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The letters 'RMT' are rendered in a large, bold, blue serif font. The 'R' and 'M' are connected at the top, and the 'T' is positioned to the right of the 'M'. The letters are centered within a white rectangular box.

**RASCH MEASUREMENT**

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- ▶ A Dimension Coefficient for Evaluating Unidimensionality: Interpreting PCA of Standardized Residuals in RaschOnline -- Tsair-Wei Chien
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Transactions of the Rasch Measurement SIG  
American Educational Research Association

## Overview of The Issue

The Spring 2026 issue of Rasch Measurement Transactions (RMT) includes one research note and several announcements that may be interesting to our community of Rasch measurement researchers.

The issue begins with a research note authored by Tsair-Wei Chien.

Next, we share news of upcoming Rasch Measurement workshops and the call for proposals for NCME's AIME-CON 2026.

Then, we present announcements and updates from the AERA Rasch Measurement Special Interest Group (SIG), highlighting events at the upcoming AERA conference in Los Angeles, California. The issue concludes with a list of Rasch-related sessions at AERA 2026.

As always, we welcome your contributions to the next issue for RMT. We would appreciate receiving your research note, conference or workshop announcement, etc. by July 1, 2026. We respectfully request that you use APA 7 to format your references. Please contact Stefanie at [swind@ua.edu](mailto:swind@ua.edu) or Leigh at [leigh.williams@memphis.edu](mailto:leigh.williams@memphis.edu) to submit something for inclusion.

Sincerely,  
Stefanie A. Wind  
& Leigh Harrell-Williams

### **Rasch Measurement Transactions**

[www.rasch.org/rmt](http://www.rasch.org/rmt)

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# A Dimension Coefficient for Evaluating Unidimensionality: Interpreting PCA of Standardized Residuals in RaschOnline

A key question in Rasch measurement is whether a test predominately measures a **single underlying construct**, a property known as *unidimensionality*. Although several statistical indicators are commonly used to evaluate this assumption (Chiu et al., 2025; Chou & Wang, 2010; Kuang et al., 2025; Kwon et al., 2025; Tennant & Pallant, 2006), interpretation can be difficult—especially when results fall in ambiguous ranges.

After fitting a Rasch model, researchers often examine the *residuals*—that is, the differences between observed responses and model-predicted responses. If the Rasch model fits well and the scale is unidimensional, these residuals should resemble random noise. However, systematic patterns in the residuals may indicate the presence of additional dimensions.

This study proposes a Dimension Coefficient (DC), derived from

principal components analysis (PCA) of standardized residuals (ZSTD), as a clear and interpretable index of residual dimensionality (Chien, 2012). The goal is to provide a simulation-referenced metric that supplements traditional eigenvalue rules and improves interpretability for applied researchers.

## Methods

### Dimension Coefficient and Interpretation Guidelines

To calculate the DC, residuals are standardized by model-implied variance and approximate random normal deviates under adequate model fit, consistent with procedures implemented in Rasch-specific software (e.g., Winsteps; Linacre, 2025). Standardized residual PCA (Chou & Wang, 2010; Linacre, 1998; Raïche, 2005) is then used to calculate eigenvalues from both the original data and data simulated to fit the Rasch model. Using these values, the DC is defined as:

$$r = \frac{v_{1,obs}}{v_{1,sim}}, DC = \frac{r}{1+r}, \quad (1)$$

where  $v_{1,obs}$  is the first residual eigenvalue from observed data and  $v_{1,sim}$  is the corresponding value from Rasch-conformant simulated data.

Based on empirical calibration, the following heuristic guidelines can be used to interpret DC values in Table 1.

**Table 1.** Interpretation of DC by five strata with odds ratio

DC range	Odds $r$	Log-odds $\ln(r)$	Meaning
$DC < 0.60$	$r < 1.5$	$< 0.405$	Strong evidence of unidimensionality
$0.60 \leq DC < 0.67$	$1.5 \leq r < 2$	$0.405-0.693$	Weak indication of a secondary dimension
$0.67 \leq DC < 0.70$	$2 \leq r < 2.33$	$0.693-0.847$	Likely presence of a secondary dimension
$0.70 \leq DC < 0.75$	$2.33 \leq r < 3$	$0.847-1.10$	Strong multidimensionality
$DC \geq 0.75$	$r \geq 3$	$\geq 1.10$	Very strong multidimensionality

Note.  $r = v_{1,obs}/v_{1,sim}$  denotes the odds ratio between the first residual eigenvalue from observed data and that from Rasch-conformant simulated data.

