ENHANCING YOUTH DEVELOPMENT
ONE ADOLESCENT AT A TIME:
Theoretical, Methodological, and Applied Implications of the Science of Learning and Development

Richard M. Lerner
Eliot-Pearson Department of Human Development

Institute for Applied Research in Youth Development

26 Winthrop Street, Tufts University, Medford, MA 02155 – Phone (617) 627-5558
DEVELOPMENTAL SCIENCE

• The goal of developmental science is to describe, explain, and optimize individual development across the life span.
Researchers and Practitioners Share The Aspiration of Wanting Every Young Person To Thrive

► Is it possible to promote more positive development in every youth, no matter what the specifics of their birth or early life experiences?

► I believe the answer is “YES.”

► I believe too that there is new, theory-based and methodologically rigorous evidence in support of my answer.

► HOWEVER, the evidence involves a major revision in how evidence about youth development is gathered AND there are complex methods associated with the collection and analysis of this evidence.

► Therefore, please bear with me as I do my best to explain this complexity.

► My hope is that your patience will be worth you time and attention.

► However…
"If you can't explain it simply, you don't understand it well enough."

I will try to speak simply. However, PLEASE remember, I am no Einstein!
Why does the study of human development necessitate the study of changes within an individual across his or her life?
What Is Studied When Human Development Is Studied?

► Human *development* involves changes within a specific person across his or her life span.

► This fundamental and, as well, obvious, point is not controversial.

► Given the unanimity about an individual’s development, it might also seem obvious that researchers studying development should use, or seek to create, measures that are able to detect within-the-person changes.

► However…
A Puzzling Fact:

- Across the history of the study of human development, most measures used to study development have NOT been measures of within-person change!
- As I shall discuss, most often researchers have studied changes in the relations among variables and not changes within individuals.
There are mathematical reasons (i.e., the ergodic theorems) that result in the study of averages, which sum scores across people.

The ergodic theorems enable researchers to use population statistics (averages, standard deviations) in analyzing data from samples if two assumptions about the sample are met:

1. *Homogeneity*. All members of the sample are the same (that is, everyone is an apple because you can’t average apples and oranges); and

2. *Stationarity*. Any differences (variation) among apples seen at one time point remain the same across time (technically, the dynamic model for each person in the sample is held to remain the same across time AND place).

These assumptions are also linked to mistaken beliefs that averages across people are equivalent to changes within each of the people whose scores are used to compute an average.
WHY?

► In addition, even when individuals are acknowledged to be different – even when there is a recognition that every individual is unique -- there is uncertainty about how science or education can be conducted if every person is unique.

► Some researchers have asked if such complexity obviates the possibility of conducting rigorous science?

► Some researchers have acknowledged that they are uncertain about how to develop a measure that is sensitive to change within specific individuals.

► Some researches contend that individual variation – that is, observations of non-stationarity or non-homogeneity – are just noise (error of measurement) that must be eliminated so that the “true” path of human development can be observed.
Two Examples
An Imaginary Example
An Imaginary Example

<table>
<thead>
<tr>
<th>Subject</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Average number correct on trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
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<td></td>
<td></td>
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<tr>
<td>3</td>
<td>0</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) Average number of items correctly recalled

Trial: 1, 2, 3
An Imaginary Example

![Table and Graph]

**FIGURE 5.8**
Results of a study of learning in childhood—the data collected and graphed for the group for Trial 2.
An Imaginary Example

![Table and Graph]

**FIGURE 5.9**
Results of a study of learning in childhood— the data collected and graphed for the group for Trial 3.
An Imaginary Example

FIGURE 5.10
Results of a study of learning in childhood—the data collected are the same as those of Figures 5.7, 5.8, and 5.9, but here they are graphed to show individual (as opposed to group) performances across trials.
AN EMPIRICAL EXAMPLE:

THE SAMPLE CASE OF CHANGE IN DAILY EMOTIONAL EXPERIENCE

Data from a Study Conducted by

Data Set

► Participants:
  o 180 students enrolled in a semester-long course on subjective well-being at the Univ. of Illinois: Mean age = 20.2 (SD = 1.8)

► Measures:
  o Daily Diary of Emotion Ratings completed on 50 successive days
    • How often was each emotion felt today?
  o Hedonic Level
    • 8 Pleasant and 8 Unpleasant Affect Items
No assessment of, or possible conclusions about, changes in any individual’s mood
Individual Daily Mood

