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Investigating the Validity of the Australian Early Development Index

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This article aims to contribute to the ongoing evaluation of the Australian Early Development Index (AEDI) by investigating its construct and concurrent validity with a subsample of 642 children aged 4 to 5 years drawn from the Longitudinal Study of Australian Children (LSAC). Construct validity was examined by considering the theoretical consistency of the network of correlations between the AEDI subconstructs and the independently reported multimethod measures of early learning skills and development collected contemporaneously by the LSAC. Concurrent validity was examined by assessing the extent to which children who were “developmentally vulnerable” on the AEDI domains corresponded with the LSAC outcome indices classification of children as “developmentally at risk.” Moderate to large correlations were observed between each of the AEDI domains and subconstructs when compared to analogous teacher-rated LSAC measures, with lower levels of association observed for parent-rated LSAC measures. Concurrent validity was explored; however, with no criterion measure with which to assess the AEDI, findings are inconclusive prior to predictive validity assessment. Future waves of the LSAC will collect information on the children’s abilities at school and developmental outcomes, enabling further interpretation of these concurrent and construct validity findings by triangulation and predictive validity analyses.

The Australian Early Development Index (AEDI) is a revised version of the original Early Development Instrument (EDI), created in Canada and adapted for use in Aus-

tralia. The EDI is a teacher-completed measure of school readiness that consists of five developmental domains: Physical Health and Well-Being, Social Competence, Emotional Maturity, Language and Cognitive Development, and Communication Skills and General Knowledge (Janus & Offord, 2000, 2007). The five domains, in turn, consist of 16 subdomains (Janus & Duku, 2005; see also Forget-Dubois et al., this issue).

Australia's interest in the EDI stemmed from the fact that the tool uniquely covers the five key aspects of child development in one instrument and appeared to be relatively easy to administer across a population. In addition, the EDI provides data for communities (rather than individuals) and could thus be a useful means of benchmarking the progress of universal rather than targeted approaches to the promotion of child development (Goldfeld, Brinkman, Sayers, Oberklaid, & Silburn, 2007; Hart, Brinkman, & Blackmore, 2003). There has been much research to suggest that a child's capacity to learn when commencing school is strongly influenced by the neural wiring that takes place in the early years (McCain, Mustard, & Shanker, 2007). Further to this, evidence suggests that this capacity at school entry then predicts a child's academic attainment as well as his or her social and emotional skills throughout life (McCain & Mustard, 1999). The EDI aims to determine if the child has the skills and developmental capacity to take advantage of the school's learning environment and can thus be used as an outcome measure of how well the community has raised its children to school entry, as well as a predictor for later school outcomes (Janus & Duku, this issue).

The first step in adapting and revising the original version of the EDI required testing its content validity and utility as a community-level measure of early child development and readiness for school learning when used in the Australian context. This was undertaken by a collaboration between the Perth North Metropolitan Area Health Service; the Swan and West Coast District Education Offices; and the Offord Centre for Child Studies, McMaster University (Brinkman & Blackmore, 2003). Apart from minor wording changes to reflect common Australian English usage, the overall content and structure of the initial revision remained essentially unchanged from the original Canadian version. After piloting with 200 students, this initial revision of the instrument was administered by teachers of 4,319 children aged 4 to 5 years attending both government and nongovernment preschools in the Perth north metropolitan health region (Brinkman, Hart, & Blackmore, 2004; Hart et al., 2003).

The next step in the revision process involved item analysis using the Rasch model (Andrich & Styles, 2004) to examine the psychometric properties of each of the five EDI domains ($N=4,319$ children). This analysis established that although all five domains had excellent reliability and validity in terms of the Rasch model, four of the domains (Personal Health and Well-Being, Social Competence, Emotional Maturity, and Communication Skills and General Knowledge) could be further improved if they were modified from their existing five ordered response categories to three such categories (Andrich & Styles, 2004). The Rasch analysis also identified that 9 of the 104 items could be safely eliminated without any loss of scale precision.

Modifications to the instrument recommended by the Rasch analysis were then considered and approved by the AEDI Project Technical Reference Group in consultation with Dr. Janus (the author of the original EDI). Authorization for the final revisions to be published and used in the national implementation of the Australia Early Development Index: Building Better Communities for Children project was formalized through a memorandum of understanding between the Offord Centre for Child Studies, the Centre for Community Child Health, the North Metropolitan Population Health Program, and the Telethon Institute for Child Health Research (Australian Early Development Index Partnership, 2005).

The commencement of the first wave of data collection of the Longitudinal Study of Australian Children (LSAC; Sanson et al., 2002) provided a convenient opportunity to further validate the AEDI, enabling the assessment of its concurrent, construct, and predictive validity. The national AEDI project team accordingly submitted a proposal to the Australian Government's Department of Family and Community Services and Indigenous Affairs, the Australian Institute of Family Studies, and the LSAC Consortium Advisory Group in late 2003 for a nested study in which the AEDI would be administered to a subsample of the LSAC Age 4 cohort. Once formal approval and ethics clearance were secured, the newly revised AEDI was administered to 642 participants. Although the reliability and validity of the Canadian EDI have been reported (Duku & Janus, 2004; Janus, 2002; Janus & Offord, 2007), this is the first article to describe the construct and concurrent validity of the AEDI.

METHODS

LSAC

The LSAC is a nationally representative clustered cross-sequential sample of two cohorts of Australian children: 5,104 infants and 4,976 four-year-olds (Sanson et al., 2002). The first wave of the LSAC commenced in May 2004, collecting a wide range of data on early development, health, education, and living circumstances. This information was gathered from face-to-face interviews with parents, parent self-completed questionnaires, interviewer observation, direct child assessment, and teacher-/caregiver-completed questionnaires. One advantage of the clustered design was to provide the opportunity to gather multiple observations within a community, to increase the capacity of the study to analyze community-level effects, and to cost-effectively conduct face-to-face interviews. Postcodes with fewer than 20 eligible children were excluded from the selection process (605 postcodes), with the remaining 1,976 postcodes stratified by state/territory and by capital city statistical division to ensure that the sample was distributed across

strata in the same proportions as children in the target populations. The response rate for the 4-year-old cohort was 59.4% (Soloff, Lawrence, & Johnstone, 2005).

