Early Development Instrument: Factor structure,
Sub-domains and Multiple Challenge Index

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INTRODUCTION

The Early Development Instrument (EDI) is a 104-item teacher checklist designed to provide an assessment of children's readiness to learn at school in five broad domains (physical health and well-being; social knowledge and competence; emotional health/maturity; language and cognitive development; and general knowledge and communication skills). This document provides additional analyses of the EDI normative data. For full description of the composition of the sample, please see the document "Normative data for the Early Development Instrument" (www.offordcentre.com/readiness/results.html).

Further sub-domains were identified within four out of the five domains. This document presents the factor structure of EDI domains, and the composition of the sub-domains. Furthermore, an indicator of poor functioning has been developed based on the scores in the 16 sub-domains, called the Multiple Challenge Index or MCI.[1] The development, statistics and meaning of the MCI are outlined in this document.

SECTION 1. FACTOR STRUCTURE OF THE EDI

Factor analyses, using the principal component analyses with varimax rotation, were carried out on the normative sample data. The results demonstrated that while there were five distinct areas, four of these five major domains could be subdivided for greater precision. These subscales have been first identified on the 1999/2000 EDI cohort data, and confirmed on the 2000/2001 cohort data, so the current normative sample analyses essentially represent yet another confirmatory analysis.

Internal consistency of the domains and subdomains were tested using Cronbach's alpha. These are presented for all domains and subdomains. All scales and subdomains, except for the Physical independence subdomain, had a high Cronbach's alpha indicating unidimensionality and good internal consistency.

On the following pages, there are tables of factor loadings for items within each of the major five domains. The highest loadings were retained in the majority of cases. Separation into sub-domains was achieved largely based on the highest loadings (listed in the tables). In a few exceptional cases, it was judged that items conceptually belonged in a sub-domain with the second highest loading. These items are indicated in tables. These are between four and eight items in each sub-domain.

To facilitate reading, EDI items are listed in full, as they appear in the questionnaire. At the bottom of each table, a short description of each sub-domain is provided.

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[1]Clyde Hertzman and his team at HELP, UBC, are gratefully acknowledged for helpful discussions leading to the definition of the MCI.

Table 1. Physical Health and Well-Being: Factor loadings.

		Sub-domains		
		Gross and fine motor skills	**Physical readiness for school day**	**Physical independence**
QA2	Over or underdressed for school-related activities		.754	
QA3	Too tired/sick to do school work		.736	
QA4	Late		.640	
QA5	Hungry		.773	
QA6	Is independent in washroom activities most of the time			.561
QA7	Shows an established hand preference (right vs. left or vice versa)			.657
QA8	Is well coordinated (moves without running into things or tripping over things)			.536
QA9	Proficiency at holding pen, crayons, or brush	.829		
QA10	Ability to manipulate objects	.897		
QA11	Ability to climb stairs	.874		
QA12	Level of energy throughout the school day	.763		
QA13	Overall physical development	.868		
QC58	Sucks a thumb/finger			.401
	Internal consistency (Cronbach's alpha)	0.918	0.715	0.256

Full domain internal consistency (Cronbach's alpha):   0.831

Sub-domain descriptions:

Gross and fine motor skills: Ability to perform skills requiring gross and fine motor competence, and ability to sustain energy level during the school day.

Physical readiness for school day: Physical preparedness for active participation in school activities: being dressed appropriately, coming to school on time, not hungry or tired.

Physical independence: Self-hygiene, independence, handedness, coordination and signs of dependence, like finger-sucking.

Table 2. Social Competence: Factor loadings.

