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## **Appendix Quantitative Study Measures**

### **Satisfaction**

Satisfaction with the DEKA Arm was assessed using multiple items. Twenty seven items were administered to both Gen 2 and Gen 3 participants, 3 items were administered only to Gen 2 participants, and 20 items were administered to Gen 3 participants only. Test statistics were examined in order to create summary scales from these items, whenever possible. In all satisfaction items subjects were asked to rate satisfaction with specific aspects of the DEKA Arm's function on a 7-point scale (from "1" very unhappy, "2" unhappy "3", mostly dissatisfied "4", mixed, "5" mostly satisfied, "6" happy to "7" very happy).

The 25-item Gen 2-Gen 3 satisfaction scale was constructed from 27 items that were administered to both Gen 2 and Gen 3 participants. These items measured satisfaction with a variety of aspects of the DEKA Arm including: its overall function, IMU controls, other controls, EMGs, tactor for grip pressure, VRE software, donning and doffing, hand operation, each of the grips, switching grips, movement of the wrist, movement of the forearm, elbow, upper arm rotation, comfort of the socket, harnessing system, inflatable bladders, stability of the socket, and user notifications for grip, error, mode and battery status. Prior to constructing the scale test statistics for all 27 items were examined. Only those items that had adequate item-test statistics (item-total correlations >0.20), and showed good internal consistency with other items were included in the overall satisfaction scale. After omitting 2 items the scale alpha was 0.89. The summary score was calculated by averaging the ratings for all items that were completed.

The two items that did not fit well with the overall scale (related to EMGs and error indicator) were examined individually.

A separate Gen 2 satisfaction scale was constructed from 3 items related to satisfaction with FSRs, air bladder controls and dynamic straps that were used in the Gen 2 portion of the study, and not used in the Gen 3 portion. The summary score was calculated by averaging the ratings for all items that were completed. This scale had an alpha of 0.79.

A Gen 3 satisfaction scale was constructed from items that were asked only in the Gen 3 portion of the study. The scale included items related to satisfaction with device appearance, shoulder appearance, hand shape, hand size, hand covering, Arm system, hardware reliability, durability of hand covering, hand covering material, fingernails, IMU speed, EMG speed, tactor for grip, tactor for mode, endpoint control, weight, wires and cables, DSC, battery charger, and waterproofing. This scale was developed after evaluating the test statistics of 20 items. After deleting 5 items with item-total or item-rest correlations below 0.20, the final 15-item scale had an alpha of 0.85. The summary score was calculated by averaging the ratings for all items that were completed. Items that did not fit well with the overall score related to shoulder appearance, EMG speed, endpoint control, DSC, and battery charger) were evaluated as individual items

## **Usability**

Usability was assessed using multiple items, 23 of which were administered to both Gen 2 and Gen 3 participants, 5 items were administered to Gen 2 participants only, and 9 items were administered to Gen 3 participants only. All usability items used a 1-6 scale (“1” unable to do, “2” very difficult, “3” difficult, “4” neither easy nor difficult, “5” easy, to “6” very easy.)

The 17 item Gen 2-Gen 3 Usability scale was constructed from the 23 items that were administered to both Gen 2 and Gen 3 participants. These items asked participants to rate the

ease of use of various aspects of the DEKA Arm including: the overall Arm, IMU controls, other controls, EMG, factor for grip pressure, VRE, donning and doffing, each of the grips, switching between grips, forearm movement, wrist movement, elbow movement, rotation of the upper arm, harnessing system, bladders, grip indicator, mode indicator, and battery indicator. After removing the 6 items that had item-total correlations  $>0.20$ , the alpha of the final scale was 0.89. The summary score was calculated by averaging the ratings for all items that were completed. The items that did not fit well with the overall scale (EMGs, VRE, bladders, grip indicator, mode indicator and battery indicator) were examined as individual items.

The Gen 2 usability scale included all 5 study items that were asked in the Gen 2 portion of the study only. These items related to the usability of FSRs, air bladder controls, hand operation use, dynamic straps, and socket stability. This scale had an alpha of 0.64. The summary score was calculated by averaging the ratings for all items that were completed.

The Gen 3 usability scale was constructed after examining test statistics for the 9 items that were asked only in the Gen 3 portion of the study. After removing 4 items that had item-total correlations below 0.20, the final scale had 5 items with an alpha of 0.85. The 5 items related to the hand covering, hand covering materials, fingernails, dynamic socket controller and battery charger. The summary score was calculated by averaging the ratings for all items that were completed. The items that did not fit well with the overall scale (arm system, factor for mode, factor for grip change, and endpoint control) were examined as individual items.