The subsample for this AEDI validation study consisted of all the families participating in the LSAC that resided in Queensland, Victoria, or Western Australia. These three States of Australia were the first to gain ethics approval for the administration of the AEDI by the state-governed Departments of Education, and this conveniently coincided with the first wave of data collection for the LSAC study in 2005.

The LSAC data collection initially involved an interviewer spending 1 to 2 hr in the home, where detailed information about the child was collected from the primary caregiver (Parent 1). The interviewer also gathered information on parental health status, family functioning, parenting, child care, social support, parental education, and other family sociodemographic information. Parent-reported measures of children's functioning included the Strengths and Difficulties Questionnaire (SDQ; Goodman, Ford, Simmons, Gatward, & Meltzer, 2000), the Parent's Evaluation of Developmental Status (PEDS; Glascoe, 1997), and the Short Temperament Scale for Children (Sanson, Prior, Garino, Oberklaid, & Sewell, 1987). The interviewer then undertook physical measurement and direct assessment of the child, including administration of the Who Am I? (WAI; de Lemos & Doig, 1999) school readiness test and the Peabody Picture Vocabulary Test (PPVT) of receptive language (Dunn & Dunn, 1997). Consent was also sought to contact any nonresident parent and child care provider or teacher. Additionally, self-completed modules for both Parent 1 and Parent 2, covering aspects of family functioning, health, and support, were provided. When time permitted, these modules were completed while the interviewer was in the home.

When consent was obtained, questionnaires were then sent to the child's teacher as soon as feasible after completion of the home interview (Soloff, Millward, & Sanson, 2003). On average there was a 2-month gap between the home interview and when the teacher completed the instrumentation. The teacher questionnaire included the SDQ, the Short Temperament Scale for Children, and the AEDI. Teacher-completed data collection occurred during the third school term of 2004.

Assessing Construct Validity

The construct validity of the AEDI as a general measure of early child development and as a predictor of readiness for school learning can only be examined indirectly, as the constructs that the AEDI seeks to measure are latent in that they are not directly observable or immediately measurable (Cronbach & Meehl, 1967). Investigation of this aspect of the AEDI's validity thus involves demonstrating from the set of available observations that the overall scale score and each of the domain and subdomain scores correlate consistently with other relevant measures of early

child development. Given that the analysis of the AEDI's prediction of readiness for school learning is contingent on the second wave of LSAC data collection (which is due for release in mid-2007), the current article is confined to examining the AEDI with the currently available data from the first wave of the LSAC. The AEDI's predictive validity will be the subject of future analyses.

The strength of association between each of the AEDI domains and the relevant LSAC variables was assessed with Spearman correlation coefficients. There is sound theoretical expectation to justify the predicted direction of the correlations, and thus one-tailed tests are reported in this article. However, it should be noted that prior to undertaking the one-tailed analyses, we initially undertook two-tailed tests to confirm the expected direction. The conventions¹ recommended by Hopkins (1997) are used to describe the correlation strength of paired observations for a sample of 600. A sample of this size provides 95% confidence intervals of less than 0.1 across the full range of possible correlations (i.e., from *little or none* to *very large*).

Comparable LSAC Instruments

The data collected in the LSAC included assessments of various aspects of early child development using well-established measures with known measurement properties (Sanson et al., 2002). This enabled comparisons to be made between AEDI domains and subdomain scores and the corresponding LSAC measures of comparable (or theoretically similar) constructs. The relevant LSAC measures selected for these comparisons included the following.

PEDS. The authorized Australian version of the PEDS is a 10-item, parent-completed screening measure designed for detecting and addressing development and behavioral problems in children from birth to age 8 years. It is reported to have high sensitivity, correctly identifying 74% to 80% of children with developmental disabilities, and 70% to 80% of children without developmental disabilities identified as developing normally (Glascoe, 1997). The instrument also has a longitudinal recording form for summarizing surveillance and promotion activities and has been translated into English, Spanish, and Vietnamese (Glascoe, 1993).

Pediatric Quality of Life. The parent-report version of the Pediatric Quality of Life InventoryTM was used in the LSAC to assess children's health-related quality of life and school functioning. This 23-item instrument is designed for use with children aged 2 to 18 years in community, school, and clinical population settings. It provides summary scores on physical functioning, emotional functioning, social

¹Correlation coefficients of .9 to 1.00 are very large, .7 to .89 large, .5 to .69 moderate, .3 to .49 small, and 0 to .29 little or none

functioning, psychosocial health, and school functioning, along with a total scale score (23 items). It is reported to have sound internal reliability (total score $\alpha = .90$, physical health summary score $\alpha = .88$, and psychosocial health summary score $\alpha = .86$) and sound validity in distinguishing between healthy children and pediatric patients with acute or chronic health conditions (Varni, Seid, & Kurtin, 2001).

SDQ. The SDQ is one of the most widely used measures of children's emotional and behavioral difficulties. The instrument comprises 25 items and produces scores for five areas of psychological adjustment—emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. It has a total difficulties score calculated by totaling the four deficit-focused subscales (i.e., excluding prosocial behavior). Originally developed as a screening tool, the SDQ is also increasingly being used as an individual outcome measure in clinical and preventive interventions (Goodman, 1999; Goodman et al., 2000; Hawes & Dadds, 2004). There is a substantive body of research on the psychometric properties of the use of the SDQ in different cultures supporting the validity and reliability of its versions for parent, teacher, and youth self-report (although this was not used in the LSAC), despite some variation in cutoff scores (Vostanis, 2006). The LSAC collected SDQ data using both the parent and teacher (child care worker) versions of the instrument.