		Sub-domain			
		Responsibility and respect	Approaches to learning	Overall social competence	Readiness to explore new things
QC1	Overall social/emotional development			.754	
QC2	Ability to get along with peers			.721	
QC3	Plays and works cooperatively with other children at the level appropriate for his/her age			.576	
QC4	Is able to play with various children			.635	
QC5	Follows rules and instructions	.678			
QC6	Respects the property of others	.779			
QC7	Demonstrates self-control	.733			
QC8	Shows self-confidence			.578	
QC9	Demonstrates respect for adults	.764			
QC10	Demonstrates respect for other children	.823			
QC11	Accepts responsibility for actions	.726			
QC12	Listens attentively		.617		
QC13	Follows direction		.666		
QC14	Completes work on time		.760		
QC15	Works independently		.778		
QC16	Takes care of school materials	.623			
QC17	Works neatly and carefully		.628		
QC18	Is curious about the world				.677
QC19	Is eager to play with a new toy				.890
QC20	Is eager to play a new game				.892
QC21	Is eager to play with/read a new book				.736
QC22	Is able to solve day-to-day problems by him/herself		.429		
QC23	Is able to follow one-step instructions		.636		
QC24	Is able to follow class routines without reminders		.585		
QC25	Is able to adjust to changes in routines		.504		
QC27	Shows tolerance to someone who made a mistake (e.g. when a child gives a wrong answer to question posed by the teacher)	.630			
	Internal consistency (Cronbach's alpha)	0.921	0.911	0.862	0.863

Full domain internal consistency (Cronbach's alpha):   0.953

Sub-domain descriptions:

Overall social competence: Overall social skills, self-confidence, ability to get along with various children.

Responsibility and respect: Respect for others and for property, shown by self-control, following rules, taking care of materials, and accepting responsibility for actions.

Approaches to learning: Working habits and problem-solving abilities, ability to adjust to class routines.

Readiness to explore new things: Curiosity and eagerness to explore new toys, books, and games.

Table 3. Emotional Maturity: Factor loadings.

		Sub-domain			
		Prosocial and helping behaviour	Hyperactivity and inattention	Anxious and fearful behaviour	Aggressive behaviour
QC28	Will try to help someone who has been hurt	.797			
QC29	Volunteers to help clear up a mess someone else has made	.777			
QC30	If there is a quarrel or dispute will try to stop it	.823			
QC31	Offers to help other children who have difficulty with a task	.837			
QC32	Comforts a child who is crying or upset	.881			
QC33	Spontaneously helps to pick up objects which another child has drops	.796			
QC34	Will invite bystanders to join in a game	.787			
QC35	Helps other children who are feeling sick	.873			
QC36	Is upset when left by parent/guardian			.548	
QC37	Gets into physical fights				.773
QC38	Bullies or is mean to others				.795
QC39	Kicks, bites, hits other children or adults				.779
QC40	Takes things that do not belong to him/her				.616
QC41	Laughs at other children's discomfort				.633
QC42	Can't sit still, is restless		.824		
QC43	Is distractible, has trouble sticking to any activity		.828		
QC44	Fidgets		.833		
QC45	Is disobedient				.653
QC46	Has temper tantrums				.542
QC47	Is impulsive, acts without thinking		.615		
QC48	Has difficulty awaiting turn in games or groups		.559		
QC49	Cannot settle to anything for more than a few moments		.756		
QC50	Is inattentive		.766		
QC51	Seems to be unhappy, sad or depressed			.668	
QC52	Appears fearful or anxious			.822	
QC53	Appears worried			.818	
QC54	Cries a lot			.615	
QC55	Is nervous, high-strung, or tense			.676	
QC56	Is incapable of making decisions			.513	
QC57	Is shy			.532	
	Internal consistency (Cronbach's alpha)	0.944	0.921	0.808	0.862

Full domain internal consistency (Cronbach's alpha)   0.923

Sub-domain descriptions:

Prosocial and helping behaviour: basic empathy and willingness to help others who may need assistance or encouragement.

Hyperactivity and inattention: restlessness and distractibility, inability to concentrate.

Anxious and fearful behaviour: anxiety, excessive crying, sadness, and fearfulness, lack of comfort with school

Aggressive behaviour: physical and non-physical aggression and disobedience.

Table 4. Language and Cognitive Development: Factor loadings.

