

Appendix: The D-score: a metric for interpreting the early development of infants and toddlers across global settings

Table A1: Name, abbreviation and citations for instruments during early childhood and at school-age

Country/cohort	Early Childhood Instruments	Abbreviation
Colombia 2	Ages & Stages Questionnaires, 3 rd edition ¹	ASQ-3
Brazil 2, Chile 2, Colombia 2	Battelle Developmental Inventory and Screener, 2 nd edition ²	BDI-2 BDI-2 Screener
Bangladesh, Chile 1, China, Colombia 1 & 2, Ethiopia, South Africa	Bayley Scales for Infant and Toddler Development, 1 st , 2 nd , and 3 rd editions ^{3,4,5}	Bayley-I, II, and III
Brazil 1, Colombia 2	Denver Developmental Screening Test, 2 nd edition ^{6,7}	Denver-II
Ecuador	Barrera Moncada ⁸	Barrera
The Netherlands 1 & 2	Van Wiechenschema ⁹ (Dutch Developmental Instrument)	DDI
Jamaica 1 & 2, South Africa	Griffiths Mental Development Scales ¹⁰	Griffiths
Madagascar	Stanford Binet Intelligence Scales version, 5 th edition ¹¹	SB-5
Chile 2	Test de Desarrollo Psicomotor ¹²	Tepsi
South Africa	Vineland Social Maturity Scale ¹³	Vineland
Country/cohort	School-age Tests	Abbreviation
South Africa	Denver Developmental Screening Test, 2 nd edition ^{6,7}	Denver-II
Jamaica 2 and South Africa	Raven's Progressive Matrices ¹⁴ and Raven's Coloured Progressive Matrices ¹⁵	Raven's
Ethiopia, Jamaica 1, Madagascar	Peabody Picture Vocabulary Test (PPVT-III ¹⁶ and PPVT-4 ¹⁷)	PPVT
Chile 2, Colombia 1 & 2, Ecuador	Test de Vocabulario en Imagenes Peabody ¹⁸ (Spanish version of the PPVT)	TVIP
Jamaica 2 and Madagascar	Stanford Binet Intelligence Scales, 4 th edition ¹⁹ and 5 th edition ¹¹	SB-4 SB-5
Brazil 1, Jamaica 2	Wechsler Adult Intelligence Scale ²⁰	WAIS
Colombia 2	Wechsler Intelligence Scale for Children-Revised ²¹	WISC-V
Bangladesh, Chile 1, Jamaica 1	Wechsler Preschool & Primary Scale of Intelligence, 3 rd and 4 th editions ^{22,23}	WPPSI
Netherlands 1	Utrechtse Korte Kleuter Intelligentietest ²⁴	UKKI

Citations for Instruments

- 1 Squires J, Bricker D, Twombly E, Nickel R, Clifford J, Murphy K, et al. Ages & Stages English Questionnaires, Third Edition (ASQ-3): A Parent-Completed, Child-Monitoring System. Baltimore, MD: Paul H. Brookes Publishing Co; 2009.
- 2 Newborg J. Battelle Developmental Inventory-2nd Edition. Rolling Meadows, IL: Riverside

