Box and Block Test (BBT): Reference Guide
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Introduction

The Box and Block Test (BBT) is an outcome measure used to assess and monitor unilateral upper extremity manual dexterity[1]. It has been found to be a valid and reliable outcome measure in a variety of populations including people with Cerebral Palsy[1](CP), Fibromyalgia[2], Charcot-Marie-Tooth (CMT)[3], Multiple Sclerosis[4,8](MS), Stroke[5,6,7,8,9,10], Traumatic Brain Injury (TBI)[5,8], traumatic upper extremity injury[11], children[12,13] and community-dwelling adults[14,15,16].

Establishing author: Ayres and Holser[1]   Data Type: Ratio

Measurement Type: Performance-based   Assessment Type: Observer

Required Resources

Time: ~5 minutes

Personnel: 1 clinician

Equipment: Standard table, chair, stopwatch, Box and Blocks kit

Space: Clinic room

Cost: One time cost of ~$200 to purchase Box and Block box, no cost to administer test

Test Administration

Box and Block set-up includes: a wooden box with dimensions 21.5" by 10.1" divided into two equal compartments by a wooden partition with a height of 6.0". The box should be opened and placed on a table top in a horizontal orientation in front of the patient, who is seated in a chair. All cubes of 1" are placed on one side of the partition and the patient is asked to transfer as many blocks as they can in 60 seconds to the other side of the box[1]. The blocks must be transferred one at a time, the patient must only use one hand and the hand should cross the partition in the transfer. The score is indicated by the number of blocks that can be transferred in 60 seconds. The patient should be given a minimum of 15 seconds to practice prior to beginning the test and should start with the dominant hand. At least two trials should be done for each hand and the score averaged.

For standardized instructions see https://www.sralab.org/sites/default/files/2017-06/Box%20and%20Blocks%20Test%20Instructions.pdf.

Psychometric Properties

Reliability.

Excellent test-retest reliability was found in the populations with CMT[3], children ages 3-10[12], stroke[8,9], MS[8], TBI[8], and traumatic upper extremity injury or amputation (ICC=0.95-0.96, 0.85, 0.963, 0.98, and 0.91, respectively). Excellent interrater reliability was established for populations with fibromyalgia[2], children ages 3-10[12], stroke[8,9], MS[8], TBI[8] and adult[16] (ICC = 0.85, 0.99, 0.993, respectively). Excellent intra-rater reliability was established for populations with fibromyalgia (ICC=0.90)[2].

Validity.

In community-dwelling adults, moderate correlation with the BBT was found with the 9HP, NMSE, and MVPT-3 (r=0.357, 0.420, and 0.341, respectively)[14]. Construct validity was established for populations with Fibromyalgia as the BBT is able to distinguish between the control and fibromyalgia groups[2]. In children ages 3-10, there was a significant correlation with the MABC-2[12]. In pediatric populations with CP, there was a strong correlation with MACS (r=-0.81)[13]. In populations with stroke, MS, and TBI, concurrent validity was found to have a strong correlation with the following tests: Grip Strength (r=0.87)[5], TEMPA (r=0.73-0.78)[5], Fugl-Meyer Assessment (motor) (r=0.91-0.92)[5,8], Action Research Arm Test (r=0.64-0.95)[8,5], Motricity Index (r=0.798)[5], UE STREAM (r=0.76)[10], 9HP (r=-0.71)[7], MAL-QOM (r=0.522)[7], and SIS Hand Function (r=0.52)[7]. Moderate correlation was found with the Fugl-Meyer Assessment (joint movement and pain) (r=0.43)[5], Barthel Index (r=0.44)[5], FMA (r=0.35)[7], and MAL-AUO (r=0.49)[7]. In the traumatic upper extremity injury and/amputation group, there was a strong correlation with the AM-ULA and a moderate correlation with the UNB skill and spontaneity (r=0.63 and 0.42-0.43, respectively)[11].

Responsiveness.

In populations with CMT, the MDC(95) has not been established, however, a change of 11.5 blocks/minute has been suggested[3]. In populations with MS, a deterioration MIC of between -3.48 and -5.23 was noted[4]. The SRM was found to be between 0.67-0.74 in the stroke population and 0.56 in other populations[7,15]. The SRD was found to be 5.5 blocks/minute in the stroke population[9]. The MDC(95) was found to be 7.7 in the traumatic upper extremity injury group[11].

