

Does the SHAP reflect the amount of compensatory movements in upper limb tasks?

Abstract:

The SHAP is commonly used to assess hand functions and performance of hand prostheses [1]. In 3D kinematics, the Arm Profile Score is an index to simplify compensatory movements relative to a normative group. No correlation was found between the SHAP and the APS. The SHAP is therefore no robust indicator to describe compensatory movements.

Introduction:

The Southampton Assessment Procedure (SHAP) is a commonly used application to assess the function of normal or impaired hands, or the performance of hand prostheses. It is a time-based test which no assessment of quality of movements. Fast performance in that case does not indicate good quality of movement. Because of non-transparencies in calculation of the SHAP score (Index of Function, IOF) and predefined normative data (GL), Burgerhof et al. suggest an alternative scoring system (Linear Index of Function, LIF [2]). In 3D motion analysis, the APS is also a commonly used value to measure the function of upper limbs. The APS based on 3D kinematics is a summary index estimated to normative movement patterns. A high APS indicates more compensatory movements [3]. This work will clarify the connection of the LIF and the APS and the question, if the SHAP is appropriate to assess hand functions.

Method:

19 subjects are randomly separated into two groups (11 self-captured normative (age: 31 ± 7.6 years) - G1 and 10 able-bodied participants (age: 30 ± 8.4 years) - G2: 8 left, 9 right handed). They perform all 26 items with one repetition and both sides following the guidelines of the SHAP. If participants execute a task badly, it will be repeated once. If the test is not evidently performed, it will be excluded. Performance of the tasks has to be as fast and precisely as possible. The time of each item is calculated as LIF including G1. The LIF is directly linear transformed of the observed time and is scaled from 0 (poor) to 100 (excellent). 3D kinematics is simultaneously captured with Vicon Nexus 2.6. The APS [3] is estimated as summary index of movement patterns. The Spearman Rank correlation is applied on these non-normally distributed parameters. It is hypothesized that there is no correlation between the APS and the LIF.

Results:

Fehler! Verweisquelle konnte nicht gefunden werden. represents the median times of 8 able-bodied subjects (G2) for the left side while page turning and rotate key task [1]. The grey bands in Figure 1a and 1c show mean times \pm standard deviation of the self-captured normative group (G2). The red line represents the mean time of the normative group (GL) of Light et al. [4]. The black lines in 1b and 1d describe the mean APS of the self-captured normative group in Figure 1b and 2b. G1 (able-bodied subjects) nearly provides the same mean execution time compared to GL. Figure 1a shows two outliers in execution time. The maximum value of APS (1b) is about 20° and the minimum about 7° . Figure 2a also shows short execution times with no outliers. Figure 2b represents maximum APS of about 13° and minimum of 7° . The results show no significant correlation of the LIF and the APS ($p = .127$).

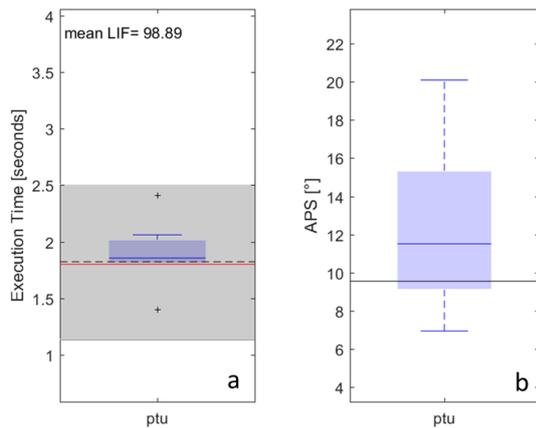


Figure 2: Execution Time and Arm Profile Score of 10 normative (grey band and black line) and 8 healthy subjects (blue box) of SHAP task page turning. Red line: mean time of norm. group by Light et al. [4]

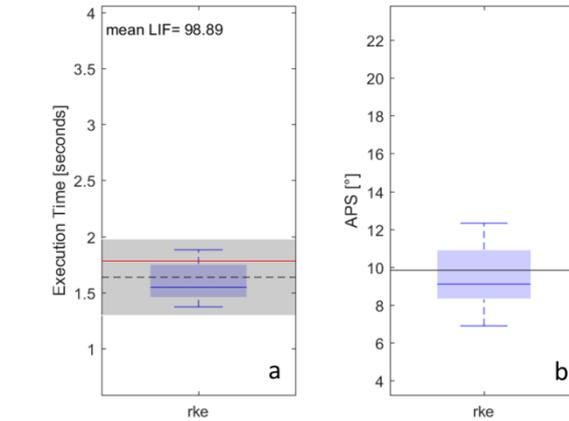


Figure 1: Execution Time and Arm Profile Score of 10 normative (grey band and black line) and 8 healthy subjects (blue box) of SHAP rotate key task. Red line: mean time of norm. group by Light et al. [4]

Conclusion:

The mean time of GL differs to G1 mean time in Figure 2a, but we found no deviation in performance considering the guidelines of the SHAP. A reason could be the age of the normative subjects of G1 which includes participants from 21 to 49 years. In the study of Light et al. [4] the normative group ranges from 18 to 25 years.

In conclusion, no significant correlation was found by clarifying the connection of the APS and the LIF. These figures are impressive to this result because Figure 1 indicates high variability and high APS values and Figure 2 represents small APS values and lower variability. Although both items mainly indicate low variability in time they show different APS results. The page turning task is additionally less guided and allows more variability in execution as the rotate key task. But based on all items, it is supposed that the clinical SHAP is not evident to assess quality of movements.

Literature:

- [1] C. M. Light, P. H. Chappell, and P. J. Kyberd, "Establishing a standardized clinical assessment tool of pathologic and prosthetic hand function: Normative data, reliability, and validity," *Arch. Phys. Med. Rehabil.*, vol. 83, no. 6, pp. 776–783, 2002.
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