Because  $DC = r/(1 + r)$ , the thresholds correspond to interpretable odds levels (e.g.,  $DC \approx 0.67$  corresponds to  $r \approx 2$ ).

### Data Source

We will illustrate the DC using the *Liking for Science* dataset (Wright & Masters, 1982), which is a popular dataset for Rasch methodology demonstrations (Linacre, 2007). The data include 25 rating-scale items administered to 75 children with a three-category ordinal response scale. Rasch person separation reliability was 0.87 with step thresholds at  $-0.86$  and  $0.86$  logits.

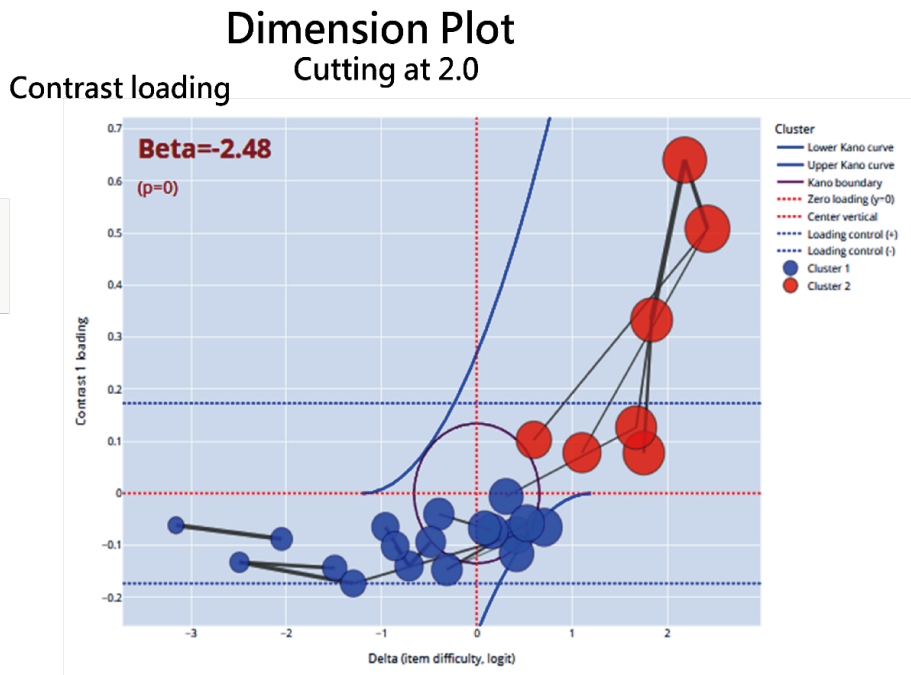
### Software

RaschOnline (Chien et al., 2026; Chien & Chou, 2026) is a web-based analysis platform for the Rasch rating scale model (RSM; Andrich, 1978). This software performs PCA of standardized residuals (ZSTD) after extracting the primary Rasch dimension by selecting “Run Demo”

and generating the HTML Report. The system automatically displays the item dimension plots with Kano-style contrast bands (described in the next section).