PPVT—Third Edition (PPVT-III). For the purposes of the LSAC, an abbreviated version of the PPVT-III adapted for use in the Australian context was administered by the interviewers in the child's home after completion of interviews with the child's parents. This version of the PPVT is designed for children aged 2 months to 6 years and provides a norm-referenced measure of receptive vocabulary for standard English (Sanson et al., 2002). Developed as a screening tool, the PPVT-III allows a verbal or nonverbal response, is individually administered, and is not timed (although administration typically takes 10 to 15 min). It comprises 204 test items in which the examiner says a word, and the child responds by selecting the picture that best illustrates that word's meaning (Dunn & Dunn, 1997).

WAI. The WAI was developed at the Australian Council for Educational Research for use with children aged 4 to 7 years as an individual measure of aspects of child development relevant to school readiness. It consists of a series of copying and writing tasks designed to distinguish between achievements that are based on specific learning or teaching (such as the child's ability to write his or her own name) and achievements that are based on a more advanced level of conceptualization (e.g., the ability to copy complex geometrical forms or to transform spoken words into written form; de Lemos & Doig, 1999). For the purposes of the LSAC, the WAI was administered by interviewers in the family home after completion of

the parent interview. Interviewers were trained in the administration of the instrument.

Short Temperament Scale for Children. This is a 30-item parent-report inventory that enables the assessment of temperament style in Australian children and provides norms for three developmental age periods: 3 years 5 months to 4 years 5 months, 4 years 10 months to 6 years 6 months, and 6 years 8 months to 8 years 3 months. The child's temperament style is classified on four dimensions: approach, persistence, rhythmicity, and inflexibility. The scores on three of these dimensions (approach, persistence, and inflexibility) are then combined to form a continuous *easy to difficult* scale that permits the classification of each child's overall temperament style. The scale has test-retest reliability ranging from .77 for inflexibility to .90 for approach (Prior, Sanson, & Oberklaid, 1989; Sanson et al., 1987).

Other LSAC Measures Used

A range of other specific LSAC items were selected for comparison with the AEDI. These included teacher ratings of children's reading, writing, and numeric competencies, their behavior on separation from and reunion with parents, peer relationship quality, and how the child compared with other children of the same age in terms of fine and gross motor skills.

Table 1 provides an overview of the AEDI domains and subconstructs, and Table 2 provides an overview of the comparable LSAC measures.

Assessing Concurrent Validity

In addition to the correlational analyses conducted to describe the nomological network of associations between the various developmental constructs measured in both the AEDI and the LSAC, the extent to which the AEDI and LSAC outcome indices agreed in their identification of children who may be considered "developmentally vulnerable" or "on track" was also examined.

The LSAC Outcome Index is a composite measure encompassing three broad domains of child development (physical, social/emotional, and learning) developed specifically for the LSAC as an aggregate indicator of children's overall development and well-being (Sanson et al., 2005). The physical health domain was derived from parent ratings of the child's overall health status, special health care needs, body mass index (very high or low), and the PEDS physical health summary. The social/emotional domain was derived from social competence, internalizing and externalizing measures from the SDQ prosocial, peer problems, emotional symptoms, hyperactivity, and conduct problems scales. The learning domain was derived from the PPVT; parent ratings of reading skills; teacher ratings of reading, writing, and numeracy skills; and approach to learning score of the

TABLE 1
Descriptive Statistics for Australian Early Development Index Variables
Included in the Analysis

<i>Variable</i>	<i>N</i>	<i>M</i>	<i>SE</i>	<i>Median</i>	<i>Min</i>	<i>Max</i>
Domain						
Physical Health and Well-Being domain score	639	6.94	0.05	7.27	0.91	9.09
Emotional Maturity domain score	634	7.89	0.05	8.08	4.62	10.00
Social Competence domain score	638	7.85	0.07	8.33	0.43	10.00
Language and Cognitive Development domain score	611	6.58	0.08	6.92	0.00	10.00
Communication Skills and General Knowledge domain score	640	7.38	0.10	8.13	0.00	10.00
Vulnerable						
Vulnerable Physical Well-Being	642	0.14	0.01	0.00	0.00	1.00
Vulnerable Emotional Maturity	642	0.10	0.01	0.00	0.00	1.00
Vulnerable Social Competence	642	0.13	0.01	0.00	0.00	1.00
Vulnerable Language and Cognitive Development	642	0.12	0.01	0.00	0.00	1.00
Vulnerable Communication Skills and General Knowledge	642	0.12	0.01	0.00	0.00	1.00
Subdomain						
Physical readiness for school work	639	6.35	0.05	6.67	0.00	10.00
Physical independence	640	6.38	0.04	6.67	0.00	10.00
Gross and fine motor skills	640	7.60	0.09	8.00	0.00	10.00
Prosocial and helping behavior	638	5.20	0.11	5.00	0.00	10.00
Anxious and fearful behavior	638	9.18	0.05	10.00	5.00	10.00
Aggressive behavior	639	9.22	0.05	10.00	5.00	10.00
Hyperactive and inattentive behavior	639	8.73	0.06	9.17	5.00	10.00
Overall social competence with peers	640	7.18	0.10	7.50	0.00	10.00
Respect and responsibility	640	8.15	0.08	8.75	0.00	10.00
Independence and adjustment	640	7.65	0.08	8.13	0.00	10.00
Readiness to explore new things	638	8.20	0.09	8.75	0.00	10.00
Basic literacy	640	7.86	0.09	8.75	0.00	10.00
Interest and memory	640	8.25	0.10	10.00	0.00	10.00
Complex literacy skills	636	1.93	0.09	1.67	0.00	10.00
Basic literacy and numeracy	640	8.15	0.09	8.57	0.00	10.00
Communication skills	640	7.38	0.10	8.13	0.00	10.00

WAI. Although similar in concept to the Vulnerability Index used in the Canadian National Longitudinal Survey of Children and Youth (Willms, 2002), the Outcome Index is derived from a multistage standardization process utilizing the aforementioned measures selected to include developmental strengths and weaknesses within each of the three broad developmental domains. The resultant percentile distributions of each of the continuous domain scores reflect the fact that most children have good developmental outcomes (Sanson et al., 2005).

