

# The Capabilities of Upper Extremity Test (CUE-T): Factor Structure and Item-test Characteristics

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## Introduction

There is no generally accepted standard test of upper extremity function for tetraplegia. The capabilities of Upper Extremity (CUE) questionnaire has been used to evaluate outcomes of tendon transfers and other upper extremity reconstruction procedures. However for clinical trials of neurorecovery an objective measure would be beneficial. We developed a test of upper limb functional capabilities based on the CUE questionnaire, the CUE Test (CUE-T).

## Methods

The CUE-T consists of 19 tasks, 17 unilateral, and tests basic upper limb actions and grasp patterns. Test procedures were developed based on items in the CUE questionnaire, with a few additional items. Thirty adults with SCI, neurological levels C4-T6, were tested on one occasion.

Most items were scored based on time or number of repetitions in 30 seconds. Items were then rescored on a 0-4 scale and internal consistency was evaluated by Cronbach's alpha. Factor analysis was used to assess dimensionality. One and two-dimensional item response theory (IRT) analyses were used to evaluate item difficulty and discrimination.

## Results

There were 23 males and 7 females with an average age of 44.8 years. Motor levels and degree of completeness are found in table 1. Cronbach's alpha was high for total scale and subscales (table 2), as were item-total correlations (table 3). Total CUE-T scores were highly correlated to upper extremity motor scores (figure 1). Factor analysis found that two factors accounted for 59% of the variance (see table 3). IRT analyses showed that push/pull items were the easiest and manipulation and thumb items the hardest. Grasp items had the highest discrimination. Push-pull items and wide grasp (container lid) right displayed some misfit, possibly due to low variance in scores.

Item and person distribution maps and information function for one-dimensional and two-dimensional models are shown in figure 2a and 2b. There is a wide range of ability covered by the items in the test.

## Discussion

These preliminary results support the theoretical structure of the CUE-T as a global measure of upper extremity functional capabilities in tetraplegia. Internal consistency was excellent, and factor analysis grouped items into ARM and HAND factors as anticipated.

The push-pull task was not very difficult, and almost all subjects were able to move the total weight used. We have since glued a piece of foam to the bottom of the container to increase friction.

The pilot study is limited by low numbers, but demonstrated that the test was practical and could be completed in a reasonable amount of time, generally less than one hour. We are now evaluating reliability in subjects with chronic SCI and responsiveness in subjects at the start and end of initial rehabilitation or before and after upper extremity reconstructive surgery.