		Sub-domain			
		Basic numeracy skills	**Advanced literacy skills**	**Interest in literacy/ numeracy and memory**	**Basic literacy skills**
QB8	Knows how to handle a book (e.g. turn a page)				.592
QB9	Is generally interested in books (pictures and print)			.631	
QB10	Is interested in reading (inquisitive/curious about the meaning of printed material)			.651	
QB11	Is able to identify at least 10 letters of the alphabet [a]				.145
QB12	Is able to attach sounds to letters [a]				.043
QB13	Is showing awareness of rhyming words [a]				.133
QB14	Is able to participate in group reading activities [a]				.300
QB15	Is able to read simple words		.628		
QB16	Is able to read complex words		.662		
QB17	Is able to read simple sentences		.766		
QB18	Is experimenting with writing tools				.373
QB19	Is aware of writing directions in English (left to right, top to bottom)				.458
QB20	Is interested in writing voluntarily (and not only under the teacher's direction)		.541		
QB21	Is able to write his/her own name in English				.477
QB22	Is able to write simple words		.620		
QB23	Is able to write simple sentences		.728		
QB24	Is able to remember things easily			.383	
QB25	Is interested in mathematics			.757	
QB26	Is interested in games involving numbers			.757	
QB27	Is able to sort and classify objects by a common characteristic(e.g. shape, color, size)	.437			
QB28	Is able to use one-to-one correspondence	.603			
QB29	Is able to count to 20	.692			
QB30	Is able to recognize 1-10	.749			
QB31	Is able to say which number is bigger of the two	.693			
QB32	Is able to recognize geometric shapes (triangle,circle,square)	.546			
QB33	Understands simple time concepts(e.g. today,summer,bedtime)	.409			
	Internal consistency (Cronbach's alpha)	0.802	0.808	0.779	0.751

Footnote: [a] selected for conceptual reasons

Full domain internal consistency (Cronbach's alpha):   0.907

Sub-domain descriptions:

Basic literacy skills: basic abilities to recognise written words and to participate in literacy-oriented play.

Interest literacy/numeracy and memory: interest in participating in literacy and numeracy-oriented activities.

Advanced literacy skills: reading and writing.

Basic numeracy skills: number recognition and counting, comfort with basic mathematical concepts.

Table 5. Communication and General Knowledge: Factor loadings.

		Sub-domain
		Communication and General Knowledge
QB1	Ability to use language effectively in English	.921
QB2	Ability to listen in English	.872
QB3	Ability to tell a story	.916
QB4	Ability to take part in imaginative play	.813
QB5	Ability to communicate own needs in a way understandable to adults and peers	.924
QB6	Ability to understand on first try what is being said to him/her	.897
QB7	Ability to articulate clearly, without sound substitution	.840
QC26	Answers questions showing knowledge about the world	.279

Internal consistency (Cronbach's alpha): 0.931

Sub-domain description:

Communication and General Knowledge: ability to communicate needs and ideas effectively, interest in the surrounding world

SECTION 2. MULTIPLE CHALLENGE INDEX: AN EDI-BASED INDICATOR OF POOR FUNCTIONING AT SCHOOL ENTRY

Community reports on the EDI results summarize the scores per domain for schools and neighbourhoods. The "poor" school readiness results are indicated in relative terms – by calculating how many children have low scores in each domain. The "low" boundary is established by examining the distribution of EDI scores in the community, and by identifying the 10th percentile value for each of the domains. If a child's score falls below the 10th percentile boundary, the score is categorized as "low". Number and percent of children categorized as "low" in each domain as well as in more than one domain are reported for each community.

While this is a useful method to assess the magnitude of differences within a community, it is based on the relative, community-specific distribution. To provide a complementary, more standardized way of presenting the EDI results, we developed the EDI Norms (Normative data for the Early Development Instrument (www.offordcentre.com/readiness/results.html) , and the Multiple Challenge Index (MCI).

Development of the MCI

As described in Section 1, 16 sub-domains emerged within the five major domains of the EDI. Each of the sub-domains represents a relatively homogenous aspect of a child's development.

A "challenge" ability range was identified within each sub-domain, based on the range of scores. For each subdomain, zero (0), equivalent to a child having no ability in all items within the sub-domain, was the lower boundary. The "challenge" cut-off boundary (i.e., the one below which a child would be classified as having the challenge) was based on a mix of poor and average scores, with some exceptions. For example, the *Physical independence* sub-domain of the *Physical health and well-being* has four items, scored *yes (10)* or *no (0)*, each of which represents a specific developmental skill, generally mastered by children by 4 years of age. Therefore, a "challenge" score for this sub-domain was set at lower than 9.99, which would be given to a child who has not mastered any of the four skills. It is important to note, that over 90% of children score 10 on this sub-domain.