TABLE 2
Descriptive Statistics for LSAC Variables Included in the Analysis

<i>AED Domain</i>	<i>LSAC Measure</i>	<i>N</i>	<i>M</i>	<i>SE</i>	<i>Median</i>	<i>Min</i>	<i>Max</i>
Physical Health and Well-Being	Parent-reported measures						
	Global health	642	1.58	0.03	1.00	1.00	4.00
	Peds QL physical health summary	542	82.88	0.50	84.38	25.00	100.00
	Teacher-reported measures						
	Fine motor skills	636	1.89	0.05	2.00	1.00	4.00
	Gross motor skills	639	1.93	0.05	2.00	1.00	4.00
	Parent-reported measures						
	PedsQL social functioning	541	82.91	0.66	85.00	18.75	100.00
	STSC sociability	542	3.74	0.05	3.75	1.00	6.00
	SDQ prosocial	638	7.78	0.07	8.00	1.00	10.00
Social Competence	SDQ peer problem	638	1.63	0.06	1.00	0.00	9.00
	SDQ conduct	638	2.50	0.08	2.00	0.00	10.00
	Teacher-reported measures						
	Child separation behavior	614	3.36	0.02	3.38	1.38	4.00
	Child reunion behavior	613	3.39	0.02	3.43	1.71	4.00
	SDQ prosocial	633	6.55	0.09	6.00	0.00	10.00
	SDQ peer problem	633	1.73	0.08	1.00	0.00	9.00
	SDQ conduct	633	1.15	0.07	0.00	0.00	10.00
	Total relationship	632	4.43	0.02	4.60	2.47	5.00
	Parent-reported measures						
SDQ prosocial behavior	638	7.78	0.07	8.00	1.00	10.00	
SDQ hyperactivity	638	3.43	0.09	3.00	0.00	10.00	
SDQ emotional symptoms	637	1.62	0.07	1.00	0.00	8.00	
STSC reactivity	542	2.69	0.04	2.75	1.00	5.75	
PedsQL emotional functioning	542	72.09	0.63	75.00	20.00	100.00	
Teacher-reported measures							
SDQ prosocial	633	6.55	0.09	6.00	0.00	10.00	
SDQ hyperactivity	633	2.67	0.10	2.00	0.00	10.00	
SDQ emotionality	632	1.09	0.06	0.00	0.00	8.00	

(continued)

TABLE 2 (Continued)

AED Domain	LSAC Measure	N	M	SE	Median	Min	Max	
	Warm relationship	632	4.41	0.02	4.60	1.40	5.00	
	Conflict/anger	632	1.48	0.03	1.24	1.00	4.43	
	Interviewer observation							
	Fear towards interviewer	642	3.84	0.02	4.00	-2.00	4.00	
Language and Cognitive Development	Parent-reported measures							
	PEDS expressive language concern	641	1.75	0.02	2.00	1.00	2.00	
	PEDS receptive	642	1.92	0.01	2.00	1.00	2.00	
	Speech therapy via school	637	-1.29	0.13	0.00	-9.00	1.00	
	Reading competencies scale	641	0.34	0.03	0.00	0.00	3.00	
	Home activities	642	1.74	0.02	1.71	0.00	3.00	
	Teacher-reported measures							
	Reading competencies	622	1.67	0.03	2.00	0.00	5.00	
	Writing competencies	623	3.02	0.06	3.00	0.00	6.00	
	Numeracy competencies	620	3.33	0.05	3.00	0.00	5.00	
Direct child assessment								
	PPVT	567	64.05	0.34	65.00	20.00	84.00	
	WAI	631	62.41	0.29	63.00	35.00	86.00	
Communication Skills and General Knowledge	Parent-reported measure							
	Reading competencies	622	1.67	0.03	2.00	0.00	5.00	
	Teacher-reported measures							
	Open communication factor	632	4.24	0.03	4.33	1.00	5.00	
	Reading competencies	622	1.67	0.03	2.00	0.00	5.00	
	Writing competencies	623	3.02	0.06	3.00	0.00	6.00	
	Numeracy competencies	620	3.33	0.05	3.00	0.00	5.00	
	Direct child assessment							
		PPVT	567	64.05	0.34	65.00	20.00	84.00
		WAI	631	62.41	0.29	63.00	35.00	86.00

Note. LSAC = Longitudinal Study of Australian Children; AEDI = Australian Early Development Index; PEDS = Parent's Evaluation of Developmental Status; PedsQL = Pediatric Quality of Life Inventory; STSC = Short Temperament Scale for Children; SDQ = Strengths and Difficulties Questionnaire; PPVT = Peabody Picture Vocabulary Test; WAI = Who Am I?

For this study, the concurrent validity analyses utilized the outcome indices calculated from the entire LSAC sample (i.e., the percentile distribution was not specifically computed for the current subsample utilized for the purposes of this article). In addition to the three domain scores, a Negative Outcome Index was calculated. This index was categorical and was computed by counting the number of domains on which a child fell within the bottom 15% (thus ranging from 0–3). Concurrent validity was examined using Kappa, with sensitivity, specificity, positive predictive ratio, and negative predictive ratios calculated.

RESULTS

Sample Characteristics

Of the 720 eligible children for whom household interviews were completed, there were 642 children for whom the teacher completed the LSAC and AEDI assessments. Eligible children were those in the third and fourth workloads of the first wave of LSAC data collection in Queensland, Victoria, and Western Australia. Forty six percent (46.4%) of the LSAC/AEDI sample was from Victoria, 33% from Queensland, and 20.4% from Western Australia. As the third and fourth LSAC workloads occurred later in the school year, these children were between 2 and 3 months older than the overall (i.e., national) LSAC Age 4 cohort at the time of their teacher assessments.

