

Bioecological Theory, Early Child Development and the Validation of the Population-Level Early Development Instrument

Martin Guhn · Hillel Goelman

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Abstract The Early Development Instrument (EDI; Janus and Offord in Canadian Journal of Behavioural Science 39:1–22, 2007) project is a Canadian population-level, longitudinal research project, in which teacher ratings of Kindergarten children’s early development and wellbeing are linked to health and academic achievement variables at the individual level, and to demographic, cultural, and socioeconomic variables at the community level. In this article, we draw from Bronfenbrenner’s bioecological theory of human development to create a coherent theoretical framework for guiding validation research within a population-level approach to child development research in general and for the EDI project in particular. The discussion draws from a range of social and health sciences as well as validity theory. The paper seeks to align complex conceptual, theoretical, methodological, and psychometric considerations, to provide specific design, methodology, and validation recommendations for a population-level approach to studying children’s development and wellbeing, and to discuss the strengths and challenges of this approach.

Keywords Bioecological theory of human development · Validation research framework · Early Development Instrument (EDI) · Interdisciplinary child development theory · Urie Bronfenbrenner

1 Introduction

This paper seeks to generate recommendations pertaining to future validation research and measurement practices pertaining to the Early Development Instrument (EDI, Janus and Offord 2007) project, a population-level, longitudinal research project on children’s early development and wellbeing. We draw from Bronfenbrenner’s bioecological theory of

M. Guhn · H. Goelman
University of British Columbia, Vancouver, BC, Canada

M. Guhn (✉)
Human Early Learning Partnership, University of British Columbia, 4th Floor, Library Processing
Centre, 2206 East Mall, Vancouver, BC V6T 1Z3, Canada
e-mail: martin.guhn@ubc.ca

human development to integrate different disciplinary theoretical views on child development with methodological issues and considerations from validity theory, and we discuss the challenges, strengths, and limitations of this approach.

Our intention is to contribute methodological and theoretical detail to discussions that, to a large extent, occur in discrete research literatures (e.g., on early child development; school readiness; neighborhood effects; population health; or validity theory). We argue that these diverse literatures can benefit from an integration of the different disciplinary foci and perspectives, and that an integration of theoretical and methodological issues has important implications for validation research, measurement practice, and, possibly, for educational practice. The sections of this article, respectively, (1) introduce the population-level Early Development Instrument project; (2) discuss pertinent arguments from the literatures on validity, school readiness, child development, and neighborhood effects; (3) delineate key propositions of Bronfenbrenner's bioecological theory of human development; (4) present a bioecological integration of the presented arguments; and (5) provide recommendations for validation research.

2 The Early Development Instrument as an Indicator of Children's Developmental Outcomes

'*Kasserian ingera?*'—'How are the children?'—is a traditional Massai greeting that reflects societal concern for children's wellbeing. This concern is similarly reflected in current national and international indicators of children's wellbeing, which ask the same question: "How are the children?" The traditional response to the Massai greeting is: "All the children are well". However, according to a range of indicators of different aspects of child development, not all children are doing well. In the Canadian context, for example, surveys and statistics show that the prevalence of mental health/psychiatric disorders among children is about 10–20% (Breton et al. 1999; Offord et al. 1987; Spady et al. 2001), approximately 13% of all children are obese (Tremblay and Willms 2000), provincial child poverty rates range from about 5 to 20% (CCSD 2004), approximately 3% of all children aged 5–14 are diagnosed with a learning disability (Statistics Canada 2006), and about 10% of all children drop out from school (Bowlby 2008).

Measuring children's wellbeing or developmental outcomes is not, of course, an end in itself. Rather, it is one component in describing and understanding phenomena in human development—which, in turn, is part of an even larger objective, namely that of generating knowledge that can be used to inform decisions and to implement practices, which help children and their families to do well (cf. Bronfenbrenner and Morris 2006).

In correspondence with this view, creating useful research knowledge is the purpose of the Early Development Instrument (EDI; Janus and Offord 2000, 2007; Janus et al. 2007; www.offordcentre.com/readiness/; www.earlylearning.ubc.ca/EDI/), a measure administered by teachers in the middle of the Kindergarten year to assess "developmental outcomes as reflected in children's *school readiness*" (p. 1). One of the conceived uses of the EDI is, through linking EDI data with other child development data (e.g., pre-school screenings; school achievement) at the individual level, and with social indicators (e.g., socioeconomic status; social capital) at the neighborhood level, to provide communities with knowledge that can inform families, practitioners, educators, researchers, and policy makers in their practices and decisions in support of children's and families' wellbeing (see Nosbush 2006).

The EDI has been implemented at a population-level in several jurisdictions in Canada and abroad. In British Columbia (BC), for example, the implementation has been

conducted by the Human Early Learning Partnership at the University of British Columbia, in collaboration with the Ministries on Health, Education, and Child and Family Development since 1999. To date, EDI data have been collected for three cohorts of about 40,000 Kindergarten children (per cohort) across BC, and these data have been linked with school achievement and administrative health records at an individual (anonymised) level, and with demographic and socioeconomic census data at an aggregated neighborhood level. In addition, the EDI is being administered in four other Canadian provinces and the city of Montreal, and the Australian adaptation of the EDI is being administered nationally in Australia.

3 Conceptualizations of Validity and Validation

The question of whether the EDI provides valid data on children's developmental outcomes can be approached from numerous directions, as 'validity' refers to a broad range of concepts and validity types (see Kane 2006). For the purpose of this paper, we focus on construct validity and test validation, as they broadly pertain to theoretical, methodological, and psychometric issues. Given the numerous and occasionally conflicting interpretations of validation and validity (e.g., compare Borsboom et al. 2004; with Messick 1995; Kane 2006; or Zumbo 2009), we provide definitions of how the terms validity and validation are used in this context. The definitions primarily refer to Cronbach and Meehl's (1955) theoretical work on construct validity and validation, and to Messick's (1995, 1998) work on integrating test-use-based social consequences into a holistic view of test validity.

Cronbach and Meehl (1955) define construct validation as the process of testing hypotheses set forth by theory—a nomological network of associations and propositions—pertaining to the construct. As psychological constructs themselves are unobservable, construct validation needs to occur via measurements of observable indicators (of the respective constructs) within the nomological network, and the relationships between these observables need to adhere either to the theoretical predictions, or the nomological network might have to be modified to accommodate accumulating measurement evidence. Accordingly, theory building and construct validation are iteratively intertwined (cf. Smith 2005).

Figure 1 illustrates three examples of nomological networks, as widely used in psychological and social research, which represent different approaches to conceptualizing and studying child development. In these examples, theoretically proposed relationships (represented as arrows) among the latent constructs (the theory level; represented as circles) and the observable indicators (the measurement level; represented as rectangles) are shown.¹ Example 1 (top of figure) represents a scenario, which is often employed in sociological or epidemiological research, in which a developmental outcome at a group level (in this case, school readiness) is examined in its relationship to neighborhood characteristics (in this case, socioeconomic status of the neighborhood, simultaneously taking individual families' socioeconomic status into account). In example 2 (middle), which shows a typical scenario from an educational, psychological, or intervention approach, the developmental outcome is studied in the context of developmentally relevant

¹ The illustrations adhere to conventional structural equation model, or path analysis, notation, and follow Bollen and Lennox' (1991) recommendations for distinguishing between *composite indicators*, such as socioeconomic status, and *effect indicators*, such as school readiness and academic achievement, for both of which the arrows represent, respectively, the direction of association. For associations among constructs, arrows with open-shaped arrow heads are used, and for relationships between measures and constructs, arrows with solid heads are used.