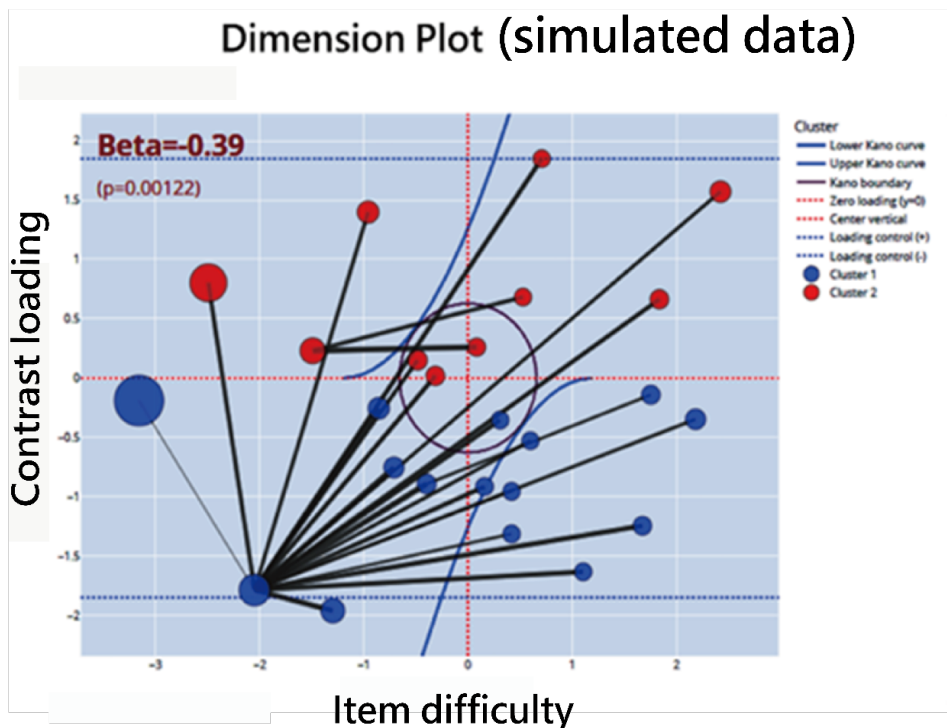
### Interpretation of Dimension Plots

Kano diagrams (Kano et al., 1985) are graphical displays that can be used to represent item dimensions (clusters). Nodes are colored by the sign and magnitude of residual PCA contrast loadings, scaled by silhouette scores (Chuang & Chou, 2025), and linked according to residual item–item correlations. To facilitate interpretation, only the maximum correlation between items is highlighted in these plots. Loading control criteria are defined by the smallest absolute contrast loadings. Items with nearly equivalent loading magnitudes across dimensions—indicative of random dispersion—are treated as controls, consistent with patterns observed in Rasch-simulated data.



**Figure 1.**

Item dimension plot with Kano-style contrast bands (corr. = -0.718,  $\beta = -2.48$ ,  $p < .0001$ ) using observed data



**Figure 2.**

Item dimension plot with Kano-style contrast bands (corr.= 0.126,  $\beta = -0.39$ ,  $p = .001$ ) using simulated data

The beta estimate (path coefficient) is obtained using the Ordinary Least Squares (OLS) slope for  $y \sim x$ , where  $x = \text{mean}(ZSTD)$  across items in Cluster 1 and  $y = \text{mean}(ZSTD)$  across items in Cluster 2. Clusters are defined by the sign of the Contrast 1 loading (residual PCA).

We define:

Cluster 1 (C1): items with positive loading on *Contrast 1* (residual PCA)

Cluster 2 (C2): items with negative loading

For each item:

$x_i =$   
*mean ZSTD across items in Cluster 1*

$y_i =$   
*mean ZSTD across items in Cluster 2*

Then we run:

$$y_i = \alpha + \beta x_i + \varepsilon_i, (2)$$

With these specifications,  $\beta = \text{OLS slope}$ . This estimate indicates how strongly average residual misfit in Cluster 1 predicts average residual misfit in Cluster 2. Please note that the Pearson correlation coefficient (corr.) is also calculated. When the correlation is negative, the y-axis contrast loadings are sign-reversed (multiplied by  $-1$ ) to ensure a consistent positive orientation consistent with the Kano diagram structure. Additionally, an interactive dashboard application (Chien,

2026) is provided to facilitate the interpretation of DC values.

## Results

Figures 1 and 2 illustrate the assessment of unidimensionality for the Liking for Science data based on the PCA of standardized residuals, presenting a comparison between observed data and data simulated to fit the Rasch model. The first residual contrast yielded the following results:

$$v_{1,obs} = 4.624, v_{1,sim} = 2.167 \text{Odds} \\ = 4.624/2.167 = 2.134$$

$$DC = Odds/(1 + Odds) = 0.681$$

The resulting DC indicates likely presence of a secondary dimension. Residual contrast plots revealed three items that exceeded control limits (Figure 1), whereas simulated Rasch-conformant data show minimal deviations (Figure 2). The observed eigenvalue substantially exceeded simulation-based expectations, indicating a non-random residual structure for the observed data.