Analysis of the distribution of the number of challenges in one or more sub-domain indicated that having scores below the challenge ability in 9 or more pointed to serious problems in multiple domains. Three of the 5 domains have 4 sub-domains, one has 3, and the last one has 1. Therefore experiencing challenge in 9 sub-domains means that they are from at least 3 of the major five developmental domains.

The Multiple Challenge Index is therefore an indicator of a child experiencing challenges in at least three EDI domains. The MCI is scored based on challenges in 9 or more sub-domains, and is expressed as "existence of multiple challenges" (1), or "no multiple challenges" (0).

Detailed descriptions and cut-off boundaries for each of the sub-domains are listed below, along with the percentage of children in the normative sample who have each of the challenges.

6

Table 6. Sub-domain challenge cut-off scores and description.

Physical Health and Well-being	Challenge cut-off	Children below the Challenge cut-off on this subscale…	% below the Challenge cut-off in normative sample
Physical readiness for school day Being dressed appropriately coming to school on time not hungry or tired	6.249	vary from those who have experienced all four conditions at least sometimes to those who have always experienced them	3.9
Physical independence Independence Handedness coordination	9.999	vary from those who have not developed one of the three skills (independence, handedness, coordination) and/or suck a thumb to those who have not developed any of the skills and suck a thumb	8.9
Gross and fine motor skills Holding pen, crayons, or brush Manipulating objects Climbing stairs Level of energy throughout the school day Overall physical development	6.499	vary from those who have a good ability to perform up to two of the five skills and average ability to perform the other three, to those who have poor abilities in all five	21.8
Social Competence			
Overall social competence Overall social/emotional development Gets along with peers Cooperative Plays with various children Demonstrates self-confidence	4.999	vary from those who rate as average on the first two items and can only sometimes demonstrate the behaviours described in the last three items to those who rate as very poor on the first two items and can never show any of the three behaviours.	8.4
Responsibility and respect Follows rules Respects property Demonstrates self-control Demonstrates respect for adults Demonstrates respect for other children Accepts responsibility for actions Takes care of materials Shows tolerance to someone who made a mistake	4.999	vary from those who never show one of the behaviours, and the remaining seven sometimes to those who never show any of the behaviours.	4.7
Approaches to learning Listens attentively Follows directions Completes work on time Works independently Works neatly and carefully Able to solve problems by him/herself Able to follow simple instructions Able to follow class routines Able to adjust to changes in routines	4.999	vary from those who never demonstrate one of the behaviours/skills but all the remaining eight show sometimes, to those who never show any of the nine behaviours/skills.	8.1
Readiness to explore new things Curiosity about the world Eager to play with a new toy Eager to play a new game Eager to play with/read a new book	4.999	vary from those who never show one of the behaviours and sometimes show the remaining three to those who never show any of the four behaviours	3.2

Emotional Maturity	Challenge cut-off	Children below the Challenge cut-off on this subscale…	% below the Challenge cut-off in normative sample
Prosocial and helping behaviour Help someone who has been hurt Clear somebody else's mess Try to stop a quarrel Offers help with a task Comforts a child who is upset Spontaneously helps Invite bystanders to join in Help children who are feeling sick	4.999	vary from those who never show one of the behaviours and sometimes show the remaining seven to those who never show any of the eight behaviours.	33.5
Anxious and fearful behaviour Upset when left at school Seems unhappy or sad Fearful or anxious Worried Cries a lot Nervous or tense Incapable of making decisions Excessively shy	4.999	vary from those who often show one of the behaviours and only sometimes show the remaining seven to those who never show any of the eight behaviours.	2.1
Aggressive behaviour Gets into physical fights Bullies or is mean Kicks, bites or hits others Takes things that do not belong to him/her Laughs at others Is disobedient Has temper tantrums	7.139	vary from those who sometimes show most of the seven behaviours to those who often show all of them	7.8
Hyperactivity and inattention Restless Distractible Fidgets Impulsive Difficulty awaiting turns Can't settle to anything Inattentive	5.709	vary from those who sometimes show all seven behaviours to those who often show all of them	13.1
Language and Cognitive Development			
Basic literacy Know how to handle a book Identify some letters Attach sounds to letters Show awareness of rhyming words Participate in group reading activities Experiment with writing Aware of writing directions Able to write own name	7.499	do not have three or more of the eight skills	11.0
Interest in literacy/numeracy and memory Interest in books Interest in reading Remember things easily Interest in mathematics Interest in games involving numbers	7.999	do not have two or more of the five skills	15.8
Advanced literacy Read simple words Read complex words Read sentences Write voluntarily Write simple words Write simple sentences	3.329	have only one or none of the six skills	19.4
Basic numeracy Sort and classify Use one-to-one correspondence Count to 20 Recognize numbers 1-10 Compare numbers Recognize geometric shapes Understand simple time concepts	8.569	do not have two or more of the seven skills	14.2