In terms of other demographic characteristics, there were no systematic differences observed between the AEDI subsample and the overall LSAC cohort. English was the main language spoken at home for 87.5% of the AEDI subsample and 89.2% of the entire LSAC cohort. Children of Aboriginal or Torres Strait Islander descent comprised 2.1% of the AEDI subsample and 3.9% of the overall LSAC cohort. In addition, there was no significant difference observed between the socioeconomic status of the AEDI subsample compared to the entire LSAC cohort (mean Socioeconomic Indicator for Areas of Advantage/Disadvantage Index = 1,003.3 vs. 1,005.0). In summary, apart from being around 2 to 3 months older at the time of their teacher-completed assessments, children in the AEDI subsample were demographically similar to those in the entire LSAC sample and could thus be considered representative of the general Australian population of children aged 4 to 5 years.

Table 1 details the summary descriptive statistics for each of the AEDI variables included in the analysis. This shows the number of children with valid data, the means, standard errors, medians, and maximum and minimum values for each variable. Table 2 shows the equivalent descriptive statistics for each of the LSAC variables included in the analyses.

Construct Validity Findings

AEDI Physical Health and Well-Being domain (Table 3). The PEDS Physical Health Summary showed only a weak correlation with the AEDI Physical Health and Well-Being domain score (.091). This observation suggests that very different aspects of physical health and well-being were being measured in these components of the LSAC and AEDI. However, small correlations were observed between the LSAC teacher-rated fine motor skills and gross motor skills and the AEDI Gross and Fine Motor Skills subdomain (−.45 and −.38).²

AEDI Social Competence domain (Table 4). A moderate correlation was observed between the LSAC teacher-rated Prosocial scale and the AEDI Social Competence domain score (.69), and similar moderate correlations were observed with the AEDI subdomain scores of Overall Social Competence With Peers, Respect and Responsibility, and Independence and Adjustment (.57, .64, and .59). The LSAC teacher-reported Relationship Quality scale was also strongly correlated with the AEDI Social Competence domain score (.62) and moderately correlated with the Overall Social Competence With Peers, Respect and Responsibility, and Independence and Adjustment AEDI subdomain scores (.54, .59, and .50). The LSAC teacher-rated Conduct Problems Scale was negatively and moderately to strongly correlated with the AEDI Social Competence domain score, and the Respect and Responsibility and the Independence and Adjustment subdomain scores (−.53, −.64, and −.45). Finally, the LSAC teacher-rated Peer Problems scale was moderately negatively correlated with the AEDI Social Competence domain score and the Overall Social Competence With Peers subdomain score (−.46 and −.58).

AEDI Emotional Maturity domain (Table 5). The strongest correlation was observed between the teacher-rated Prosocial LSAC measure and the AEDI Emotional Maturity domain scores (.75). The LSAC teacher-rated Hyperactivity SDQ measure showed a moderate negative correlation with the AEDI Emotional Maturity domain score (−.63) and the AEDI Hyperactivity and Inattentive Behaviors subdomains (−.42 and −.69). Moderate negative correlations were observed between the LSAC teacher-rated Conflict scale and the AEDI (a) Aggressive Behavior and (b) Hyperactive and Inattentive Behavior subdomains (−.55 and −.44). Whereas the parent-rated SDQ Hyperactivity scale was moderately correlated with the AEDI Hyperactive and Inattentive Behavior subdomain score (−.32), little or no correlation was observed between the parent-rated PEDS Emotional Functioning and the

²The teacher ratings on the fine and the gross motor skills scales ranged from 1 to 4, with 1 representing *more competent than others* and 4 representing *much less competent than others*, whereas the AEDI was scored in the opposite direction, thus accounting for the direction of the correlation.

TABLE 3
Spearman Correlations Among the AEDI and LSAC Physical Health and Well-Being Measures

Informant	Measure	Parent Response PEDS Physical Health Summary	Teacher Assessment			
			How Study Child Compares to Others— Fine Motor Skills	How Study Child Compares to Others— Gross Motor Skills	AEDI Physical Well-Being	AEDI Gross and Fine Motor Skills
LSAC	PEDS physical health	—	—	—	—	
	Tch fine motor skills	-.101**	—	—	—	
AEDI	Tch gross motor skills	-.109**	.401**	—	—	
	Physical well-being	.091*	-.448**	-.370**	—	
	Gross and fine motor skills	.088*	-.449**	-.378**	.960**	

Note. The values in bold are those discussed in the body of the text. AEDI = Australian Early Development Index; LSAC = Longitudinal Study of Australian Children; PEDS = Parent's Evaluation of Developmental Status; Tch = teacher-rated.

* $p < .05$, one-tailed. ** $p < .01$, one-tailed.

TABLE 4
Spearman Correlations Among the AEDI and LSAC Social Competence Measures

Informant	Measure	Parent Response				Teacher Assessment				AEDI Overall Social Competence With Peers	AEDI Respect and Responsibility	AEDI Independence and Adjustment					
		PEDS Social Functioning	Sociability Scale	Prosocial Scale	Peer Problems Scale	Conduct Problems Scale	Separation From Parent	Behavior on Parent	Reunion With Parent				Prosocial Scale	Peer Problems Scale	Conduct Problems Scale	Relationship Quality Scale	AEDI Social Competence
LSAC	PEDS social functioning	—															
	Sociability scale	.197**	—														
	Prosocial scale	.245**	.135**	—													
	Peer problems scale	-.395**	-.258**	-.193**	—												
	Conduct problems scale	-.214**	.018	-.362**	.231**	—											
	Tch separation from parent	.126**	.238**	.061	-.193**	-.101**	—										
	Tch reunion with parent	.105**	-.064	.079*	-.082*	-.105**	.041	—									
	Tch prosocial scale	.145**	-.036	.177**	-.195**	-.244**	.379**	.348**	—								
	Tch peer problems	-.270**	-.115**	-.108**	.344**	.154**	-.416**	-.077*	-.420**	—							
	Tch conduct problems	-.076*	.175**	-.133**	.107**	.242**	-.196**	-.331**	-.512**	.219**	—						
	Tch relationship quality	.124**	-.001	.200**	-.183**	-.201**	.445**	.310**	.639**	-.410**	-.530**	—					
	Social competence	.239**	-.023	.201**	-.273**	-.216**	.398**	.280**	.690**	-.457**	-.533**	.626**	—				
	Overall social competence	.225**	.098**	.176**	-.289**	-.166**	.454**	.157**	.572**	-.579**	-.350**	.535**	.788**	—			
Respect and responsibility	.193**	-.078*	.168**	-.217**	-.233**	.316**	.316**	.642**	-.336**	-.639**	.585**	.874**	.583**	—			
Independence and adjustment	.235**	-.082*	.164**	-.218**	-.205**	.260**	.261**	.586**	-.330**	-.445**	.497**	.905**	.579**	.762**	—		

Note. The values in bold are those discussed in the body of the text. AEDI = Australian Early Development Index; LSAC = Longitudinal Study of Australian Children; PEDS = Parent's Evaluation of Developmental Status; Tch = teacher-rated. * $p < .05$, one-tailed. ** $p < .01$, one-tailed.