## Discussion

Following Rasch measurement principles, these results are interpreted diagnostically rather than inferentially. The proposed DC (observed/simulated SR variance) complements existing heuristics (Smith, 1994; Wright, 1996; Linacre, 1998; Linacre, 2026a/2026b, Smith & Miao, 1994; Raïche, 2005; Linacre & Tennant, 2009) when the first residual eigenvalue falls in the

ambiguous range of about 1.4–2.05, which may vary with test length and sample size.

Parallel analysis was conducted to determine the number of factors to retain in exploratory factor analysis (Hayton et al., 2004; Horn, 1965). In this study, simulated data generated under the Rasch model were compared with the original data. This approach provides a rational and appropriate basis for assessing the tendency toward unidimensionality in the present research.

The proposed DC provides a simple way to judge whether a test is measuring mainly one thing or more than one thing. Instead of relying only on raw statistical values (called eigenvalues), which can be difficult to interpret and can change depending on the number of items or respondents, the DC compares the observed results to what would be expected if the test were truly unidimensional. This comparison makes the results easier to understand, especially in situations where traditional guidelines are unclear. An interactive dashboard application (Chien, 2026), developed in R, is provided to facilitate interpretation of DC values.

The DC is intended to serve as a practical indicator rather than a strict statistical test. It should be considered together with the content of the items and other Rasch model results when evaluating a scale.

## Conclusion

The DC provides a clear and intuitive summary of whether a scale shows signs of

measuring more than one underlying trait. By comparing real data to simulated data that follow ideal Rasch model conditions, the DC helps users judge whether residual patterns are likely random or reflect a potentially meaningful multidimensional structure.

In the example presented, the DC successfully differentiates between weak and stronger signs of multidimensionality while remaining consistent with Rasch model principles. Overall, this approach improves clarity and transparency in evaluating dimensionality and supports more informed interpretation within RaschOnline.

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## Upcoming Rasch Workshops

Dr. Everett V. Smith, Jr. (University of Illinois Chicago) will be offering two online four-week Rasch workshops using Winsteps through [statistics.com](http://statistics.com).

Rasch Measurement – Core Topics  
 May 15 – June 12, 2026  
<https://www.statistics.com/courses/rasch-measurement-core-topics/>

Rasch Measurement – Further Topics  
 June 19 – July 25, 2026  
<https://www.statistics.com/courses/rasch-measurement-further-topics/>

## Call for Proposals for NCME’s AIME-CON 2026

[Proposals](#) for the National Council on Measurement in Education (NCME) Artificial Intelligence in Measurement and Education Conference (AIME-CON) 2026 are now being accepted. This year’s theme is *Measurement Science in AI-Integrated Assessment and Pedagogy*. The conference will be held October 5-7, 2026 in Pittsburgh, PA. The proposal deadline is June 14, 2026, 11:59pmn EST. Authors will be notified in July.

# Journal Announcement: Teaching Educational Research Methods

Announcing a BRAND-NEW JOURNAL focused on research methods! The journal *Teaching Educational Research Methods (TERM)* is a no-fee, open-access interdisciplinary journal focused on the importance of quality teaching, teaching preparation, and teaching practices—specifically within research methods courses, with emphasis on equipping ethical and effective educational researchers across qualitative, mixed methods, quantitative, measurement, and evaluation classrooms.

The journal is a part of the UNC Press Partnership for Open Publishing, and is hosted by UNC Press, in partnership with the University Library at UNC-Chapel Hill. The journal has appreciated additional support from the University of Alabama College of Education, University of

Minnesota Twin Cities College of Education and Human Development, and the University of North Carolina at Chapel Hill School of Education.

Journal sections include:

- Empirical Studies / Research Articles
- Conceptual / Theoretical Discussions
- Pedagogical Practices
- Student Voices
- Literature Reviews
- Book / Software Reviews

Use [this link](#) learn more, to review the aims and scopes, to see the Editorial Board, and to access the submission system.