- Publishing, 2005.
- 3 Bayley N. Bayley Scales of Infant Development. New York: Psychological Corp, 1969.
 - 4 Bayley, N. The Bayley Scales of Infant Development-II. San Antonio, TX: Psychological Corporation, 1993.
 - 5 Bayley N. Bayley Scales of Infant and Toddler Development—Third Edition: Technical manual. San Antonio, TX: Harcourt Assessment, 2006.
 - 6 Frankenburg WK, Dodds J, Archer P, Shapiro H, Bresnick B. The Denver II: a major revision and restandardization of the Denver Developmental Screening Test. *Pediatrics* 1992; **89**: 91–7.
 - 7 Frankenburg WK, Dodds J, Archer P, *et al.* The DENVER II Technical Manual. Denver, CO: Denver Developmental Materials, 1990.
 - 8 Barrera Moncada, O. 1981. Crecimiento y desarrollo psicológico del niño venezolano. Ediciones psicopediátricas. Caracas.
 - 9 Schlesinger-Was EA. Ontwikkelingsonderzoek van zuigelingen en kleuters op het consultatiebureau. 1981.
 - 10 Griffiths R. The Abilities of Babies: A Study in Mental Measurement. University of London Press, 1967.
 - 11 Roid GH. Stanford–Binet Intelligence Scales, Fifth Edition. WPS Psychological Tests, 2003.
 - 12 Haeussler IM, Marchant T. Tepsi: test de desarrollo psicomotor 2-5 años. Eds. Universidad Católica de Chile, 1999.
 - 13 Doll EA. The measurement of social competence: A manual for the Vineland Social Maturity Scale. 1953.
 - 14 Raven JC, Court JH. Raven’s progressive matrices and vocabulary scales. Oxford psychologists Press, 1998.
 - 15 Raven JC. Coloured Progressive Matrices: Sets A, Ab, B. Oxford Psychologists Press, 2003.
 - 16 Lloyd M. Dunn, Leota M. Dunn. "Peabody Picture Vocabulary Test-Third Edition (PPVT-III)". Pearson Education.
 - 17 Lloyd M. Dunn, Douglas M. Dunn. "Peabody Picture Vocabulary Test, Fourth Edition (PPVT™-4)". Pearson Education.
 - 18 TVIP Dunn LM, Lugo DE, Padilla ER, Dunn LM. Test de Vocabulario en Imagenes Peabody (TVIP), Pearson Clinical, 1986.
 - 19 SB-4 Hagen E, Stattler J, Stanford–Binet Intelligence Scales, Fourth Edition·Thorndike, 1986.
 - 20 Wechsler D. Wechsler Adult Intelligence Scale®-Fourth Edition. Pearson Education, 2008.
 - 21 Wechsler D. Wechsler Intelligence Scale for Children®-Fifth Edition. Pearson Education, 2014.
 - 22 Wechsler D. Wechsler Preschool and Primary Scale of Intelligence™ - Third Edition. Harcourt Assessment, Inc., San Antonio, TX, 2002.

- 23 Wechsler D. Wechsler Preschool and Primary Scale of Intelligence™ - Fourth Edition. Pearson Education, 2012.
- 24 Baarda, D.B. 1978. UKKI: Utrechtse Korte Kleuter Intelligentietest. Lisse: Swets en Zeitlinger.

Table A2: Comparison of the average number of items administered to children and the average number of items included in the final Rasch model by study and overall.

Country/cohort	Number of items administered	Number of items in final model	Difference	Ratio
Bangladesh	63.2	14.2	49	22%
Brazil 1	19.5	17	2.5	87%
Chile 1	42.1	30.4	11.7	72%
Chile 2	61.9	33	28.9	53%
China	42.8	28	14.8	65%
Colombia 1	91.5	46.5	45	51%
Columbia 2	123.9	59.5	64.4	48%
Ecuador	6.1	3.5	2.6	57%
Ethiopia	79.5	38.6	40.9	49%
Jamaica 1	86.6	42.5	44.1	49%
Jamaica 2	100.8	38.5	62.3	38%
Madagascar	29.5	7.5	22	25%
Netherlands 1	11	8.6	2.4	78%
Netherlands 2	16.8	14.2	2.6	85%
South Africa	53.6	23	30.6	43%
Average	55.3	27	28.3	55%
Min	6.1	3.5	2.4	22%
Max	123.9	59.5	64.4	87%

Correlations of the early round scores (Time 1) with follow-up rounds (Time 2) are shown in Table A3a for the DAZ and Table A3b for the original instruments (e.g., Bayley-III, Denver-II). Because time between Time 1 and Time 2 varied considerably for different cohorts, Tables A3a and A3b were split into prediction to middle childhood (>4 to 9 years) and adolescence (>9 to 18 years). When multiple original domain measures were available, we included the cognitive measure (e.g., over language or motor) or the Bayley-III measure (e.g., over the Denver-II in Colombia 2).