TABLE 5
Spearman Correlations Among the AEDI and LSAC Emotional Maturity Measures

Informant	Measure	Parent Response				Teacher Assessment					Interviewer Assessment			
		Prosocial Scale	Hyperactivity Scale	Emotional Symptoms Scale	Reactivity Scale	PEDS Emotional Functioning Scale	Prosocial Scale	Hyperactivity Scale	Emotional Problems Scale	Warm Relationship Scale	Conflict Scale	AEDI Emotional Maturity	AEDI Prosocial and Helping Behavior	AEDI Hyperactive and Inattentive Behavior
LSAC	Prosocial scale	—												
	Hyperactivity scale	-.367**	—											
	Emotional symptoms	-.030	.172**	—										
	Reactivity scale	-.287**	.307**	.189**	—									
	PEDS emotional functioning	.116**	-.153**	-.364**	-.342**	—								
	Tch prosocial	.177**	-.257**	-.066*	-.256**	.055	—							
	Tch hyperactivity	-.158**	.348**	.014	.197**	-.050	-.563**	—						
	Tch emotional problems	-.048	-.019	.219**	.068	-.152**	-.126**	.109**	—					
	Tch warm	.142**	-.071*	-.007	-.142**	.027	.531**	-.284**	-.157**	—				
	Tch conflict	-.155**	.223**	-.057	.164**	-.043	-.471**	.480**	.137**	-.325**	—			
	Child fear interview	.068*	-.026	-.091**	-.106**	.002	.137**	-.027	-.136**	.062	.071*	—		
AEDI	Emotional maturity	.185**	-.273**	-.097**	-.202**	.032	.745**	-.633**	-.264**	.457**	-.495**	-.106**	—	
	Prosocial and help	.194**	-.201**	-.102**	-.176**	.023	.729**	-.451**	-.172**	.470**	-.303**	.154**	.870**	
	Aggressive behavior	.109**	-.218**	.064*	-.151**	.015	.424**	-.423**	-.015	.192**	-.546**	-.019	.570**	
	Hyperactivity and inattention	.151**	-.320**	-.034	-.137**	.027	.446**	-.689**	-.103**	.247**	-.439**	.013	.683**	
													.510**	

Note. The values in bold are those discussed in the body of the text. AEDI = Australian Early Development Index; LSAC = Longitudinal Study of Australian Children; PEDS = Parent's Evaluation of Developmental Status; Tch = teacher-rated. * $p < .05$, one-tailed. ** $p < .01$, one-tailed.

AEDI Emotional Maturity domain and subdomain scores. It is interesting to note however, that the other teacher-rated measurements of emotional maturity also did not correlate substantially with the PEDS Emotional Functioning indicator.

AEDI Language and Cognitive Development domain (Table 6). The LSAC teacher-rated measures of writing, reading, and numeric competencies were found to have the strongest correlations with the AEDI Language and Cognitive Development domain (.69, .62, and .70). This result was expected, as 6 out of the 40 individual items on the AEDI are exactly the same as those in the LSAC teacher-rated measures (2 per competency scale). These LSAC measures also had moderate correlations with the AEDI Basic Literacy subdomain (.49, .60, and .53). Similarly moderate correlations were evident between the LSAC teacher measures and the AEDI subdomains of (a) Basic Literacy and Numeracy and (b) Complex Literacy. Smaller correlations were seen between the LSAC teacher measures and the AEDI Interest and Memory subdomain (.44 and .49).

In contrast, small correlations were found between parent-reported PEDS expressive language concern, receptive language concern, and the teacher-rated AEDI Language and Cognitive Development domain, with correlations ranging from .18 to .25. The direct observation LSAC measures, PPVT, and WAI showed small to moderate correlations with the AEDI Language and Cognitive Development domain (.34, .49).

AEDI Communication Skills and General Knowledge domain (Table 7). The LSAC teacher-rated Open Communication and Numeric Competencies scales both correlated moderately with the AEDI Communication Skills and General Knowledge domain scores (.47 and .40). Small correlation was also evident between the LSAC WAI score and the AEDI Communication Skills and General Knowledge domain score (.32). Finally, the LSAC PPVT showed weak but significant correlations with AEDI Communication Skills and General Knowledge domain score (.30).

Concurrent Validity

For the assessment of concurrent validity, those children categorized as “vulnerable” on the AEDI domains were compared to those children classified as “developmentally at risk” by the LSAC outcome indices. For each of the AEDI domains, those children scoring within approximately the bottom 10% were classified as vulnerable (with the percentile cutoff differing slightly depending on the domain; Sayers, Brinkman, Goldfeld, Silburn, & Oberklaid, 2006; cf. Janus & Offord, 2007; Kershaw, Irwin, Trafford, & Hertzman, 2005). As explained in the Methods section, the LSAC study group created composite measures encompassing three broad domains of child development (physical, social/emotional, and learning). For each of these LSAC outcome indices, children falling within the bottom 15%

TABLE 6
Spearman Correlations Among the AEDI and LSAC Language and Cognitive Development Measures