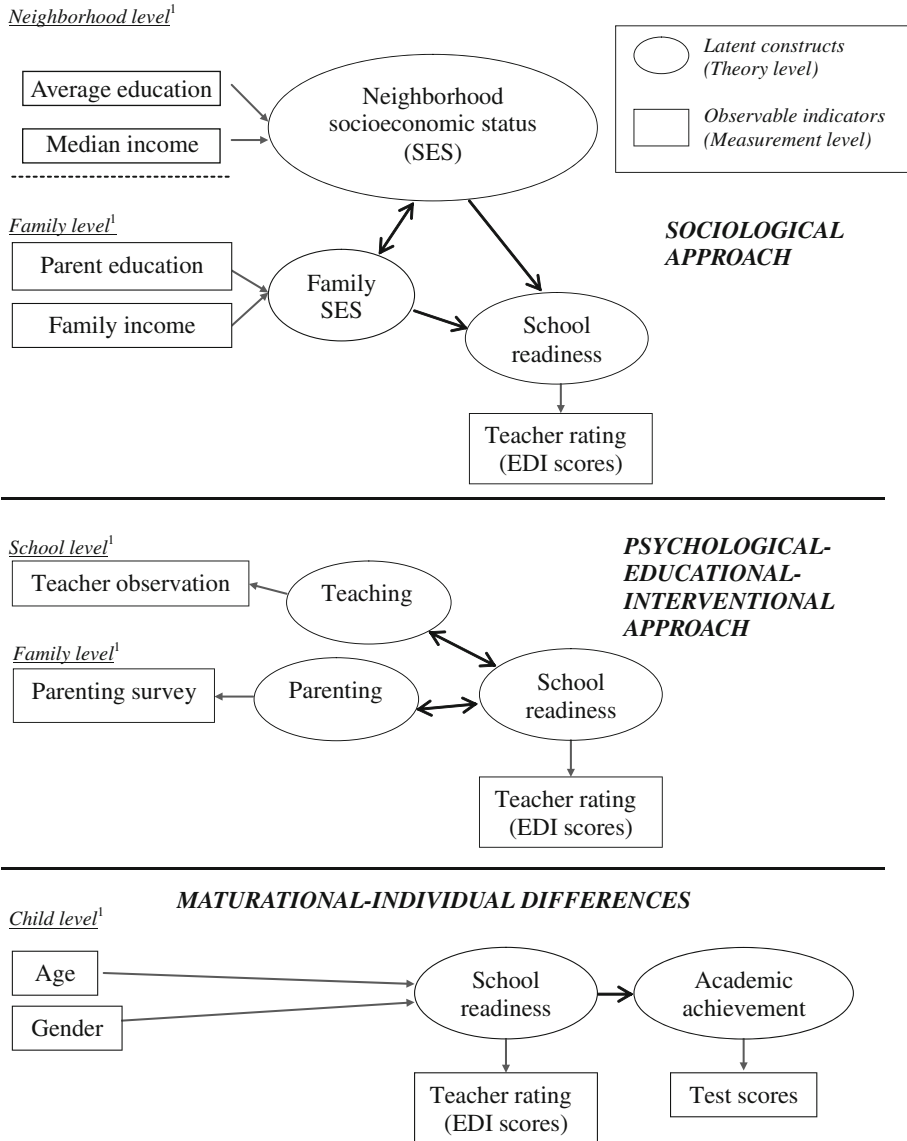


Fig. 1 Three nomological networks representing common disciplinary approaches to human development.
¹Level of measurement at which data are obtained

experiences; in this case, parenting and/or teaching practices. In example 3, the nomological network represents a longitudinal approach from a maturational, or individual differences perspective, conceptualizing the developmental outcome as the result of genetic and biological factors, as well as a long-term predictor of later developmental outcomes (e.g., academic achievement).

In the research literature(s) pertaining to (multiple definitions of) school readiness—the construct the EDI intends to capture—all three approaches can be found. Taking a sociological/epidemiological approach, a few Canadian studies examined the relationship

between socioeconomic neighborhood characteristics and (a particular definition of) school readiness (e.g., Kohen et al. 1998) and early child development outcomes (Kohen et al. 2002). Examples from the educational or early intervention field are the *Head Start* program (Zigler et al. 2006) and the Perry/High Scope Preschool program from the US (Schweinhart et al. 1993), and the *Better Beginnings, Better Futures* program in Canada (bbbf.queensu.ca), all of which have been examined with respect to their effects on children's school readiness. A number of longitudinal studies have examined the relationships between school readiness and later academic achievement (see Duncan et al. 2007, for a meta-analysis), with some of them including a wide range of individual and family variables (e.g., child behavior, parental support, family socioeconomic status) as control or predictor variables. (For the US context, see, e.g., Alexander and Entwisle 1988; Entwisle et al. 2007, and the Early Childhood Longitudinal Study [ECLS; e.g., Hair et al. 2006]. For the Canadian context, see, e.g., the National Longitudinal Study of Children and Youth [NLSCY], Statistics Canada 2007).

Similarly, teacher ratings of children's school readiness from the EDI have been studied within these different approaches: Lapointe et al. (2007) and Kershaw et al. (2005) used a sociological approach to examine the relationship between socioeconomic neighborhood characteristics and aggregated EDI ratings of children's development; Pelletier and Corter (2005) conducted a study that related preschool intervention program efforts with EDI ratings; and Lloyd and Hertzman (2009), in a longitudinal study, linked children's individual EDI ratings to their later academic achievement.

From a construct validity perspective, it is important to examine to what degree these approaches are methodologically and theoretically compatible. As will be discussed below, Bronfenbrenner's bioecological theory can serve as an apt framework for integrating these different approaches, and allows one to generate specific validation recommendations for the EDI project.

A definition of validity that is broader than that of Cronbach and Meehl has been advocated by Messick (1995, 1998). According to Messick, validity includes the notion that interpretations and inferences that are based on measurements must be valid, and that measurement-related social consequences and actions must be in line with the purpose of the test. This view requires that a test's purpose, underlying theoretical assumptions, intended uses, and the social context's values are explicitly stated. For the EDI, Messick's broad view of validity has not yet been systematically addressed. Therefore, the following discussion seeks to explicate the EDI's underlying theoretical assumptions, and to describe the purpose for and context within which the EDI is (intended to be) used.

Previous papers have addressed some of the theoretical aspects pertaining to the EDI (Janus and Offord 2000, 2007), the purpose for and context within which the EDI may be used (Janus and Offord 2000; Nosbush 2006), and specific validity issues of the EDI (Guhn et al. 2007). As the theory, purpose, practice, and validity of the measurement of school readiness are all inherently connected, it is, however, necessary to formulate a comprehensive framework that explicitly formulates the interconnections between these strands. Accordingly, we (1) explicate and develop underlying theoretical assumptions of the EDI, (2) expand the scope of the theoretical discussion by integrating theoretical considerations from the child development, sociology, neighborhood effects, and validity literatures, (3) explicitly link the theoretical foundations to the purpose and (assessment) practice of the EDI, and (4) illustrate how Bronfenbrenner's bioecological theory of human development can serve as a unifying conceptual framework to inform validity and validation issues with respect to the EDI.

4 Key Questions on the Theoretical Construct of *School Readiness*

We use the term school readiness with some caution, as there are numerous definitions of the term and numerous approaches to the measurement of the construct(s) of school readiness. For the current discussion, we draw upon the definition of *school readiness* that has been offered by Janus and Offord's (2007), the developers of the EDI. According to them, the EDI was “designed to provide communities with an informative, inexpensive and psychometrically sound tool to assess outcomes of early development as reflected in children’s school readiness” (Janus and Offord 2007, p. 1). On the EDI, Kindergarten teacher’s rate developmental outcomes as reflected in children’s school readiness in five domains: (1) Physical health and well-being, (2) Social competence, (3) Emotional maturity, (4) Language and cognitive development, and (5) Communication skills and general knowledge. Competence in these domains is considered essential for children to be “ready to benefit from educational activities offered in the school environment” (p. 4).