Communication Skills and General Knowledge	Challenge cut-off	Children below the Challenge cut-off on this subscale…	% below the Challenge cut-off in normative sample
Communication skills and general knowledge Effective use of the language of instruction Listens in the language of instruction Tells a story Participates in imaginative play Communicates own needs in understandable way Easily understands what is said to him/her Articulates clearly without sound substitutions Answers questions about the world	6.939	vary from those who rate as good on two or less of the first seven items, and average on the reminder of the first seven items and only sometimes demonstrate the general knowledge, to those who rate as poor or very poor on the first seven items and almost never demonstrate general knowledge	29.0

MCI versus other characteristics

A. Normative sample (N=116860)

Approximately one in 20 children in the normative sample has been classified as having multiple challenges (4988, 4.3%). Since this sample did not include children with special needs (see section B below), it is clear that this proportion represents children who are not identified with having any special problems before entering kindergarten. As with the prevalence of any problems, there is a marked difference between boys and girls (2.3% vs. 6.1%), and younger children versus older ones (5.5% vs. 3.0%), with the highest frequency of 8.6% found in the 4.9-5.2 years age range. MCI is also more prevalent among children for whom the language of instruction was not the first language (6.9% vs. 3.9%).

One in four children had scores in the lowest 10th percentile in at least one domain of the EDI (25.9%), 12.9% had scores in the lowest 10th percentile in at least two domains of the EDI.

All children with MCI also scored low in more than one EDI domain. They made up 16.5% of this group. All but 37 (less than 0.01%) students with MCI scored low in two or more domains.

B. Children with Special Needs: "Full" sample (N=119921)

To explore the relationship between the MCI and special needs (SN), we reverted to the "Full sample", that is the group that had valid gender, age, and EDI data, and included children with Special Needs. Of the original 125,282 children, 5361 were missing on their SN classification, which resulted in 119,921 children being available for this analysis.

There were 3061 children with special needs in this sample, which is about 2.6%. Less than half children with SN were classified as having the MCI (1305 or 42.6%). Thus, inclusion of children with SN raised the total number of children with MCI to 6293 (or 5.2%).

Table 7. MCI vs. Special Needs Status

	No Special Needs	Special Needs	Total
No MCI	111872	1756	113628
MCI	4988	1305	6293
Total	116860	3061	119921

84.2% of children with SN, however, scored low in 1 or more domains, and 67.6% low in 2 or more.

In addition, the distribution of special problems differed slightly between the populations of children with Special Needs and children with MCI, as indicated in the table below.

Table 8. Prevalence of specific problems among children with Special Needs and with MCI

Variable	Special Needs		MCI	
	Valid N[1]	% with problem	Valid N[2]	% with problem
physical disability	2498	20.9	4525	8.0
visual impairment	2472	9.5	4430	5.8
hearing impairment	2404	7.7	4302	3.2
speech impairment	2524	58.3	4414	29.6
learning disability	2072	43.9	3368	25.9
emotional problem	2304	22.1	3847	20.5
behaviour problem	2484	34.2	4189	32.8
home problem	2211	22.6	3558	30.3
other problem	1745	35.8	2888	19.5

[1] N of children with Special Needs for whom the answer to this question was reported
[2] N of children with MCI for whom the answer to this question was reported