Informant	Measure	Parent Response			Teacher Assessment			Interviewer Assessment		AEDI						
		Expressive Language	Receptive Language	Speech Therapy	Reading Competencies Index	Home Activities Index	Reading Competencies	Writing Competencies	Numeracy Competencies	PPVT Score	WAI Score	Language and Cognitive Development	Basic Literacy	Interest and Memory	Complex Literacy Skills	Basic Literacy and Numeracy
LSAC	PEDS expressive language	—														
	PEDS receptive language	.430**	—													
	Speech pathology	-.211**	-.138**	—												
	Reading competencies	.075*	.036	-.040	—											
	Home activities	.040	.054	-.038	.049	—										
	Tch reading	.151**	.124**	-.025	.113**	.024	—									
	Tch writing	.190**	.169**	-.048	.122**	.001	.571**	—								
	Tch numeracy	.076*	.118**	-.021	.081*	.069*	.473**	.554**	—							
	PPVT score	.126**	.164**	.084*	.128**	.059	.333**	.256**	.329**	—						
	WAI score	.200**	.127**	-.034	.273**	.010	.392**	.475**	.367**	.319**	—					
AEDI	Language and cognitive domain	.245**	.208**	-.070*	.136**	.058	.620**	.691**	.698**	.342**	.491**	—				
	Basic literacy	.212**	.181**	-.078*	.088*	.028	.487**	.595**	.533**	.287**	.416**	.862**	—			
	Interest memory	.201**	.180**	-.041	.082*	.067*	.492**	.436**	.479**	.265**	.319**	.707**	.522**	—		
	Complex literacy	.194**	.115**	-.038	.121**	.054	.530**	.629**	.438**	.195**	.383**	.754**	.558**	.386**	—	
	Basic literacy and numeracy	.164**	.188**	-.046	.120**	.112**	.411**	.428**	.674**	.320**	.376**	.779**	.596**	.527**	.401**	—

Note. The values in bold are those discussed in the body of the text. AEDI = Australian Early Development Index; LSAC = Longitudinal Study of Australian Children; PEDS = Parent's Evaluation of Developmental Status; PPVT = Peabody Picture Vocabulary Test; WAI = Who Am I?; Tch = teacher-rated.
* $p < .05$, one-tailed. ** $p < .01$, one-tailed.

TABLE 7
Spearman Correlations Among the AEDI and LSAC Communication Skills and General Knowledge Measures

Informant	Measure	Teacher Assessment			Teacher Assessment		
		Open Communication Scale	Writing Competencies	Numeracy Competencies	Interviewer Assessment	Direct Observation	Teacher Assessment
					PPVT Score (Integers)	WAI Score (Integers)	Communication and General Knowledge
LSAC	Tch open communication	—					
	Tch writing competencies	.260**	—				
	Tch numeracy competencies	.233**	.554**	—			
	PPVT score	.180**	.256**	.329**	—		
	WAI score	.133**	.475**	.367**	.319**	—	
AEDI	Communication and general knowledge	.467**	.361**	.403**	.295**	.315**	—

Note. The values in bold are those discussed in the body of the text. AEDI = Australian Early Development Index; LSAC = Longitudinal Study of Australian Children; PPVT = Peabody Picture Vocabulary Test; WAI = Who Am I?; Tch = teacher-rated.

* $p < .05$, one-tailed. ** $p < .01$, one-tailed.

were classified as developmentally at risk, with this calculation made for the entire LSAC sample. In our current LSAC/AEDI sample, 19.5% of children were classified as at risk on the Negative Learning Outcome Index, 13% on the Social and Emotional Outcome Index, and 13% on the Negative Physical Health Outcome Index; 34% showed some degree of risk on the overall Negative Outcome Index. Table 8 shows the strength of concurrence between each of the specific LSAC outcome indices and AEDI measures of developmental vulnerability as measured by the Kappa statistic. A number of different measures of diagnostic effectiveness have also been described regarding the extent to which children considered vulnerable on one of the AEDI domains were also likely to be considered developmentally at risk on one of the LSAC outcome domains. These include (a) sensitivity, (b) specificity, (c) positive predictive value, and (d) negative predictive value.³

The results indicated poor sensitivity for the Physical Health and Well-Being, Social Competence, and Emotional Maturity AEDI domains when measured against the LSAC outcome indices (29%, 26%, and 24%) but good specificity (89%, 90%, 92%). Similarly, the negative predictive validity results for these comparisons were stronger than the positive predictive validity results. Weak to moderate sensitivity and high specificity was observed when comparing the Language and Cognitive Development and the Communication Skills and General Knowledge AEDI domains to the LSAC Negative Learning Outcome Index (sensitivity = 51% and 40%, specificity = 97% and 95%). The global measure of vulnerability on one or more of the AEDI domains and the LSAC Negative Outcome Index showed moderate sensitivity (54%) and good specificity (85%). The relationship between these measures, as assessed using the Kappa statistic, although statistically significant showed a weak association for the Physical Health and Well-being domain (.18), the Social (.15) and Emotional (.18) AEDI domains, and moderate correlations for the Language and Cognitive Development (.56) and Communication Skills and General Knowledge (.41) domains when correlated against the LSAC outcome indices. In general the results indicated modest, but satisfactory, probability of observing a true negative result but a poor probability of a child who has been classified as developmentally vulnerable on the AEDI being classified as developmentally at risk on the LSAC outcome indices.

DISCUSSION

Although there are a number of descriptions of the reliability and concurrent and predictive validity of the original Canadian version of the EDI (Janus & Offord,

³*Sensitivity* = True Positive / (True Positive + False Negative), *specificity* = True Negative / (True Negative + False Positive), *positive predictive value* = True Positive / (True Positive + False Positive), and *negative predictive value* = True Negative / (True Negative + False Negative).