Table A3a: DAZ in children under 48 months correlated with IQ in Middle Childhood (>4 to 9 years) and Adolescence (>9 to 18 years)

DAZ	Time 1	Time 2: Middle Childhood				Time 2: Adolescence				
	Ages (months)	Ages (years; months) ^d	N	IQ ^a	Ravens ^c	PPVT	Ages (years; months) ^d	N	IQ ^b	PPVT
Bangladesh	18	5;3-5;8	1599	0·376						
Brazil 1	5-11						18;6	1151	0·172	
	11-19						18;6	1117	0·187	
Chile 1	6	5;6-5;8	71	0·381						
	12	5;6-5;8	834	0·194						
	18	5;6-5;8	196	0·167						
Chile 2	24-35	4;1-5;2	2761			0·241				
	36-47	5;1-6;2	2700			0·391				
Colombia 1	10-26	4;6-5;8	608			0·368				
	28-45	4;6-5;8	561			0·521				
Colombia 2	6-17	6;0-6;11	280	0·126		0·008				
	18-29	6;10-7;11	336	0·424		0·357				
	30-42	7;10-8;11	324	0·437		0·391				
Ecuador	0-11	5;7-6;7	158			0·069	9;2-10;2	166		0·070
	12-23	6;8-7;8	240			0·029	10;2-11;3	246		0·122
	24-35	7;7-8;8	230			0·131	11;1-12;2	233		0·226

DAZ	Time 1	Time 2: Middle Childhood				Time 2: Adolescence				
	Ages (months)	Ages (years; months) ^d	N	IQ ^a	Ravens ^c	PPVT	Ages (years; months) ^d	N	IQ ^b	PPVT
Ethiopia ^c	11-12						9;10-10;10	150		0·113
	29-32						9;10-10;10	369		0·159
	41-44						9;10-10;10	391		0·163
Jamaica 1	15	6;6-7;1	187	0·401						
	24	6;6-7;1	188	0·542						0·533
Jamaica 2	9-25	7;0-8;3	154	0·372	0·240	0·389	16;9-18;0	126	0·363	
	21-37	7;0-8;3	154	0·506	0·287	0·537	16;9-18;0	126	0·562	
	33-48	7;0-8;3	135	0·501	0·455	0·476	16;9-18;0	109	0·543	
Madagascar	34-42	6;10-7;10	174	0·172		0·165				
Netherlands 1	0-11	4;7-6;1	2662	0·074						
	12-23	4;7-6;1	1366	0·149						
	24-32	4;7-6;1	396	0·287						
South Africa ^f	6	4;10-5;6 & 7;0-8;6	196	0·183	0·052					
	12	4;10-5;6 & 7;0-8;6	155	0·115	0·059					
	24	4;10-5;6 & 7;0-8;6	935	0·104	0·053					

Differences significant <0·05 are in bold

^aIQ measures at Time 2: middle childhood are WPPSI (Bangladesh, Chile 1, Jamaica 1), WISC-V (Colombia 2), SB-4 (Jamaica 2), SB-5 (Madagascar), UKKI (Netherlands 1) and Denver-II (South Africa)

^bIQ measures at Time 2: adolescence are WAIS (Brazil 1, Jamaica 2)

^cRaven's are the Raven's Progressive Matrices (Jamaica 2) and Raven's Coloured Progressive Matrices (South Africa)

^eThe PPVT in Ethiopia was a combined measure of versions 3 and 4

^fSouth Africa had follow-up measures at 5 years (Denver-II) and 7 years (Raven's) at Time 2

