2015
RESEARCH BRIEF

HUMAN EARLY LEARNING PARTNERSHIP

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UNDERSTANDING CRITICAL DIFFERENCE IN EDI RESULTS

The Human Early Learning Partnership (HELP) has administered the Early Development Instrument (EDI) throughout British Columbia since 1999. The EDI is a teacher-reported survey that measures five core areas of early child development in populations of Kindergarten children. HELP has a number of waves of province-wide EDI data that can be used to explore trends over time in children's development. The broad question that we want to answer is: "Are our kindergarten-aged children doing better, worse or about the same as in the past?" We can answer this question for areas as large as the whole province and also for smaller jurisdictions such as school districts, local health areas and neighbourhoods.

What are waves?

EDI data are collected in groups called waves. Each wave is comprised of data collected from several consecutive school years. To accurately measure statistically significant changes in the data over time, school districts with smaller numbers of kindergarten students participate annually. Medium and larger school districts participate less frequently.

With a rich data set covering 15 years, researchers at HELP have developed a method to help communities and stakeholder groups make informed judgments about change over time in EDI scores. The method we use is critical difference.

CRITICAL DIFFERENCE: A DEFINITION

Critical difference is the amount of change over two time points in an area's EDI vulnerability rate that is large enough to be considered as meaningful in the statistical sense. A meaningful change means we are confident the change in the vulnerability rate is real, rather than as a result of uncertainty due to sampling or measurement issues.

The concept of critical difference can be applied in **two** ways:

1. **To calculate whether a change in the EDI vulnerability rate for one area (e.g., a neighbourhood) is significant between two time periods.**

2. **To calculate whether the difference in EDI vulnerability rates between two areas (e.g., between neighborhoods) is significant during the same time period.**

ESTIMATING UNCERTAINTY

When an EDI vulnerability rate is calculated for a neighbourhood, school district or any other geographic unit, there is always some uncertainty about the true vulnerability rate.

Uncertainty can be related to the sample of children for whom EDI data are collected in a certain area. On average, EDI data are collected for approximately 85% of children in neighbourhoods across BC. In some neighbourhoods this sample might not represent the whole population. For example, although the EDI is administered in the majority of public schools, it has not been completed for the majority of children attending independent and on-reserve schools.

There is also a degree of uncertainty in EDI vulnerability rates due to the measurement process. This uncertainty may be small or large and is common to all measurement tools, particularly those that measure complex constructs such as health, well-being or social status. In the case of the EDI, measurement-related uncertainty is associated with two main sources:

1. The challenge of measuring children's developmental health. Measurement tools, such as rulers, are very precise for measuring simple qualities such as length or height. In contrast, the EDI measures complex qualities such as social competence or emotional maturity. The EDI items are valid, in that they measure relevant aspects of development. However, these are complex qualities and cannot be precisely captured using only a few items.

2. Variation within and between Kindergarten teachers in how they rate the developmental status of children in their class using the EDI. Teacher-related measurement error can result in uncertainty as teachers may rate the EDI items differently.