Three Concepts that Go Beyond an Exclusive Focus on Average

1. **Jaggedness**: At any point in time each person has his or her specific and unique constellation of attributes (e.g., academic, moral, civic, social, and leadership).
Three Concepts that Go Beyond an Exclusive Focus on Average

2. **Context**: The attributes manifested by an individual at any point in time are moderated by the specific context of development.
Context

- Monozygotic rodents exposed to different *in utero* and post-natal experiences

Slavich & Cole (2013, p.332)
Three Concepts that Go Beyond an Exclusive Focus on Average

3. **Pathways**: We all walk the road less traveled (every individual will have his/her own specific history of development across time and place).
Pathways: 4-H Study of Positive Youth Development

- 8 waves (Grades 5 to 12, respectively), 7087 participants
- Gender: 60.6% Female; 39.4% Male
- Race: 70.7% White; 10.2% Hispanic; 7.9% Black; 3.7% Multiethnic; 3.3% Other; 2.3% Native American; 2.1% Asian
- Mother’s education: 33.6% 4-year degree or higher; 37.2% 2-year or technical degree; 20.5% High School; 8.6% less than High School
- Mean per capita income $15,279.26

*Note that the longitudinal sample presented in these analyses includes all cases with at least 6 waves of data.*
Goal Optimization Skills:
(e.g., strategic thinking, executive functioning, resource recruitment)
Full Sample (N = 7,087)
Goal Optimization Skills:
Longitudinal Sample Average (N = 59)
Goal Optimization Skills:
Person-Specific Pathways for Longitudinal Sample (N = 59)
Confronting Complexity

► Can developmental science actually study and make sense of such great variation in within-person change?

► YES, if change-sensitive measures, designs, and data analysis methods are used!
What are change-sensitive measures, designs, and data analyses?
What Are Change-Sensitive Measures, Designs, and Data Analyses?

► To be change-sensitive, a **measure** must be able to detect change (within an individual) if change in fact occurs.

► To be a change-sensitive **design**, data must be collected in a manner that enables within-person change, if it occurs, to be identified. Therefore, repeated (longitudinal) designs are needed AND the divisions of the x-axis (time) must be distributed in a manner commensurate with theory-based understanding of changes in the person-specific developmental process being studied.

► To be a change-sensitive **data analysis** method, the procedure must be able to identify non-ergodic change. The analysis must be able to analyze the interconnections of changes across time (the dynamics of change) for each individual studied.
Features of Change-Sensitive Measures

- Measures can detect change across adjacent divisions of the x-axis, when x-axis divisions are spaced in theoretically appropriate ways.
- Measures avoid problems of the _non-equivalent temporal metric_. That is, x-axis divisions appropriate for one process or one period of the life span may not be appropriate for other processes or periods of the life span.
- Measures can yield sufficient systematic variation to identify moderating or mediating covariation with other individual or contextual variables.
- **THEREFORE, MEASURES _DO NOT_ CORRESPOND TO TRAIT-LIKE MEASURES.**
Examples of Change-Sensitive, Person-Specific Research Designs

► P-technique designs
► Times-Series Analyses
► Burst Designs
► Qualitative Analyses
► Mixed-Method Designs
An Example of Change-Sensitive Analyses: Dynamic Factor Analysis

► Developed by Peter Molenaar (1985), dynamic factor analysis (DFA) addresses the idea that the state of the individual at any specific point in time is a function of both concurrent influences and past states.

► Events that influence an individual at one point in time contribute to both concurrent behavior and, as well, may carry forward to influence later behavior. *The connection of changes across life is the essence of a developmental approach.*

► DFA models such processes by relaxing the assumption that all observations of a person are independent observations. Occasion-to-occasion dependencies (as in time series with equally-spaced observations) are explicitly modeled, thus allowing for carryover, spillover, or system memory effects from one occasion to the next.
The Idiographic Filter

Of course, in addition to person-specific attributes, each individual has attributes that are general across all humans (termed “nomothetic” attributes) and that are associated with specific groups (subgroups) of people.

The idiographic filter (IF) involves identifying relations among variables at the latent construct level that are invariant across individuals (subgroup or even nomothetic relations), while explicitly recognizing idiosyncratic features of the manifest indicators of the latent constructs.

A key feature of the IF is that relations (factor loadings) between manifest (observable) variables and latent (unobservable) variables or factors are not necessarily invariant from individual to individual.

Thus, the idiographic filter consists of the first order factors and their loadings on the manifest variables. These factor loadings can reflect considerable idiosyncrasy in the relations between the latent and manifest variables.
The integration of the dynamic factor model (DFM) and the Idiographic Filter (IF) provides one promising way to ascertain what, if anything, specific individuals have in common and then building generalizations based on that information.