Table A3b: Original* age-standardized measures in children under 48 months correlated with IQ in Middle Childhood (>4 to 9 years) and Adolescence (>9 to 18 years)

DAZ	Time 1	Time 2: Middle Childhood				Time 2: Adolescence				
	Ages (months)	Ages (years; months) ^d	N	IQ ^a	Ravens ^c	PPVT	Ages (years; months) ^d	N	IQ ^b	PPVT
Bangladesh	18	5;3-5;8	1599	0.347						
Brazil 1	5-11						18;6	1151	0.224	
	11-19						18;6	1117	0.189	
Chile 1	6	5;6-5;8	71	0.379						
	12	5;6-5;8	834	0.214						
	18	5;6-5;8	196	0.252						
Chile 2	24-35	4;1-5;2	2761			0.266				
	36-47	5;1-6;2	2700			0.407				
Colombia 1	10-26	4;6-5;8	608			0.249				
	28-45	4;6-5;8	561			0.447				
Colombia 2	6-17	6;0-6;11	280	0.137		0.119				
	18-29	6;10-7;11	336	0.394		0.305				
	30-42	7;10-8;11	324	0.469		0.344				
Ecuador	0-11	5;7-6;7	158			0.121	9;2-10;2	166		0.051
	12-23	6;8-7;8	240			0.046	10;2-11;3	246		0.145
	24-35	7;7-8;8	230			0.072	11;1-12;2	233		0.204
Ethiopia ^{d*}	11-12						9;10-10;10	150		0.038
	29-32						9;10-10;10	369		0.196
	41-44						9;10-10;10	391		0.162
Jamaica 1	15	6;6-7;1	187	0.401		0.313				
	24	6;6-7;1	188	0.498		0.439				
Jamaica 2	9-25	7;0-8;3	154	0.328	0.033	0.138	16;9-18;0	126	0.211	
	21-37	7;0-8;3	154	0.525	0.289	0.535	16;9-18;0	126	0.543	
	33-48	7;0-8;3	135	0.571	0.443	0.535	16;9-18;0	109	0.593	

DAZ	Time 1	Time 2: Middle Childhood				Time 2: Adolescence				
	Ages (months)	Ages (years; months) ^d	N	IQ ^a	Ravens ^c	PPVT	Ages (years; months) ^d	N	IQ ^b	PPVT
Madagascar	34-42	6;10-7;10	174	0.218		0.165				
Netherlands 1	0-11	4;7-6;1	2655	0.076						
	12-23	4;7-6;1	1361	0.166						
	24-32	4;7-6;1	394	0.289						
South Africa ^e	6	4;10-5;6 & 7;0-8;6	196	0.122	-0.041					
	12	4;10-5;6 & 7;0-8;6	155	0.168	0.077					
	24	4;10-5;6 & 7;0-8;6	935	0.142	0.051					

Differences significant <0.05 are in bold

*For the original instruments, Bayley-I and Bayley-II, we used the MDI in the correlations (Bangladesh, Chile 1, South Africa); for Bayley III, we used the measure from the cognition domain (Colombia 1, Colombia 2, Ethiopia).

^aIQ Measures at Time 2: middle childhood are WPPSI (Bangladesh, Chile 1, Jamaica 1), WISC-V (Colombia 2), SB-4 (Jamaica 2), SB-5 (Madagascar), UKKI (Netherlands 1) and Denver-II (South Africa)

^bIQ measures at Time 2: adolescence are WAIS (Brazil 1, Jamaica 2)

^cRavens are the Ravens Progressive Matrices¹³ (Jamaica 2) and Ravens Coloured Progressive Matrices¹⁴ (South Africa)

^dAge in years rounded to nearest half year

^eThe PPVT in Ethiopia was a combined measure of versions 3 and 4

^fSouth Africa had follow-up measures at 5 years (Denver-II) and 7 years (Ravens) at Time 2