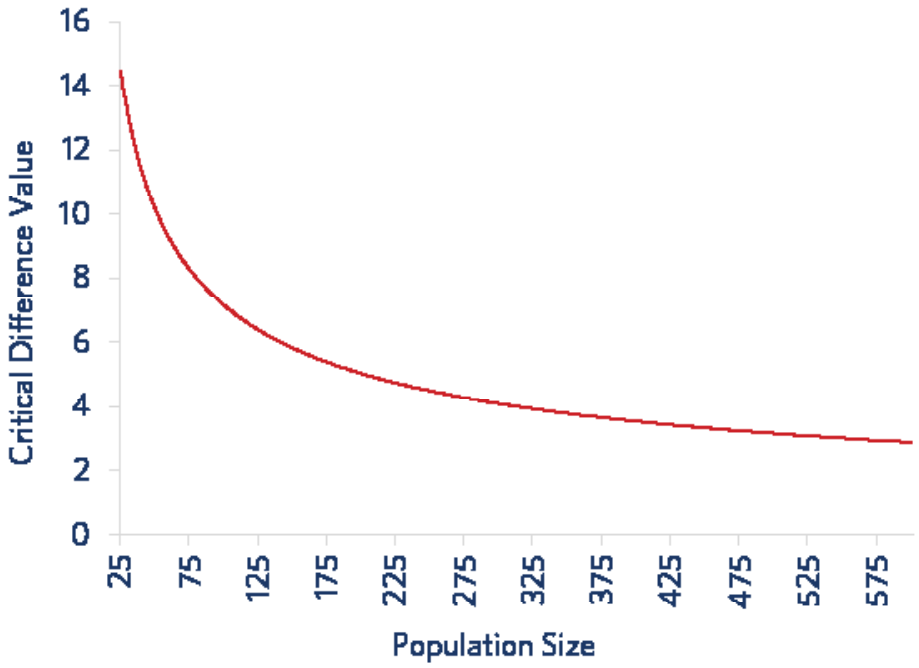
In addition to these two main sources of uncertainty, uncertainty in EDI vulnerability rates is also related to population size. Uncertainty gets smaller as the number of children in a geographic area increases.

DERIVING CRITICAL DIFFERENCE

Using real patterns from BC EDI data, HELP researchers simulated the ways in which the variability in vulnerability rates are sensitive to different sources of measurement error. This involved analyzing neighbourhoods with varied population sizes and simulating different amounts of teacher effects (including leniency and consistency of scoring). For each combination of neighbourhood size and teacher-effect, the uncertainty of the vulnerability rate was calculated. The critical difference curve for vulnerability on one or more EDI scales (Figure 1) shows how uncertainty changes with neighbourhood size, assuming there is a moderate level of teacher effects. Each of the five individual EDI scales has its own critical difference curve; these can be found on the HELP website earlylearning.ubc.ca/supporting-research/critical-difference, along with the equations that were used to create all of the curves.

HELP uses a minimum critical difference value of 2%, regardless of population size. Without such a minimum critical difference would continue to decline, becoming very small for very large areas like the whole province. While this is important for statistical analyses, one of our primary interests is in helping communities use critical difference to understand meaningful changes in the vulnerability of their children. Therefore the 2% minimum is essential in these contexts.

FIG 1: CRITICAL DIFFERENCE CURVE



As the graph shows, vulnerability rates for large populations are more precise (critical difference values are lower) than for smaller populations. For all EDI scales, the curves end when the critical difference value reaches two percent; this is the limit placed on critical difference, regardless of group size. This graph shows the critical difference curve for vulnerability on one or more scale.

HOW TO ACCESS CRITICAL DIFFERENCE INFORMATION FOR YOUR DISTRICT

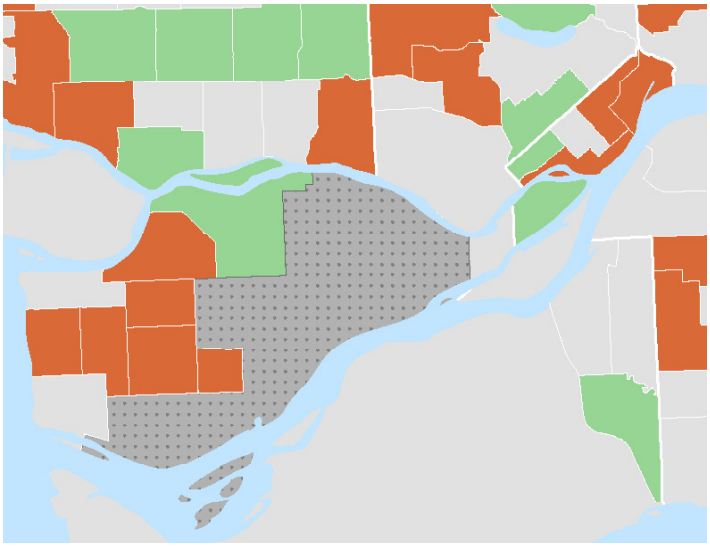
An online critical difference calculator and interactive maps are available to help with interpreting change over time and differences between EDI scores in the province.