## Conclusion

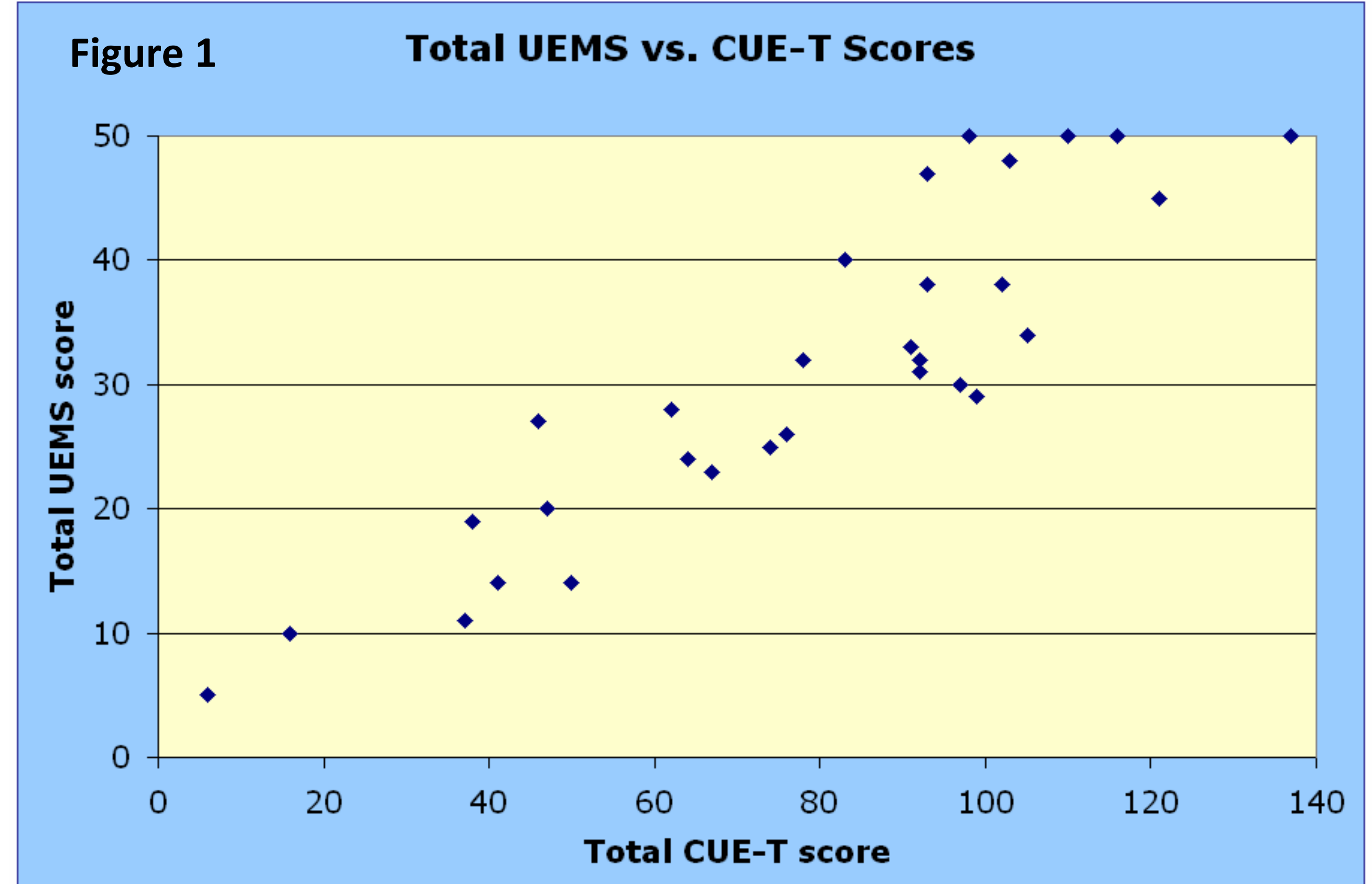
The Capabilities of Upper Extremity Test (CUE-T) appears to be a comprehensive measure of functional limitations of the upper limb in persons with tetraplegia. Further evaluation is needed to determine if it is responsive and to identify the minimal clinically important difference.

**Table 1: Subject Characteristics**

Motor	Motor Levels		
	C4-C6	C7-T1	T2-T6
Complete	9	7	4
Incomplete	6	4	0

**Table 2: Cronbach's alpha**

Total	Right	Left
.96	0.94	0.93
Hand	0.94	0.94



ACTION	Factor Loading				Cronbach's	
	RIGHT		LEFT		RIGHT	LEFT
	Factor 1	Factor 2	Factor 1	Factor 2	Corr with total	Corr with total
Reach forward	0.09	0.78	0.02	0.9	0.58	0.38
Reach up	0.39	0.72	0.39	0.67	0.74	0.6
Reach down	0.49	0.46	0.44	0.44	0.65	0.62
Pull weight	0.14	0.79	0.14	0.79	0.51	0.55
Push weight	0.19	0.82	0.14	0.79	0.57	0.55
Wrist up	-0.01	0.8	-0.05	0.86	0.49	0.45
Pronate	0.36	0.49	0.5	0.43	0.58	0.57
Supinate	0.3	0.6	0.28	0.62	0.61	0.54
Grasp dynamometer	0.91	0.16	0.9	0.06	0.78	0.76
Pinch die (2 finger)	0.62	0.38	0.76	0.29	0.75	0.78
Pencil (3-finger)	0.77	0.23	0.76	0.09	0.71	0.66
Key pinch	0.85	0.21	0.89	0.14	0.76	0.77
Wide grasp	0.82	0.24	0.81	0.09	0.79	0.75
Manipulate	0.87	0.13	0.84	0.03	0.75	0.72
Push index finger	0.59	0.45	0.58	0.37	0.62	0.82
Push with thumb	0.76	0.19	0.89	0.02	0.76	0.7
Acquire/release	0.35	0.29	0.39	0.31	0.5	0.42
	BILATERAL					
Push down	0.54	0.46			0.68	