In order to discuss the validation of the EDI as a population-level measure of ‘developmental outcomes as reflected in children’s school readiness’, it is informative to examine to what extent the EDI’s conceptualization of school readiness relates to current conceptualizations of school readiness in the research literature. In the research literature, there is a great heterogeneity of theories and practices regarding the construct(s) of *readiness*, *readiness to learn*, *school readiness*,² or *readiness to learn at school*, and this diversity reflects the historical and cultural diversity inherent to theories and practices pertaining to learning and schooling. This diversity is not only indicative of the complexity of these issues, but it also hints at their societal relevance. After all, a society’s collectively endorsed perceptions of school readiness define at what age school starts, can influence admission decisions for individual children, can affect educational practices at the (pre)-school, and can even shape the social structuring of family and community life. Therefore, recurrent debates about school readiness have been highly contentious, as opinions on education are based on a blend of people’s values, political ideologies, social and cultural norms, habits, knowledge, research evidence, intuitions, experiences, economic constraints, and feasibility considerations. To address these issues on both school readiness and validity, we focus on five key questions.

1. What developmental domains or characteristics are facets of school readiness?

The scholarly literature has come to a certain degree of consensus with regard to what developmental domains are considered facets of school readiness. This is illustrated in Table 1. Table 1 aligns the results from a review of the school readiness literature (Doherty 1997; cf. National Education Goals Panel 1995) with results from a national parent and teacher survey (US) on school readiness (Lewit and Schuurmann Baker 1995), as well as with Gardner’s *multiple intelligences*, which are defined as societally valued capacities for problem solving and creative action (1999), in order to illustrate how these respective examples map onto each other. It should be noted, however, that despite the (suggested)

² The authors recognizes the multiple—and often conflicting—definitions of the term “(school) readiness”. In this paper, the term school readiness is used to refer to the teachers’ assessment of their Kindergarten class children’s developmental status in five different domains. For a current review of theoretical and empirical approaches to school readiness the reader is directed to Pianta et al. (2007). With regard to the EDI, Janus and Offord (2007) explicitly differentiate school readiness from readiness (to learn from birth), and consider school readiness to consist of a set of competences that will allow children to benefit from educational activities offered in the school environment (Janus and Offord 2000). In this paper, the term *school readiness* is consistently used.

Table 1 Developmental domains of school readiness

Doherty (1997): school readiness domains ^a	Gardner (1999): multiple intelligences	National household education survey (1995): teacher and parent perceptions ^c of school readiness
Cognition and general knowledge	Logical-mathematic (Spatial)	Can count to 20 or more ^P Able to use pencils or paint brushes ^P
Language use	Linguistic	Knows letters of the alphabet ^P
Social knowledge and competence ^b	Interpersonal	Takes turns and shares ^{T/P} ; Can follow directions ^T ; Is not disruptive of the class ^T ; Is sensitive to other children's feelings ^T ; Communicates needs, wants, and thoughts verbally (in child's primary language) ^{T/P}
Emotional health and a positive approach to new experiences ^c	Intrapersonal	Sits still and pays attention ^P Enthusiastic and curious in approaching new activities ^{T/P}
Physical well-being and motor development	Bodily-kinesthetic (Spatial, Musical) ^d	Physically healthy, rested, and well-nourished ^T

^a Research in this area has frequently endorsed the view that either the cognitive domain or the social-emotional domain is the primary domain of school readiness and, accordingly, a recent meta-analysis (La Paro and Pianta, 2000) solely distinguishes between these two broad domains

^{b,c} The National Education Goals Panel's (1995) categorization of school readiness domains is equivalent, except that it labeled these two domains as 'Social and emotional development' and 'Approaches to learning (motivation; independence, etc.)', respectively

^d In later versions of the theory, Gardner included naturalist, spiritual, existential, and moral intelligences

^e Characteristics of school readiness considered important by more than 50% of teachers (indicated by ^T) and parents (indicated by ^P) (from Lewit and Schuurmann Baker, 1995)

scholarly consensus, common preschool practices and school readiness tests do not always reflect the entire range of components suggested by this consensus.

2. In what ways do biological maturation (nature) and experiences (nurture) jointly affect school readiness?, and
3. To what extent is school readiness an individual child characteristic, a group characteristic (e.g., individual scores aggregated to the school or neighborhood level) or an (interdependent) combination of both (i.e., a characteristic of an ecology)?

These two questions are intricately related, and an overview of different approaches to these questions is illustrated in Fig. 2.

Figure 2 depicts how biology, education, sociology, and sociobiology, and sub-disciplines of psychology have (traditionally) focused on individual or group characteristics (vertical axis), and biological or environmental factors (horizontal axis) with respect to examining human behavior and development. These foci are reflected in theories of development and learning that grew out of different disciplinary traditions. Likewise, the different foci can be found in views of school readiness that are associated with these child development and learning theories. Maturationist views (e.g., Gesell) emphasize the importance of biological maturation for school readiness. Empiricist and behaviorist views, on the other hand, emphasize the need for children to learn specific skills before school entry. Constructivist views (e.g., Piaget) stress that learning experiences need to be developmentally appropriate, in that they fall within the biologically delimited capacities

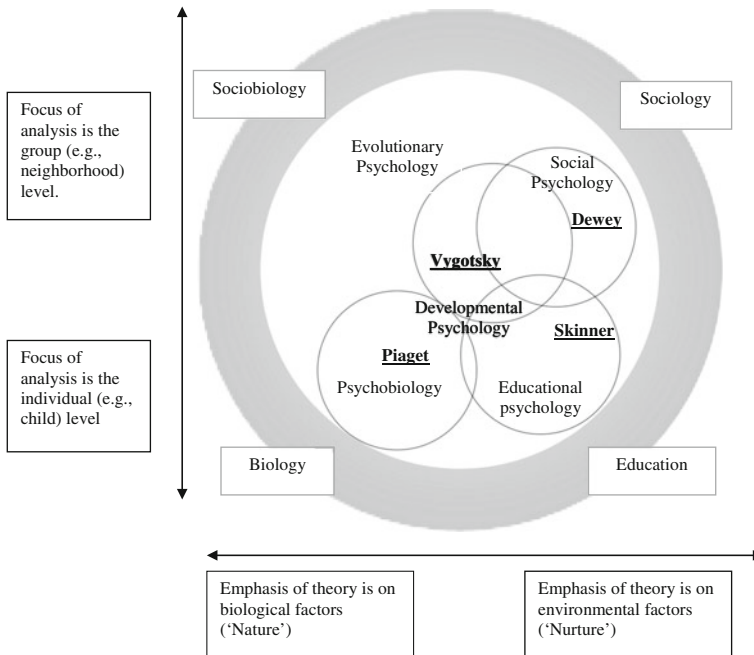


Fig. 2 Disciplinary foci in human development research

of the child. Social constructivist views highlight the role of the social context; for example, Vygotsky's concept of the *zone of proximal development* (1936/1978) refers to the difference between a child's current developmental status and the potential that can be reached under guidance by others (e.g., teachers, peers). Attachment theory underlines the primacy of emotional relationships for children's development and learning (e.g., Watson and Ecken 2003). Finally, some sociological theories of development and learning (e.g., Dewey's transactional view) emphasize the notion that development is not only affected by the social, cultural context, but cannot even be interpreted without it. Accordingly, some conceive of school readiness as a construct that characterizes entire ecologies (e.g., a community, including its families, children, and child education and care institutions), rather than exclusively individual children (e.g., Piotrkowski 2004; Kagan and Rigby 2003).³ As discussed below, Bronfenbrenner's bioecological theory defines an intellectual space that allows one to view these different theories as mutually informative and complementary.

4. Can school readiness be defined in terms of objective, absolute criteria (i.e., observable, measurable norms; standardized references), or is school readiness a subjective and/or relative concept (i.e., person-, context-, and time-dependent)?

Most current conceptions of school readiness contain a blend of both the objective, absolute and the subjective, relative approaches, with implications for the assessment of school readiness. For example, certain cognitive competences, such as knowledge of basic

³ Cf. Meisels (1999) for this categorization of school readiness theories.

numbers and vocabulary, and skills such as holding a crayon represent fairly objective, absolute criteria. Not surprisingly, such items feature prominently in widely used school readiness tests (e.g., *School Readiness Test*, Anderhalter and Perney 2004), as they are relatively easy to obtain. On the other hand, social, emotional, or communicative competences, such as getting along with peers, being interested and motivated to learn, and being able to communicate needs are inherently context-dependent (i.e., teacher- and peer-dependent), and thus subjective and relative by nature. This latter point has prompted some authors to argue against standardized school readiness tests, and in favor of so-called authentic assessment. Authentic assessment refers to a practice that occurs over time, is embedded within the student–teacher relationship, and is solely to be performed if it evidently supports the learning and development of the child (see Graue 1995).