The critical difference calculator can be used to assess meaningful change, or differences, by entering both the vulnerability rates and population sizes from a single area across two points in time (e.g. between Wave 2 and Wave 5), or two areas within one time point. The calculator can be found at: earlylearning.ubc.ca/supporting-research/critical-difference.

Interactive maps that focus on illustrating critical difference and change over time are also available for the province, each school district and neighbourhoods. Please see Figure 2 for an example. The maps can be accessed by visiting: **earlylearning.ubc.ca/maps/edi/nh/interactive-critical-difference-maps**.

You can also manually calculate Critical Difference for any region by using HELP's Critical Difference Equations. You can find a simple guide to using these equations on the HELP website **earlylearning.ubc.ca/supporting-research/critical-difference/#calculator.**

FIG 2: EXAMPLE OF CRITICAL DIFFERNCE MAP - VULNERABLITY ON ONE OR MORE SCALES OF THE EDI



Critical Descrease in Vulnerability

Critical Increase in Vulnerability

No Critically Different Change

No Data

Visit earlylearning.ubc.ca/maps/edi/nh/interactive-critical-difference-maps to view critical difference maps for your community.

Useful Resources

Maassen, G. H. (2004).The standard error in the Jacobson and Truax Reliable Change Index: The classical approach to the assessment of reliable change. Journal of the Internatiogical Society, 10, 888–893. DOI: 10.10170S1355617704106097

Maassen, G. H. (2000). Principles of defining reliable change indices. Journal of Clinical and Experimental Neuropsychology, 22, 622– 632. DOI: 10.1076/1380-3395(200010)22:5;1-9;FT622

Maassen, G. H., Bossema &, E., & Brand, N. (2009). Reliable change and practice effects: Outcomes of various indices compared. Journal of Clinical and Experimental Neuropsychology, 31, 339-352. DOI:10.1080/13803390802169059

Perdices, M. (2005). How do you know whether your patient is getting better (or worse)? A user's guide. Brain Impairment, 6, 219-226. DOI: 10.1375/brim.2005.6.3.219

Rogosa, D. R., & Willett, J. B. (1983). Demonstrating the reliability of the difference score in the measurement of change. Journal of Educational Measurement, 20, 335–343. DOI: 10.1111/j.1745-3984.1983.tb00211.x

HOW MEASUREMENT UNCERTAINTY IS MINIMIZED

As HELP administers the EDI questionnaire in school districts across the province each year, we work closely with schools and teachers to facilitate the data gathering process and to ensure that we have high quality, reliable data on children in BC. Each year, we provide standardized training for Kindergarten teachers before they complete EDI questionnaires. This training includes information on the background and use of the EDI, a component on multi-cultural awareness, and detailed instructions on how to complete the EDI. Our goal is to build as consistent an administration and interpretation of the EDI items as possible.

CRITICAL DIFFERENCE IS NOT ENOUGH WHEN EXPLORING CHANGE OVER TIME

Critical difference is an important statistical method for understanding change over time and between communities, but to make the most meaning from the results they need to be placed in the context of social and economic changes in the community, as well as other sources of local and regional data about children, programs and services.

FREQUENTLY ASKED QUESTIONS

Can I use the critical differences to compare a neighbourhood over three or more points in time?

No. Critical difference calculations are not designed for multiple comparisons. Choose two time points representing a "beginning" and an "end". Researchers at HELP are working on a version of critical difference that can be applied to multiple time points but the results are not yet available.

In our neighbourhood, the number of children in Wave 2 is much lower than in Wave 4. Does this affect how I would interpret meaningful change?

No. The critical difference equations work the same whether the group sizes are similar or different over time, even within the same neighbourhood. The key to the uncertainty is the number of children in the group – the more children, the less uncertainty.

Can I apply the critical differences equations to change over time for the whole province?

Yes. For any large region (such as the province) whose group size is beyond the point where the critical difference value reaches two, a 2% change is considered to be meaningful.

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