Interpretation

Table 1. Normative BBT data for ages 3-5

Age	Hand	Mean (blocks/minute)	SD	Range
3	Dominant	24.2	7.4	15-39
	Non-dominant	22.8	6.6	12-35
4	Dominant	35.7	7.3	16-45
	Non-dominant	34.1	8.8	11-49
5	Dominant	40.6	6.7	27-56
	Non-dominant	38.7	5.8	21-47

Gathered from sample of 215 participants aged 2-10 (101 Male, 114 Female)[12]

Table 2. Normative BBT data for ages 6-19

Age	Hand	Male			Female		
		Mean (blocks/minute)	SD	Range	Mean (blocks/minute)	SD	Range
6-7	R	54.5	6.6	48-77	57.9	5.3	44-68
	L	50.7	6.3	36-67	54.2	5.6	43-67
8-9	R	63.4	4.3	55-76	62.8	5.1	53-76
	L	60.1	4.9	53-71	60.4	5.2	52-71
10-11	R	68.4	6.9	53-81	70.0	7.6	52-85
	L	65.9	6.8	52-82	67.6	8.6	54-91
12-13	R	74.6	8.3	57-92	73.6	8.1	57-89
	L	72.4	8.2	58-87	70.5	6.2	55-83
14-15	R	76.6	8.7	61-94	75.4	8.5	61-94
	L	74.6	7.9	57-86	72.1	7.6	58-88
16-17	R	80.3	8.7	62-101	77.0	9.0	50-92
	L	77.6	5.1	71-87	74.3	9.1	54-91
18-19	R	79.9	8.9	58-96	77.9	9.4	56-94
	L	79.2	8.8	60-93	76.0	8.5	51-90

Gathered from sample of 471 participants aged 6-19 (231 Male, 240 Female)[1]

Table 3. Normative BBT data for adults

Age	Hand	Male			Female		
		Mean (blocks/minute)	SD	Range	Mean (blocks/minute)	SD	Range
20-24	R	88.2	8.8	70-105	88.0	8.3	67-103
	L	86.4	8.5	70-102	83.4	7.9	66-99
25-29	R	85.0	7.5	71-95	86.0	7.4	63-96
	L	84.1	7.1	69-100	80.9	6.4	63-93
30-34	R	81.9	9.0	68-96	85.2	7.4	75-101
	L	81.3	8.1	69-99	80.2	5.6	66-92
35-39	R	81.9	9.5	64-104	84.8	6.1	71-95
	L	79.8	9.7	56-97	83.5	6.1	72-97
40-44	R	83.0	8.1	69-101	81.1	8.2	60-97
	L	80.0	8.8	59-93	79.7	8.8	57-97
45-49	R	76.9	9.2	61-93	82.1	7.5	68-99
	L	75.8	7.8	60-88	78.3	7.6	59-91
50-54	R	79.0	9.7	62-106	77.7	10.7	56-94
	L	77.0	9.2	60-97	74.3	9.9	54-85
55-59	R	75.2	11.9	45-97	74.7	8.9	56-94
	L	73.8	10.5	43-94	73.6	7.8	54-85
60-64	R	71.3	8.8	52-84	76.1	6.9	60-82
	L	70.5	8.1	47-82	73.6	6.4	61-89
65-69	R	68.4	7.1	55-80	72.0	6.2	60-82
	L	67.4	7.8	48-86	71.3	7.7	61-89
70-74	R	66.3	9.2	50-86	68.6	7.0	53-80
	L	64.3	9.8	45-84	68.3	7.0	51-81
75+	R	63.0	7.1	47-75	65.0	7.1	52-79
	L	61.3	8.4	46-74	63.6	7.4	51-81

Taken from sample of 628 participants ages greater than 19 (310 Male, 318 Female). Peak manual dexterity reached within age group of 20-24[16].

Table 4. Average BBT scores for upper extremity amputees[11]

Average scores for UE levels	Known-group validity
Level	Average (blocks/minute)
Transradial	13.4
Transhumeral	9.1
Shoulder	4.5

Limitations

As the focus of the BBT is primarily on grasp and release ability, this does not adequately assess all domains within activities of daily living and thus limiting the applicability of the results[11].

Documentation in Clinical Notes

Example: Jane has a transradial amputation. Last month she scored 59 blocks/minute with her sounds hand and 8 blocks/minute with her old prosthesis. Today, Jane scored 61 blocks with her sound side. This score falls below the mean of 73.6 blocks/minute but within the range of 54 – 85 blocks/minute for established age and gender normative values. On her affected side, she scored 17 blocks. This score falls above the average of 13.4 blocks/minute for people with transradial amputations. In comparison to her old prosthesis, there was a change of 9 blocks/minute. This is above the established MDC indicating that there was an improvement with the new prosthetic device.

Acknowledgement: This document format was adapted from material published by The Australian Orthotic and Prosthetic Association, Inc.

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