From a theoretical perspective, this discussion is of interest insofar as it affects to what extent specific domains of school readiness are considered relatively independent from or highly dependent of contextual factors. From a measurement perspective, this is even more important, as it raises not only the question of how subjective, relative aspects of school readiness can be assessed, but also of whether or how such assessments can be compared across context.

5. Is school readiness conceived of as an outcome of early development, a predictor of school achievement and other developmental outcomes, or primarily a key transition within a child's developmental trajectory from a life-span perspective?

Examples for all of these conceptions of school readiness exist. Retrospective and/or longitudinal approaches are often used in evaluations of school readiness interventions, preschool curricula, or childcare programs (e.g., Zigler and Valentine 1979). A snapshot approach is commonly taken in diagnostic assessments that are intended to inform parents, teachers, or counselors about the current status of a child, so that they can plan and/or adjust their parenting, teaching, and counseling accordingly. A predictive approach has been a focus of psychological research examining the predictive validity of school readiness assessments with regard to later academic achievement (see meta-analyses by Duncan et al. 2007; La Paro and Pianta 2000).

A classic longitudinal study that examined human development is the High/Scope Perry Preschool study (Schweinhart et al. 1993), in which children have been followed from the early years into adulthood (age 3–41). In that study, the construct of school readiness has informed the measurement of one aspect of children's developmental trajectories. Longitudinal studies may also occur at an ecological level, meaning that ecological units (e.g., neighborhoods, countries), rather than individuals are tracked. For example, the OECD Programme for International Student Assessment (PISA; <http://www.pisa.oecd.org>) assesses school achievement of consecutive cohorts of 15-years olds, and the Progress in International Reading and Literacy Study (PIRLS; timss.bc.edu/pirls2001.html) assesses reading competencies in consecutive cohorts of Grade 4 students to allow for (national and international) comparisons over time. The two approaches are combined in panel studies, such as the NLSCY (Statistics Canada 2007), which tracks the development of consecutive cohorts of children from the early years through adulthood. This combined approach allows one to study whether diverse (historical or cultural) contexts are systematically related to differences in developmental trajectories between cohorts.

The panel study approach lies at the core of the *life course paradigm* (Elder 1974, 1994) or *life span* approach to studying human development (e.g., Baltes et al. 1980), and Bronfenbrenner (1988) integrated this approach into the bioecological theory, within his conceptualization of the *chronosystem*. The chronosystem will be defined in the section

that reviews Bronfenbrenner's bioecological theory (below), and it will then be discussed how the chronosystem paradigm allows one to situate the EDI with respect to developmental time.

5 Linking School Readiness Measures to Theory and Purposes

Education is an inherently practical and purposeful endeavor. Therefore, school readiness theory, educational practices, and their purposes cannot be viewed independently. Likewise, measurement practices cannot be perceived separately from educational practices and purposes (cf. Schrag et al. 2004). This argument implies that, ideally, (1) theoretical conceptions of school readiness should be explicitly linked to measurement practices of school readiness (in the case that any measurement is conducted), (2) school readiness theories and measurement practices should go hand in hand with clearly explicated educational purposes, and (3) school readiness theories, measurement practices, and educational purposes should be useful for jointly informing educational practices within a given context. In fact, this view is in line with Messick's view on validity, according to which theoretical assumptions, measurement practices, and measurement purposes should accord with practical and social implications and consequences (1995, 1998).

As stated earlier, one purpose of the EDI is, in combination with other child-level and neighborhood-level data, to provide communities with knowledge that can inform families, practitioners, educators, researchers, and policy makers with respect to (a) the current state of child development within their jurisdictions and (b) to stimulate discussion on policies, programs, and practices, which may further support children's and families' wellbeing (Janus et al. 2007; Janus and Offord 2000, 2007; Nosbush 2006). The question now is how this purpose of the EDI is related to the conceptual and theoretical underpinnings and the measurement approach of the EDI. In this regard, one issue that deserves particular attention is the fact that EDI ratings are exclusively to be communicated and interpreted at aggregate levels (e.g., the neighborhood level), and cannot be used to diagnose or place individual children. In this way, the EDI shifts the focus from the individual child to a community or a population of children (Janus et al. 2007), so that school readiness may actually be perceived as a group characteristic. In other words, rather than asking, 'In what ways is *this child* ready to benefit from the educational activities offered in the school environment?', the EDI addresses the question, 'In what ways are the children *in this neighborhood/population* ready to benefit from the educational activities offered in the school environment?'. Two inferential questions that grow out of the previous question are, 'In what ways does *this neighborhood/population* support its children in a way that they are ready to benefit from the educational activities offered in the school environment?', and 'In what ways should schools in *this neighborhood/population* interact with the children so that they benefit from the educational activities offered in the school environment?'

With the EDI's population-level approach to measuring children's developmental outcomes, the developers of the EDI (Janus and Offord 2000, 2007) intended to capture a conceptualization of school readiness that is informed by writings that view child development from an ecological perspective (e.g., Love et al. 1994), and which draw from theories that have their roots in social and developmental psychology and (urban) sociology.⁴ An ecological perspective has been at the core of *community psychology* (Dalton

⁴ With respect to Fig. 2, this perspective would be placed in the upper right quadrant—(emphasizing group characteristics and the role of experiences on development)—whereas traditionally widely employed school

et al. 2007); has, over the past decades, led to the emergence of the so-called *neighborhood effects literature* (Jencks and Mayer 1990; Sampson et al. 2002); and has increasingly permeated the field of population health (Heymann et al. 2006). Given the ecological perspective's influence on the conceptualization of the EDI, the most relevant tenets of its underlying theories are reviewed in the following section.

6 Neighborhood Effects and Sociological Views on Child Development

The neighborhood effects literature is rooted in the assumption that the neighborhood is a meaningful ecological entity, and that the social processes and mechanisms at this level can significantly influence human development and behavior, in addition to and in interaction with the processes and mechanisms that occur at other ecological levels. This notion is prominent in theories that are associated with the Chicago School (or Ecological School) of Sociology⁵ (Sampson et al. 2002), which is primarily concerned with explanations of “*how neighborhoods bring about change in a given phenomenon of interest*” (p. 447). Sampson et al. (2002) have categorized the social processes and mechanisms that are assumed to underlie neighborhood effects on development into four classes. The first class, *social ties and interactions*, refers to the strength, frequency, and density of social relationships within neighborhoods. The second, *norms and collective efficacy*, pertains to the degree to which neighbors share expectations and trust, and act upon them for a common, public good. The third, *institutional resources*, captures the quality and quantity of institutionally provided services that address community needs. The fourth, *routine activities*, encompasses (social) activities that are patterned according to land use, such as transportation, shopping, and recreation. Empirical evidence supporting this classification exists (e.g., Sampson et al. 1997), but is sparse, mainly due to methodological challenges and logistical infeasibility of data collection. Thus, major challenges in understanding *how* the theoretically proposed social processes and mechanism at the neighborhood level affect development remain (Sampson et al. 2002; Jencks and Mayer 1990).

A branch of the neighborhood effects literature that has produced a vast amount of empirical data evolved from the research on *social capital* (e.g., Bourdieu 1985; Coleman 1988; Putnam 2000). Social capital, generally speaking, refers to the capacity of social networks to produce tangible (e.g., material resources) and intangible (e.g., social support) benefits for the members of the networks. Empirically, social capital has been found to be related to a number of constructs, such as school outcomes, socioeconomic status, and health. However, due to the inconsistent operationalization of the term (for a review, see Sampson et al. 1999), questions as to how the processes and mechanisms related to social capital actually work remain a matter of debate. In fact, a theoretically problematic phenomenon is that ‘social capital’ in some contexts is correlated to arguably negative developmental outcomes (e.g., internalizing problems; see Caughy et al. 2003), whereas it is typically perceived as a generally beneficial resource, at least for those inside the social network (Putnam 2000).