This approach stands in marked contrast to initially aggregating the individual level information and extracting generality from it in the form of average tendencies—the approach of traditional differential psychology.

The integration of the DFM and the IF replaces static trait conceptions with an approach that embraces development and complexity.
But why should developmental science actually seek to make sense of such great variation in within-person change?

The answer lies in the scholarship produced within the Science of Learning and Development Alliance!
The Science of Learning and Development (SoLD) Alliance is predicated on the study of person-specific – *idiographic* – pathways across life.
The SoLD Alliance

► SoLD involves a collaboration led by renowned child psychiatrist, Pamela Cantor. The collaboration includes both universities, for example, Harvard University and Stanford University and NGOs, for example, American Institutes for Research and Turnaround for Children.

► Drawing integratively from scientific disciplines ranging from biology through sociology, economics, policy/law, and history, SoLD pursues the idea that each individual has a developmental trajectory that, at least in part, involves systematic, personalized (idiographic) components.

► It is necessary to understand this idiographic component to maximize opportunities to enhance the lives of diverse youth, perhaps especially those children who have experienced various instances of adversity and challenge in their lives.

► SoLD focuses on the Build Blocks for Learning (BBFL) model to understand the constructs that need to be enhanced to promote whole-child educational and life successes among these diverse young people.
Building Blocks for Learning

INDEPENDENCE AND SUSTAINABILITY
- Self-Direction
- Curiosity
- Civic Identity

PERSEVERANCE
- Resilience
- Agency
- Academic Tenacity

MINDSETS FOR SELF AND SCHOOL
- Growth Mindset
- Self-Efficacy
- Sense of Belonging
- Relevance of School

SCHOOL READINESS
- Self-Awareness
- Social Awareness/Relationship Skills
- Executive Functions

HEALTHY DEVELOPMENT
- Attachment
- Stress Management
- Self-Regulation
Marc Bornstein’s Specificity Principle Explains Why Person-Specific Analyses Must Be the Starting Point of Developmental Analysis

- The process of development involves mutually influential (dynamic) relations between an individual and his/her context: Individual $\leftrightarrow$ Context Relations.

- The specificity principle is derived from relational developmental systems-based ideas, and it emphasizes that specific contextual conditions, of specific people, occurring at specific times, moderate specific domains of development (e.g., physiological, psychological, sociocultural) through specific processes of individual $\leftrightarrow$ context coaction.
A Prototypic Use of the Bornstein Specificity Principle to Frame a Multi-Part Question for Developmental Research

► What specific actions,
► Of what specific individuals,
► In what specific places (contexts),
► Of what specific durations,
► In what specific communities, societies, and cultures,
► At what specific times in ontogeny,
► And at what specific times in history
► Will result in what specific features of development?

**IMPLICATIONS**: To study development, researchers must focus on changes *within* specific people, and not on relations among variables *across* people!
The Chan Zuckerberg Initiative (CZI) Funded SoLD Measures and Methods Across the Developmental Continuum (MMDC) Project

► In the MMDC project, we will measure the individual pathways of diverse youth from Kindergarten through Grade 12 in regard to academic and life achievements.

► The project is aimed especially at enhancing these life paths among youth who have experienced trauma, adversity, and challenge in their lives due to racism, poverty, intolerance (e.g., of their religion or sexual orientation), abuse, neglect, or social, economic, educational, or health disparities.
The SoLD Alliance: The Measures and Methods Across the Developmental Continuum (MMDC) Project

- The SoLD Alliance is developing change-sensitive measures of BBFL constructs (and of individual and contextual moderators of these constructs) and using them across the K-Grade 12 span.

- Of course, attributes, such as executive functioning, self-regulation, resilience, or growth mindset, need to be measured differently across the continuum. Different measures of the same constructs need to be measured at different age (grade) levels.

- The information about such measures must then be judged in regard to its equivalence (measurement invariance) across grade and, as well, across gender, race, and ecological attributes (school, out-of-school-time, and community variables, etc.).
Phases of the MMDC Project

- Phase 1 is a “proof of concept” assessment involving pilot work aimed at creating, for three Building Blocks for Learning (BBFL) constructs, measures that are change-sensitive at the individual level.
- The three constructs are: Executive Functioning (EF), Self Regulation, and Relationship Skills.
- We have developed and are piloting change-sensitive measures of each of these three constructs at each of three age periods within the K-Grade 12 span: Grades 3, 7, and 10.
- Piloting began in late October 2019
- I present later in this talk some initial results of a small pre-pilot test of the EF measures
- The pre-pilot is aimed at illuminating: 1. are average scores for developmental pathways adequate representations of individual pathway scores; and 2. if not, are individual scores meaningful or systematic?
Phases of the MMDC Project

► Using the measures derived from Phase 1, the next step will involve conducting longitudinal designs, with intensive x-axis sampling, for each measure within each of the three periods within the K-Grade 12 developmental span.