TABLE 8
Concurrent Validity: Specificity, Sensitivity, and Positive Predictive Validity

<i>AEDI Measure</i>	<i>Developmentally at Risk</i>			
	<i>LSAC Physical Health</i>	<i>LSAC Social/Emotional</i>	<i>LSAC Learning</i>	<i>LSAC Negative Outcome Index</i>
Vulnerable Physical Health and Well-Being	Sens = 29% Spec = 89% PPV = 28% NPV = 89% Kappa = .18**			
Vulnerable Social Competence		Sens = 26% Spec = 90% PPV = 26% NPV = 89% Kappa = .15**		
Vulnerable Emotional Maturity		Sens = 24% Spec = 92% PPV = 31% NPV = 89% Kappa = .18**		
Vulnerable Language and Cognitive Development			Sens = 51% Spec = 97% PPV = 81% NPV = 89% Kappa = .56**	
Vulnerable Communication Skills and General knowledge			Sens = 40% Spec = 95% PPV = 67% NPV = 88% Kappa = .41**	
No. of AEDI domains on which child is vulnerable				Sens = 54% Spec = 85% PPV = 65% NPV = 78% Kappa = .51**

Note. AEDI = Australian Early Development Index; LSAC = Longitudinal Study of Australian Children; Sens = sensitivity; Spec = Specificity; PPV = positive predictive validity; NPV = negative predictive validity

** $p < .000$.

2007), this is the first description of the way the Australian adaptation performs in relation to other measures of early child development assessed by parent interview, direct assessment, and teacher ratings.

The opportunity for this study to collect AEDI data from a subsample of the nationally representative LSAC has provided a unique means of determining the va-

lidity of the AEDI as a population-level indicator of children's current developmental status. Also, the longitudinal design of the LSAC will enable examination of the extent to which children's developmental status, as measured by the AEDI at age 4 or 5 years, is predictive of their subsequent trajectories of school learning and behavior as well as their longer term social and emotional adjustment.

A limitation of this study is that the LSAC sample of children was on average 8 months younger than the average age of children who underwent EDI data collection in Canada and was 12 months younger than children who underwent AEDI data collection in Australia (Australian Early Development Index Partnership, 2005). However in both Canada and Australia the current EDI/AEDI databases have children ranging in age from 4 through to 7 years (Janus & Duku, 2004). This age differential may have implications when comparing these data to those of validity studies conducted in Canada.

Small through to large correlations were observed between each of the five AEDI developmental domains and their subdomains and the relevant teacher-rated LSAC measures assessing comparable constructs. The observed correlations are indicative of the convergent validity component of the instrument's construct validity. The strongest associations were evident for the AEDI Language and Cognitive Development domain with teacher-rated measures of reading, writing, and numeric competencies. The AEDI Social Competence and Emotional Maturity domain and subdomain scores also showed moderate to strong correlations with the LSAC teacher-reported SDQ prosocial behavior, peer problems, conduct problems, and hyperactivity. Although the parent-reported LSAC social and emotional competence measures also showed a consistent pattern of significant associations with the AEDI Social Competence and Emotional Maturity domain and subconstruct scores, these correlations were generally much weaker than those for the comparable teacher ratings. The AEDI Physical Health and Well-Being and the Communication Skills and General Knowledge domains were found to correlate less well with the available relevant LSAC measures. Low to moderate correlations were observed between the AEDI and LSAC teacher-rated fine and gross motor skills; other aspects of the LSAC health and well-being measures showed poor correlations, suggesting that they were assessing quite different aspects of physical health.

In general, parent ratings from the LSAC did not correlate as highly with the AEDI scores as the respective teacher ratings. These results are consistent with the pattern of the correlations found between teacher ratings and parent ratings from the LSAC. These results may be partially explained by the (on average) 2-month time lag between the completion of the LSAC household-based parent interviews and the time that the teachers completed the LSAC and AEDI instrumentation. Additionally stronger evidence for construct validity of the AEDI could be provided if a different educator provided the criterion (LSAC) data rather than the same teacher who provided the child's AEDI data. This in fact is probably the main rea-

son for the higher correlations; that is, the fact that one set of correlations is from teacher (LSAC) to teacher (AEDI) ratings and the other from parent (LSAC) to teacher (AEDI) ratings, indicating in part a method effect.

The assessment of concurrent validity examined the extent to which the number of AEDI domains falling in the vulnerable range concurred with the LSAC outcome indices' classification of children who were developmentally at risk. The results of the concurrent validity assessment showed in general poor sensitivity but high specificity and weak to moderate correlations. At this stage it is unclear what meaning should be attributed to the relatively poor sensitivities and specificities and the observed Kappa measures of agreement. Only once the study children's actual trajectories of school learning and child development (to be collected in future waves of the LSAC) have been established can the meaning of the current values be properly determined. It should also be noted that the LSAC outcome indices have not yet been formally validated and should in no way be considered a gold standard criterion against which the AEDI is to be definitively compared. The level of agreement between the AEDI and the LSAC outcome indices of developmental vulnerability have thus been described to enable their triangulation against children's developmental outcomes in a planned predictive validity study. As such, the concurrent validity results are inconclusive. In fact there is no gold standard measure for any of the five developmental domains of child development discussed in this article. Their validity can only be explored by investigating the theoretically expected nature of the network of relationships between like instruments.

The AEDI is not designed as an individual diagnostic instrument but is a tool in which the vulnerability of individual children is assessed on each of the developmental domains. Just as in a census, individual AEDI data are then aggregated to the group level (class, school, neighborhood, province/state, or country) before reporting. This study describes a wide range of cross-method correlations regarding the agreement between instruments. The results show that teacher-completed assessments from the LSAC consistently correlate better with the teacher-completed AEDI assessments compared with parent-completed or interviewer/direct assessments from the LSAC. When reviewing the magnitude of the correlations, it is interesting to note that the levels of agreement between the non-AEDI measurements show similar results. Consistently lower correlations were found between measures of conceptually different constructs than between similar concepts, which is indicative of the AEDI's discriminant validity.

In conclusion, this study indicates that the AEDI has good construct validity when compared with data collected independently from teacher ratings and direct assessment of children and can therefore be confidently used as a population-level indicator of children's current developmental status. However, concurrent validity results are unconvincing, and further validity analyses, particularly the predictive validity assessment of the AEDI and the LSAC measures, will be important. The predictive validity of the AEDI in assessing children's readiness for school learn-

ing will be reported in a subsequent article based on the data collected from schools and families in the second wave of the LSAC data collection once this becomes available for analysis in mid-2007.

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