Footnote 4 continued

readiness tests would have to be placed in the lower left quadrant—(emphasizing individual characteristics and the developmental primacy of genetics and maturation).

⁵ The (University of) Chicago School is typically associated with ‘sociology’, but it needs to be noted that several of its influential scholars, like Dewey, Mead, and Blumer, came from backgrounds of philosophy and education, (social) psychology, and sociology, respectively.

The construct that has received the most attention in the neighborhood effects literature is *socioeconomic status* (typically defined as a composite of education, income, and employment status) or *poverty*. Low socioeconomic status or poverty have almost universally detrimental effects on children's development (Berliner 2005; Brooks-Gunn et al. 1993; Jencks and Mayer 1990; Wilson 1987). However, it remains unclear to what extent and via which processes poverty at the neighborhood level—after taking into account poverty at the individual (family) level—exerts its influence on child development.⁶ In fact, in 1990, Jencks and Mayer had concluded that most neighborhood effect studies have employed a *black box model* as far as *processes* at the neighborhood level are concerned. And even though it has been shown that constructs such as “informal social control, trust, institutional resources and routines, peer-group delinquency, and perceived disorder” are related to socioeconomic status and to developmental outcomes in “theoretically meaningful ways” (Sampson et al. 2002, p. 473), it remains to be seen what processes and causal relationships underlie these constructs, and how, in turn, these processes and relationships are related to developmental outcomes.

An additional challenge is that neighborhood studies are highly complex methodologically, which has to do with the fact that neighborhood-level characteristics, such as social capital or neighborhood poverty, are defined as group-level constructs. Group-level constructs can be measured in numerous ways. Some constructs are measured at an individual level, and then aggregated. For socioeconomic status, for example, this can, depending on the type of aggregation, lead to quite different results (e.g., mean income vs. Gini coefficient⁷ vs. poverty percentage rate), with important implications for the interpretation of the aggregate measures. Alternatively, some constructs are measured at the group level. Social capital, for example, is not the sum or average of individuals' social capitals, but the quantity and quality of connections between people within the group. A question thus becomes how one should define these groups; an issue that is associated with further methodological challenges.

First, there are theoretical considerations for choosing specific groupings and measurement problems related to it (e.g., exclusive vs. overlapping groups; socially or geographically defined groups; sampling issues).⁸ Then, there are challenges in analyzing and interpreting group data. These challenges apply whether group-level data (e.g., neighborhood poverty) are analyzed independently or in combination with individual-level data (e.g., family poverty). At the group level, two common sources of error have been referred to as the *modifiable areal unit problem* and the *ecological fallacy*. The modifiable areal unit problem designates the phenomenon that the way in which data are aggregated into groups (units) can lead to drastically different statistical outcomes at the group (unit) level (Taylor et al. 2003). The ecological fallacy refers to an interpretational error, namely that of incorrectly inferring relationships at an individual level from ecological (i.e., group-level) correlations (Piantadosi et al. 1988).

⁶ It is well-understood, however, how poverty at the individual and family level goes hand in hand with developmentally detrimental processes, such as poor nutrition, enduring stress, exposure to toxic environments, and lack of developmentally positive experiences and opportunities (Berliner 2005).

⁷ The Gini coefficient is a statistical index used to describe the distribution of income in a population, where 0 means absolute equality of income (i.e., everyone has the same) and 1 means absolute inequality (i.e., one person has everything). A definition and world map showing each country's Gini coefficient can be found at en.wikipedia.org/wiki/Gini_coefficient.

⁸ See Raudenbush and Sampson (1999) for a discussion of methodological and conceptual issues pertaining to the assessment of ecological settings.

When group-level data are analyzed together with individual-level data, multilevel statistical procedures that account for the *nested* structure of the data (Raudenbush and Bryk 2002) allow one to simultaneously account for variance at the individual level (within group) and the group level (between group). However, even though multilevel models allow one to avoid the ecological fallacy (or, its reverse counterpart, the *atomistic fallacy*), they do not solve the modifiable areal unit problem. In other words, the decision of how to devise groups (e.g., geographically defined neighborhoods vs. socially defined neighborhoods; small vs. large groups) and their meaningfulness and interpretability remain conceptual and theoretical challenges. With regard to examining school readiness in the neighborhood context, it is thus necessary to define neighborhoods in terms of the neighborhoods' hypothesized effect on child development, and to address potential effects of the statistical and conceptual challenges when interpreting school readiness data in a multilevel (e.g., individual, family, and neighborhood) context. (Forer and Zumbo (2011) elaborate theoretically on school readiness as a multilevel construct, and refer to the EDI project for illustrative examples.)

At this point, critical questions arise as to how concepts relevant to an ecological study of school readiness, from the diverse strands of child development, education, psychology, and sociology and the neighborhood effects literature, can be integrated into a coherent framework, and how such an integrated framework might contribute to a better understanding of the processes that are (causally) related to neighborhood effects. Previous scholarly work in this area has repeatedly referred to Bronfenbrenner's bioecological theory of development (e.g., Brooks-Gunn et al. 1993; Rimm-Kaufman and Pianta 2000). Nonetheless, a number of the theory's propositions that have the potential to critically advance the field (still) seem to be underused (cf. Bronfenbrenner and Morris 2006), and for this reason we review them here.

7 The Bioecological Theory of Human Development

Urie Bronfenbrenner, one of the intellectual fathers of the US's federal compensatory preschool program *Head Start*, is primarily recognized for his *bioecological theory of human development* (or *bioecological model*; 1979, 2005; Bronfenbrenner and Morris 2006). Central to the bioecological theory is its objective to contribute to producing knowledge that is applicable for the benefit of children, for example, by informing social policies and programs. Due to the complexity of human development and of translating knowledge into practice, Bronfenbrenner provides explicit recommendations for how this objective may most effectively be accomplished.

First of all, Bronfenbrenner urges human development researchers to acknowledge the primary importance of examining *proximal processes*, which he considered the "primary engines of development" (Bronfenbrenner and Morris 2006, p. 798), and which are defined as "processes of progressively more complex reciprocal interaction between an active, evolving bio-psychological organism and the persons, objects, and symbols in its immediate external environment" (p. 797). Second, Bronfenbrenner claims that "in human development, the main effects are likely to be found in the interactions" and urges that the "interactions to be examined be theory based"⁹ (p. 802). Third, Bronfenbrenner proposes

⁹ It is noteworthy that the term interaction is used in different meaning in these two propositions. In the first, it is used to refer to processes occurring between the developing person and its environment. In the second, it refers to the concept of interactions as used in the field of statistics, where interactions refer to situations in

that human development research should (more often) employ a process-person-context-time model. This means that a research study should (1) simultaneously examine those proximal *processes*, *person* characteristics, *context* characteristics, and characteristics pertaining to *time* (e.g., historical time; the timing and/or sequence of critical events in a person's life) that are considered relevant for a specific developmental outcome, and should (2) implement research designs and statistical analyses that allow one to examine and detect the theoretically relevant (statistical) interactions between those multiple factors.

Bronfenbrenner acknowledges that a process-person-context-time model is a very ambitious model to realize in research, and that, accordingly, not many studies will be in a position to examine all the interactions between the different model components that are of theoretical interest (1988/2005, p. 90). At the same time, Bronfenbrenner criticized that previous studies often failed to examine interactions that are of theoretical import, even in cases where the research design and data would have allowed the researchers to do so (Bronfenbrenner and Morris 2006, p. 799ff.).

