch interface (F(2, 96) = 4.685, p < .05, partial $\eta^2$ = .089). Analysis of simple main effects confirmed that the response time of the touch pen was shorter than that of the index finger and the mouse, and that of the index finger was shorter than that of the mouse. Figure 1 displays the mean tap time (ms) of the high and low WMC groups for each touch interface.

Discussion
These findings indicate that a touch pen had the lowest cognitive load on the elderly among the single touch devices and that the cognitive load imposed by touch interfaces differed according to the WMC of older adults. These results suggest the importance of choosing a touch interface that is appropriate for individual differences in WMC of aged people.

Reference