► The study of each measure will involve assessing a subset of students within a grade several times a week across an academic year.

► The data from these students will be contrasted with variable-centered assessments of them and of their classmates. Both individual and contextual data will be collected.
Phases of the MMDC Project

- Using DFA and IF methods, we will seek to identify idiographic pathways and assess whether aggregate pathways might exist at the latent variable level.
- For each of the three BBFL constructs, we will test for invariance of measurement across the three time periods within the developmental continuum.
- We will assess concurrent and predictive validity by assessing covariation between the idiographic data and data about the school, family, or community contexts of the youth we study.
- Using integrated data analysis (IDA) methods for each construct (e.g., such as the IF), we will assess if there is evidence for an integrated developmental continuum across the three age groups we have studied.
The SoLD MMDC Project
Examples of Idiographically Measuring Executive Function
Executive Functioning: Cognitive Flexibility (Attention/Shifting)
Welcome to the Card Sort Challenge! In this game, you will match cards by shape or color. **In the game, go as fast as you can without making a mistake!**

Let’s look at how to play:

You will use the keyboard arrow keys to match the cards.

Press the left arrow key to select the left card.  
Press the right arrow key to select the right card.
1. The word “Shape” or the word “Color” will show.

Shape

This means you will have to match the shape.
2. Which pictures are the same shape?

The circles are the same shape.

Press the left arrow key to select the circle.
This means you were correct!

Remember, go as fast as you can without making a mistake.
Executive Functioning: Response Inhibition
Welcome to the Pet Parade! You will see animals at the top of the screen. Find the animal in the middle. Ignore the other animals, they are trying to trick you! At the bottom of the screen, one animal is looking left and one animal is looking right. Press the left or right arrow key on the keyboard to pick the animal that is looking the same way as the animal in the middle.

**In the game, go as fast as you can without making a mistake!**

Let’s do one together:

This fish is in the middle. Which way is it looking?
This fish is in the middle. Which way is it looking?

This fish is looking the same way as the middle fish.
This fish is in the middle. Which way is it looking?

Press the left arrow key to select this fish.
You are correct!

Remember, go as fast as you can without making a mistake.
If you see this, you are incorrect.
Try to learn from your mistake.
Match the fish that are looking the same way as the middle fish.
Keep working at it.
Executive Functioning:
Working Memory
Memory Marathon

Put the pictures in the correct order!

One picture at a time will show on the screen. You will have to put the pictures in order, so remember the order of the pictures. You will play 4 times, or rounds.

<table>
<thead>
<tr>
<th>Round</th>
<th>Number of Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
</tr>
</tbody>
</table>

Let’s look at how to play:
This is the first picture. Remember this picture is #1.
This is the second picture.
Remember this picture is #2.
This is the third picture.
Remember this picture is #3.
Memory Marathon

Put the pictures in the same order that you saw them. If you are not sure, take your best guess.

#1
#2
#3

Reset
Finish Round
Memory Marathon

Put the pictures in the same order that you saw them.
If you are not sure, take your best guess.

Reset

Finish Round
Memory Marathon

Put the pictures in the same order that you saw them. If you are not sure, take your best guess.

Reset

Finish Round
Memory Marathon

Put the pictures in the same order that you saw them. If you are not sure, take your best guess.
Memory Marathon

If you made a mistake, you can click and drag any picture back to this box.

- Reset
- Finish Round

If you want to put all the pictures back and start over, click here.
Memory Marathon

After you put the pictures in order, click here.
Memory Marathon

This will show you the correct order of the pictures.

The box color shows if you were correct or incorrect.

Correct  Incorrect

Next Round
Memory Marathon

The next round will have 5 pictures.