Even though Bronfenbrenner makes a conceptual distinction between developmental outcomes, person characteristics, context characteristics, process variables, and time variables, these components need to be understood within an interactional, holistic ecological system. This notion of interdependence is reflected in the concept of the four *nested systems*. Therein, the *microsystem* refers to all processes, or "activities, roles, and interpersonal relations experienced by the developing person" (p. 148) that take place within a person's immediate environment (e.g., in the home, at school). The *mesosystem* refers to the "linkages and processes taking place between two or more settings containing the developing person" (p. 148; e.g., the processes occurring between home and school). The *exosystem* "encompasses the linkages and processes taking place between two or more settings, at least one of which does *not* ordinarily contain the developing person, but in which events occur that influence processes within the immediate setting that does contain that person" (p. 148; e.g., processes taking place between a child's home and a parent's workplace). The *macrosystem* "consists of the overarching pattern of micro-, meso-, and exosystems characteristic of a given culture, subculture, or other broader social context [...]" (p. 149). In addition, Bronfenbrenner defined the *chronosystem* in reference to a life-span perspective on development, stating that developmental effects of proximal processes may critically depend on *when* and *in which order* they happen in a person's life, as well as on when they happen within the historical context.

Two things are critical about the nested systems view. First, developmentally relevant processes at different ecological levels do not solely have additive effects on development, but potentially also multiplicative (i.e., interactive, moderating, mediating) effects.¹⁰ Second, developmental outcomes are not to be understood in terms of a process-person-context-time model that exclusively operates within one system. Rather, developmental outcomes result from the interactions of process-person-context-time variables within and across each of the systems. The complexity of conceptualizing and methodologically

Footnote 9 continued

which the effects of one (or more) factor(s) are moderated (i.e., amplified, attenuated, or reversed) by one (or more) other factor(s) with regard to an outcome.

¹⁰ This point is stressed, because research using multiple regression and multi-level analyses often fails to examine interactions, potentially because researchers assume that partitioning variance among multiple main effects is, in effect, accounting for 'interactions' between those variables. However, interaction terms must, of course, be statistically modeled by producing multiplicative interaction terms and by including them in the regression equations in addition to the main effect variables (cf. Cohen et al. 2003).

realizing an examination of the interactions within and between systems grows exponentially with each variable that is added to a study. Therefore, Bronfenbrenner argues it is all the more important that developmental science is explicitly theory-based (Bronfenbrenner and Morris 2006).

8 The EDI from a Bronfenbrennerian Perspective¹¹

In this section, the five questions about the school readiness construct discussed above are now revisited from a Bronfenbrennerian perspective.

1. What developmental domains are facets of school readiness?

As was shown in Table 1, the school readiness-related literature suggests a number of developmental domains (Doherty 1997; Love et al. 1994) or skills (Lewit and Schuurmann Baker 1995), which are considered to be critical for doing well in school, an approach that is also taken by the EDI. Gardner's theory of multiple intelligences (1999), which was juxtaposed with the school readiness theories, similarly proposes a range of capacities that are considered essential for doing well in societally valued endeavors, such as becoming a teacher, athlete, scientist, writer, craftsperson, or musician.

The phrase 'societally valued' is of particular relevance. As Bronfenbrenner (1992) notes, conceptions of (cognitive) capacities have frequently been assumed to be "invariant across place and time"; an assumption that characterizes a "wide range of measures" and assessments (p. 121). According to a number of cross-cultural studies, this assumption does not, however, always hold. Rather, many capacities are highly context-dependent, leading Bronfenbrenner to conclude that "the context, in which [a capacity] takes place is not simply an adjunct to the capacity, but a constituent of it" (p. 127).

A further point illustrates why this differentiation is important. In Bronfenbrenner's (1988) definition of what constitutes a developmental outcome, he differentiates between development (as a process), developmental outcomes (patterns of mental organization resulting from development), and behaviors (as indications of developmental outcomes). Further, he operationalizes development by means of an equation, in which a given developmental outcome is the sum of the main effects and interaction effects of developmentally relevant process, person, context, and time characteristics. This has important implications for the EDI project. First, in order for the EDI to accomplish its purpose to provide communities with applicable knowledge on human development, it can only do so in combination with information on developmentally relevant context and process characteristics. Second, the developmental domains reflect, at least to some degree, societal and cultural values and expectations—after all, competences in the five developmental domains of the EDI are considered necessary in order to benefit from the experiences offered in school, which is an institution rooted in social and cultural norms (cf., Janus et al. 2007; Janus and Offord 2000; Nosbush 2006). Accordingly, the domains of the EDI need to be viewed as an attempt to capture domains that are deemed—according to the current school readiness literature—relatively representative of current social and cultural norms (cf., Doherty 1997; Duncan et al. 2007; La Paro and Pianta 2000; Meisels 1999; National

¹¹ Rimm-Kaufman and Pianta (2000) have presented an 'ecological perspective on the transition to Kindergarten', in which they use Bronfenbrenner's theory as a framework for guiding empirical research. Their approach primarily focuses on other aspects than the approach presented here, but there are several interesting parallels as well as complementary ideas between their paper and this paper.

Education Goals Panel 1995; Rimm-Kaufman and Pianta 2000). Also, it needs to be kept in mind that social and cultural norms may or may not be representative for all groups or communities within a society, and may differ considerably from one cultural or social context to the next (Graue 1995).

2. In what ways do biological maturation (nature) and experiences (nurture) jointly affect school readiness?
3. To what extent is school readiness (1) an individual (child) characteristic, (2) a group (e.g., aggregated school or neighborhood) characteristic, or (3) an (interdependent) combination of both (i.e., a characteristic of an ecology)?

These two questions were reviewed jointly above, primarily by means of Fig. 2. That figure showed how different disciplines emphasized different factors with respect to human development and behavior, along the continua of personal versus contextual, individual versus group, and biological versus environmental factors. At times, the different disciplinary approaches have been pitted against each other, but the bioecological theory claims that the different disciplinary perspectives cannot be scientifically valid on their own, but need to be coherently integrated. This notion is illustrated in Fig. 3, a revised version of Fig. 2.

In regard to the EDI, the significance of the notion illustrated in Fig. 3 needs to be explicated, because it might, at first glance, not seem like an innovation. However, Bronfenbrenner repeatedly describes the lack of a rigorous connection between an integrative, interdisciplinary theoretical framework and the realities of educational practice and policy making. Bronfenbrenner argues (1974) that this lack of rigor derives from a lack of appreciation of researchers for policies and policy making, which is reflected in a

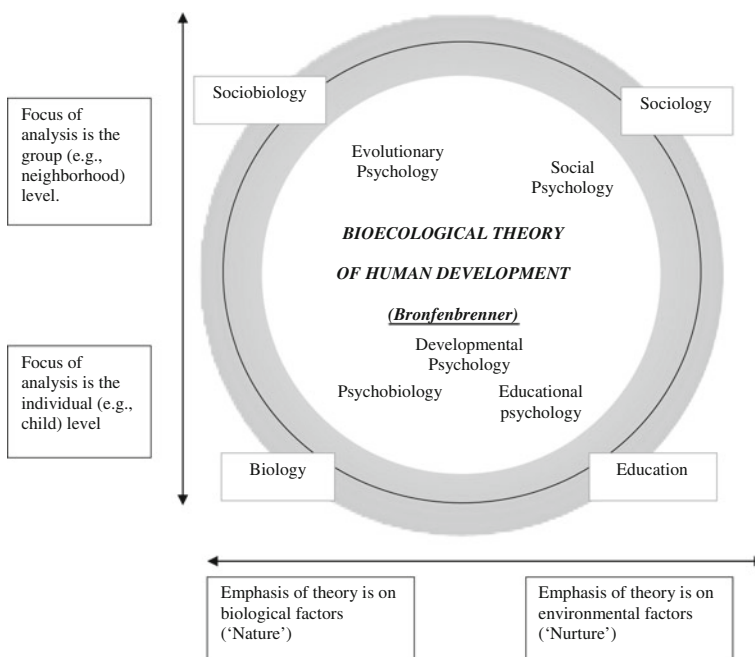


Fig. 3 Illustration of the bioecological theory of human development as integrative framework

wide-spread belief that research should inform policies—rather than the other way around. Similarly, even though Bronfenbrenner acknowledges that nothing is as practical as a good theory, he also notes that a descriptive understanding of human development does not translate into an understanding of how such understanding can be used to bring about changes that affect human development. A careful adherence to an integrative theoretical framework is thus not only necessary to safeguard against drawing invalid conclusions and inferences from research, but it is also important in terms of guiding the pursuit of an understanding of the mutual influences and connections between research, knowledge, policies, policy making, and practice (cf. Shonkoff 2000).