When you're ready to play the next round, click here.
Pre-Pilot Study

► Three children participated in the Executive Function condition of the pre-pilot study
► They completed 16-23 occasions of measurement of all three EF constructs across 8 weeks
  
  o ID 17: age = 10.08, time points = 16, female
  o ID 19: age = 12.08, time points = 21, male
  o ID 20: age = 14.50, time points = 23, female
We want to address two questions using the pre-pilot data:

1. Are average scores a good enough approximation of individual performance across trials?

2. If the average scores do not sufficiently represent the individual, is intraindividual variation systematic/meaningful?
Question 1 – Average vs. Individual Scores

- Cognitive Flexibility: Accuracy
- Average

![Graph showing DCCS Accuracy over time]
Question 1 – Average vs. Individual Scores

- Cognitive Flexibility: Accuracy
- Average & 17
Question 1 – Average vs. Individual Scores

- Cognitive Flexibility: Accuracy
- Average & 17 & 19
Question 1 – Average vs. Individual Scores

- Cognitive Flexibility: Accuracy
- Average & all participants
Question 1 – Average vs. Individual Scores

- Cognitive Flexibility: Reaction Time
- Average
Question 1 – Average vs. Individual Scores

- Cognitive Flexibility: Reaction Time
- Average & 17
Question 1 – Average vs. Individual Scores

- Cognitive Flexibility: Reaction Time
- Average & 17 & 19

![DCCS Reaction Time Graph](image-url)
Question 1 – Average vs. Individual Scores

- Cognitive Flexibility: Reaction Time
- Average & all participants
Question 1 – Average vs. Individual Scores

- Inhibitory Control: Accuracy
- Average

Graphs showing Congruent and Incongruent Trials Accuracy over trials 1 to 23.
Question 1 – Average vs. Individual Scores

- Inhibitory Control: Accuracy
- Average & 17
Question 1 – Average vs. Individual Scores

► Inhibitory Control: Accuracy
► Average & 17 & 19
Question 1 – Average vs. Individual Scores

- Inhibitory Control: Accuracy
- Average & all participants
Question 1 – Average vs. Individual Scores

- Inhibitory Control: Reaction time
- Average
Question 1 – Average vs. Individual Scores

- Inhibitory Control: Reaction time
- Average & 17

![Graphs showing Congruent and Incongruent Trials Reaction Time](image-url)
Question 1 – Average vs. Individual Scores

- Inhibitory Control: Reaction time
- Average & 17 & 19
Question 1 – Average vs. Individual Scores

- Inhibitory Control: Reaction time
- Average & all participants
Question 1 – Average vs. Individual Scores

► Working Memory COO task – Score (1 × correct objects in Trial 1 + 2 × correct objects in Trial 2 + 3 × correct objects in Trial 3 + 4 × correct objects in Trial 4)

► Average
Question 1 – Average vs. Individual Scores

- Working Memory
- Average & 17
Question 1 – Average vs. Individual Scores

- Working Memory
- Average & 17 & 19
Question 1 – Average vs. Individual Scores

- Working Memory
- Average & all participants
Question 2 – Is intraindividual variation systematic?

- Cognitive Flexibility – Participants had shorter reaction times for color trials than shape trials
Question 2 – Is intraindividual variation systematic?

- Inhibitory Control – Two participants had higher accuracy for congruent than incongruent trials
Question 2 – Is intraindividual variation systematic?

► Working Memory – Primacy and recency effects
Pre-Pilot: Conclusions

► Even with a *VERY limited* pre-pilot assessment, the evidence from this work suggests that, insofar as our measures of EF are concerned:

► Average pathways do not represent adequately the variability in the individual pathways that are aggregated to constitute the average; and

► The individual data provide evidence of being systematic and meaningful.

► These findings suggest that in the pilot studies that have now begun – wherein these EF measures and, as well measures of intentional self regulation and relationship skills will be studied across a school year among youth in Grades 3, 7, and 10 – there is reason to be optimistic that stronger evidence for will be provided for the conclusions drawn from the pre-pilot data.
Final Thoughts

► The idea, that an average score can adequately represent the meaningful, specific attributes of an individual across time and place, does not contribute to either good developmental science or to appropriate applications to education or to youth programming more generally.

► The interpretation, that deviations from average scores means some youth are in deficit and, therefore, in need to remediation, contributes mightily to bad science, bad education, and bad youth programming.

► The research and development work being undertaken within the SoLD Alliance has the potential to provide theory-predicated and methodologically rigorous evidence that youth-specific (idiographic) tools can be used to understand the specific pathways of specific youth developing in specific settings (homes, schools, programs, neighborhoods).

► Such youth-specific evidence can be used by researchers, educators, and youth development practitioners to enhance youth-context relations through focusing first on the individuality and potential malleability of each adolescent.
I AM GRATEFUL TO THE FOLLOWING FUNDERS:

► Chan Zuckerberg Initiative
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► Templeton World Charity Foundation
► Compassion International
► King Philanthropies
THANK YOU!

And I welcome your Comments and Questions