4. Can school readiness be defined in terms of objective, absolute criteria, or is school readiness a subjective and relative concept?
5. Should school readiness be perceived as the outcome of early development, or the starting point (i.e., predictor) of later school achievement and other developmental outcomes, or primarily a key transition within a child's developmental trajectory from a life-span perspective?

Bronfenbrenner argues that (1) human development can only be understood with respect to the interactions of process, person, context, and time characteristics, and that (2) researchers should attempt to identify principled patterns, which can be objectively described and embedded within a cogent theoretical framework. The critical point is that the latter needs to be done within an ecology in its entirety. In other words, the relationship between a developmental outcome and a person characteristic is relative with regard to a particular ecology's developmentally relevant process, context, and time characteristics. However, once the developmentally relevant characteristics of the process-person-context-time model are taken into account, a specific ecology can be described in theoretically predictable, patterned terms. With regard to the EDI, the implications are illustrated in Fig. 4, which represents an integration of the nomological networks presented in Fig. 1. (The dashed arrows aim to graphically convey (examples of) interactions.)

Evidently, the two integrative figures (Figs. 3 and 4) are a reiteration of Bronfenbrenner's propositions, applied to the EDI context. They emphasize the interactive, ecological nature of human development, the integration of empirical and theoretical strands, and they highlight the essential importance of the interactions between the numerous factors that jointly shape human development over time.

The figures also suggest the necessity for analytical approaches that allow one to systematically examine differences between ecologies that differ in one or more characteristics. Along these lines, Bronfenbrenner has recommended employing multi-group structural equation models (cf. Bronfenbrenner 1988/2005, p. 85), as they allow one to compare differences in path coefficients between several groups or ecologies of interest. With increasing advances in analytical tools for this purpose (e.g., multi-level/group mixture modeling; see Asparouhov and Muthen 2006), such analyses can now be conducted with a degree of sophistication that was previously limited by a lack of software availability and computational capacity.

9 Recommendations for Validation Research for the EDI Project

To this point, this paper has emphasized that proximal processes are key factors in shaping human development. Apart from reviewing neighborhood-level processes that affect children's development (see above), however, our discussion has not yet addressed the

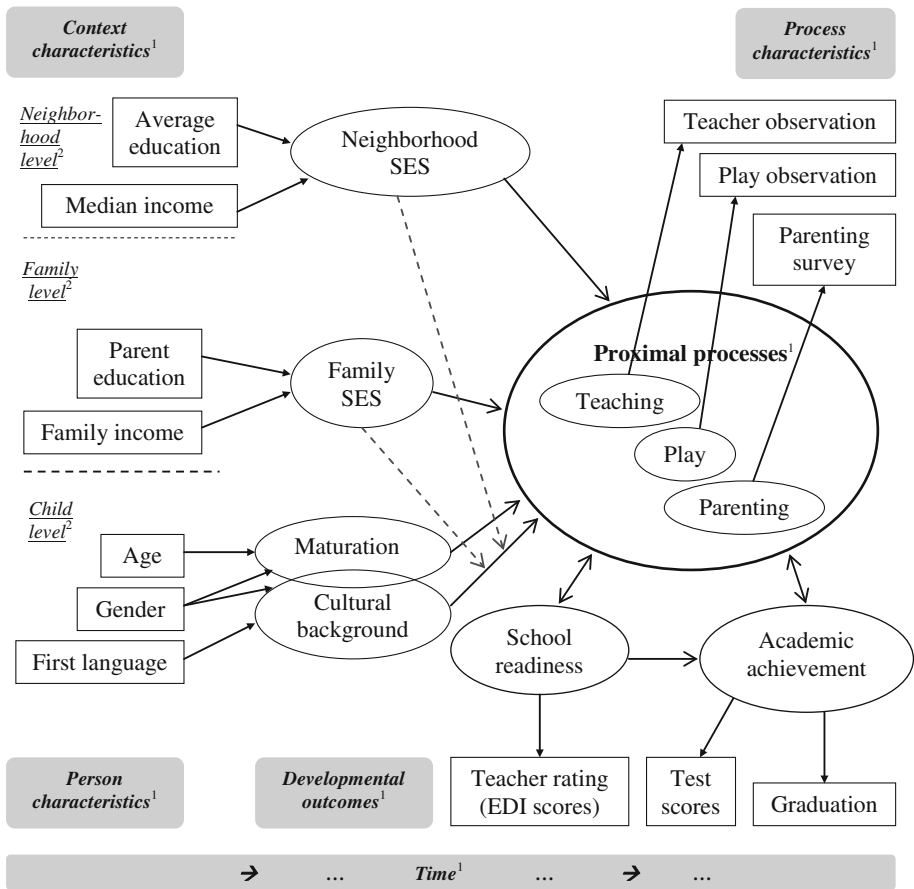


Fig. 4 A Bronfenbrennerian nomological network for human development. It must be noted that the nomological network in its entirety is primarily of theoretical and conceptual relevance to the EDI project, rather than actual data analyses, as data on children’s family-level SES or on proximal processes are not available at a population level. ¹For definitions, please refer to the description of the bioecological theory of human development and the process-person-context-time model. ²Level of measurement at which the data are obtained

actual nature of proximal processes that have previously been found to be related to developmental outcomes. Also, previous theoretical papers on the EDI have not elaborated this point. In order to address this gap, we seek to integrate the framework of developmentally appropriate practice (Bredekamp 1986; NAEYC 1996) into our theoretical discussion, with the goal to deduce specific validation research recommendations for the EDI project from it. Developmentally appropriate practice (DAP) refers to a set of principles that aim to guide practices in early childhood education, parenting, and childcare settings. The concept of DAP is of particular interest, (1) because its theoretical foundations are congruent with Bronfenbrenner’s theory, (2) because its principles are rooted in further prominent child development theories (e.g., by Piaget, and Vygotsky), (3) because it is widely (though not unanimously) endorsed by child development researchers, practitioners, and administrative organizations in Canada (e.g., Cohen et al. 2005) and the US (e.g., NAEYC 1996), and (5) because DAP delineates in concrete terms the possible

manifestations of the process*person*context*time = developmental outcome equation that is the most difficult to capture: developmentally relevant proximal processes that directly foster children's development. Furthermore, the validity of the DAP recommendations have been corroborated by empirical evidence¹²: For example, both child-initiated and adult-guided play have been found to be related to desirable outcomes such as increased conceptual understanding and social competences in children (NAEYC 1996). The EDI project might significantly benefit from collecting data on proximal processes—e.g., via observations and surveys on child-parent interactions, children's play, and teacher-child interactions—that are theoretically related to the school readiness concept underlying the EDI, as the lack of data on proximal processes remains the most important missing piece in the process-person-context-time research model. Despite the involved logistic and methodological challenges—the observation and survey data, ideally, are linked to EDI and other data at an individual child-level—such a research design would be the most powerful with respect to “yielding new, more differentiated, more precise”, and “more valid scientific knowledge” on human development (p. 4, Bronfenbrenner 2001). As noted earlier, collecting detailed, reliable data of proximal processes for entire populations of children may be unfeasible. Therefore, we recommend devising research designs that incorporate appropriate sampling techniques and replications in order to integrate proximal process data into the population-level approach of the EDI project (cf. Kershaw et al. 2009). What is critical is that the proximal process data would need to be linked to the indicators of developmental outcomes (e.g., from the EDI, from health records, and from school achievement data) at an individual level, in order to study to what extent variations in the proximal process are related to variations in developmental outcomes. (Of course, interpretations and disseminations of findings would still have to remain at an aggregated level.) Then, by comparing samples from different contexts, cohorts, and/or subgroups of the child population, it could be studied to what extent certain relationships between proximal processes and developmental outcomes can or cannot be generalized across contexts and across children with different individual characteristics. With respect to selecting methods for measuring different types of proximal processes, this approach could be informed by large-scale data collection initiatives, such as the National Institute of Child Health and Development's (NICHD) Study of Early Child Care and Youth Development (SECCYD; <http://www.nichd.nih.gov>) or the Early Childhood Longitudinal Study (ECLS; e.g., Hair et al. 2006; nces.ed.gov/ecls/). (These studies could also inform the selection of additional measures of children's developmental outcomes.) It needs to be reiterated that even though the selection of measurement tools for proximal processes is subject to practical considerations (e.g., availability, cost), the selection needs to be driven primarily by theoretical considerations, in order to allow for examinations of a priori theoretically hypothesized interactive effects of process-, person-, context-, and time factors on children's developmental outcomes. In other words, the goal of examining developmentally relevant interactions between these factors is clearly not (just) an analytical issue, but most and foremost a research design and data collection issue.

A second recommendation addresses the question of whether the practical, social consequences of the EDI measurements are in line with the purposes of the EDI—as mentioned, this issue is essential for a test's validity, as defined by Messick (1995, 1998).

¹² While DAP has gained much currency in both the theory and practice of early childhood programs, it has not been universally embraced. Some scholars have critiqued DAP as relying too much on universal notions of child development and the imposition of western ideas of child development on minority groups and on non-western societies. For a discussion, readers are referred to Kessler and Swadener (1992).

In order to address this issue, we recommend to explicitly acknowledge and integrate consequences related to the EDI—such as the dissemination of EDI research findings; the discussion of EDI findings among community groups; the process of having teachers rate Kindergarten children every year—into a comprehensive validation research design. This would allow one to examine whether EDI project-related consequences affect children’s development in (intended) positive or (unintended) negative ways—an aspect of EDI-related research that is still in its beginning.

The third recommendation pertains to the notion that the EDI domains reflect culturally and societally valued norms and expectations. We recommend that future validation research examine the heterogeneity of school readiness expectations and norms in our society. In a US context, Graue (1995) found that there were substantial differences in school readiness expectations and norms from one community to the next, and that these differences were associated with the differences in socioeconomic as well as ethno-cultural background of the community members. As the Canadian society is characterized by a high degree of ethno-cultural diversity, there might also exist diversity of school readiness norms and expectations, and such differences in norms and expectations may, in fact, even be reflected in different developmental profiles of different subgroups of children. More importantly, however, this would have important implications for the interpretation of EDI results as well as for practices in families, schools, and communities. That is, in the presence of significant heterogeneity of school readiness norms and expectations, communities and schools would need to negotiate, plan, and adjust their respective practices and policies accordingly.

A fourth recommendation refers to the developmental significance of processes occurring within different ecological units (e.g., neighborhoods, schools). As was discussed, the theoretical challenges of defining ecological units that are meaningful for children’s development and the methodological challenges of analyzing the developmental effects of ecological units on development are intricately intertwined and complex. As a result, analyses in this area are prone to spurious as well as contradictory findings. Therefore, a situation similar to that of the social capital literature—i.e., the existence of a large amount of empirical findings that are theoretically inconclusive—may arise unless such research is rigorously guided by a coherent theoretical and methodological framework, as proposed here. We therefore recommend informing research designs and data collection efforts by the theoretical work from the urban sociology literature. More specifically, we recommend to collect and integrate data on the four neighborhood mechanisms that are assumed to be causally related to developmental outcomes: (1) social ties and interactions; (2) norms and collective efficacy, (3) institutional resources, and (4) routine activities (Sampson et al. 1997, 2002). In addition, we recommend to test the generalizability of findings associated with these neighborhood mechanisms by testing to what extent their relationship with developmental outcomes differ across contexts. This can be done, for example, via geographically weighted regression techniques, that test whether relationships vary across different geographical locations (Brunsdon et al. 2003).

A fifth recommendation speaks to the issue of school readiness as a partly objective, absolute as well as a partly subjective, relative construct, and to the comparability or equivalence of EDI ratings across different contexts. On the EDI, items pertaining to different aspects of development outcomes may be affected by the measurement method—the fact that the EDI is done via teacher ratings—in different ways. For example, whether a child can write her or his own name can be assumed to be an item that is relatively unaffected by the fact that teachers rate this ability. However, an item asking whether a child is respectful towards other children or adults is highly dependent on the interaction

between the teacher and the child as well as by the expectations, values, and interpretations of teachers. When comparing school readiness ratings across contexts, this needs to be taken into account when interpreting EDI scores. Additionally, it needs to be kept in mind that similar EDI scores may be an indication of different underlying processes and factors in different contexts. For example, if two neighborhoods had the same aggregate EDI ratings on the (English) communication domain, but native English-speaking children lived in one neighborhood, and recently immigrated English-as-a-Second-Language-speaking children in the other, it would be reasonable to assume that the ratings are indicative of communication challenges in the first case, but of translation challenges in the second.

Finally, a sixth recommendation pertains to school readiness as a developmental construct within a life span paradigm (or within a Bronfenbrennerian chronosystem). Whether school readiness is considered a developmental outcome, a diagnostic snapshot, a predictor of later developmental outcomes, or a point within a developmental trajectory is an analytic issue, but, even more importantly, also a conceptual one. Our discussion implies that school readiness ratings for children, by themselves, cannot be an end in themselves, but need to be situated within a comprehensive framework that links considerations from multiple theoretical strands and measurement practice, and ties those considerations to the socially and culturally embedded pragmatics and purposes of education. Our discussion is based on the notion that education is an inherently practical and purposeful endeavor; however, the discussion also shows that practices and purposes could and/or should be specific to a given historical and cultural context. For example, in long-term follow-up studies on children growing up during the Great Depression in the US, it could be shown that children that were considered developmentally 'vulnerable' or as living under 'at risk' conditions (e.g., poverty, unemployed parents) at one point were considered as faring better later on in life (e.g., according to their own employment and income patterns) than their non-vulnerable or non at risk counterparts—and the interpretation of these findings was associated with the notion that the experiences that some children made due to their poor living conditions (i.e., having to contribute to the family income) prepared them better for doing well in the job market many years later (Elder 1974). This example illustrates that interpretations of developmental trajectories are affected by the developmental trajectories themselves, but also by the historical social and cultural contexts. An ongoing research and validation process for the EDI project is thus inevitably confronted with the challenge of obeying to objective standards of theoretical and methodological rigor, while simultaneously responding to a dynamic, diverse landscape of context factors, such as cultural norms, political values, beliefs, and habits.

10 Conclusion

The recommendations for validation research on school readiness in general, and on the EDI project in particular, have been derived from a discussion that integrated key issues from the literatures on child development, school readiness, neighborhood effects, measurement, and validity theory, using Bronfenbrenner's bioecological theory of human development as a conceptual framework. Bronfenbrenner's theory is widely cited in the child development literature, and also in the neighborhood effects literature. However, Bronfenbrenner himself noted that his own theory—despite its recognition—had not resulted in a noticeable increase of research employing his design recommendations for studying human development. In fact, Bronfenbrenner once wrote that whereas there had

been too much research on development ‘out of context’, [there now is] ... a surfeit of studies on “context without development” (Bronfenbrenner and Morris 2006, p. 794).

Now, about 20 years later, one can find numerous research studies in the neighborhood effects literature that studied child development in context. What remains missing, to date, is an increased focus on those re-occurring, proximal processes that are considered to be most relevant developmentally. What is also largely missing is an emphasis on study designs and analytical methods that can examine the interactions between those proximal processes and relevant person-, context-, and time variables. In addition to the task of gaining a deeper understanding of the developmental effects of proximal processes within a diversity of social and cultural contexts, a major remaining challenge is to develop an understanding of how to implement processes that are beneficial in one context into another context in a way that the transfer acknowledges the ecological differences between the two settings (cf. Elias et al. 2003). Creating such knowledge that can then be translated into practice is, as stated, the ultimate purpose of developmental research as envisioned by Bronfenbrenner, and also the ultimate purpose of the EDI. The EDI research project seems well positioned to make substantial contributions in this direction, and it is hoped that the integrative Bronfenbrennerian approach to the issue as presented here provides a useful conceptual framework for designing future validation research towards this end.

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