If you have questions, please email the TERM Editors at [Education\\_TERM@unc.edu](mailto:Education_TERM@unc.edu).



*Teaching Educational Research Methods (TERM)* is an open-access, no fee, interdisciplinary journal that is focused on the importance of quality teaching, teaching preparation, and teaching practices in equipping ethical and effective educational researchers across mixed methods, qualitative, quantitative, measurement, and evaluation classrooms.

*TERM* is currently accepting submissions from student authors, emerging scholars, and established scholars!



Potential authors can review the journal's aims and scopes and access our submission portal on TERM's website: <https://uncp.pop.meru.host/permalink/term>

ELEVATING  
EDUCATIONAL  
RESEARCH  
TEACHING

## Updates and Announcements from the Rasch Measurement Special Interest Group (SIG) of the American Educational Research Association (AERA)

The Rasch Measurement SIG has been actively preparing for several exciting events to be held at the 2026 AERA meeting, which will be held in Los Angeles, California from April 8-12, 2026.

We have several opportunities for connection at the annual meeting. Please join us for as many of these events as you can. We can't wait to see you soon!

### Receptions During the Conference

Consider joining our SIG members at the following receptions:

#### Women In Measurement's Annual Networking Reception

- Wednesday, April 8th – 6:00PM – 8:00PM PST at the Skyline Loft.
  - [Sign up here for \\$10](#)

#### Joint AERA and NCME reception

- Thursday, April 9, 7:15 to 8:45pm
  - This is scheduled for right after the Rasch SIG business meeting. Let's walk over together!

#### AERA Division D Reception

- Saturday, April 11th 6:45 to 8:15pm

#### Rasch SIG Informal Coffee Gathering

- Friday, April 10<sup>th</sup>, 9:15am
  - Let's meet as a group for coffee and to chat! We will convene right

after the Rasch SIG Roundtable and decide on a location as a group.

### Research Presentation Sessions

The Rasch SIG will host research presentation sessions throughout the conference. See the list at the end of this issue and [this link](#) for more details.

### Business Meeting: Keynote and Book Giveaway!

The Rasch SIG business meeting is scheduled for 6:15-7:15pm on Thursday, April 8, 2026, in the InterContinental Los Angeles Downtown, Floor: 6th Floor, Mission

The business meeting will feature a keynote address from Dr. Courtney Donovan, recipient of the 2026 Georg William Rasch Early Career Publication Award. Courtney's talk is titled: *What does Early-Career mean these days?! My 10-year Journey Building My "Early" Career*. We will also provide updates on SIG operations and discuss opportunities to engage with the Rasch SIG.

The Business Meeting will also include a giveaway with opportunities to win Rasch-related books. ***All SIG members who attend the meeting will be entered into the giveaway!***

Hope to see you in LA!

*Stefanie A. Wind*  
Rasch SIG Chair

## Snapshot of Rasch SIG Events: AERA 2026

Day	Time	What?	Where?	Why go?
Thursday, April 9	4:15- 5:45pm PDT	Rasch SIG Paper Session	InterContinental Los Angeles Downtown, Floor: 6th Floor, Mission	<ul style="list-style-type: none"> <li>Support Rasch research at AERA!</li> </ul>
	6:15- 7:15pm PDT	Rasch SIG Business Meeting with Book Giveaway	InterContinental Los Angeles Downtown, Floor: 6th Floor, Mission	<ul style="list-style-type: none"> <li>Keynote address by Dr. Courtney Donovan</li> <li>Giveaway: Chance to win Rasch books</li> <li>Connect with the Rasch SIG community</li> </ul>
Friday, April 10	7:45- 9:15am PDT	Rasch SIG Roundtable Session	W Marriott Los Angeles L.A. LIVE, Floor: Ground Floor, Gold 4 , Table 9	<ul style="list-style-type: none"> <li>Support Rasch research at AERA!</li> </ul>
	9:15-10am PDT	Rasch SIG coffee gathering	Meet at the Roundtable listed above!	<ul style="list-style-type: none"> <li>Connect with the Rasch SIG community</li> </ul>
Saturday, April 11	11:45am – 1:15pm PDT	Rasch SIG Paper Session	InterContinental Los Angeles Downtown, Floor: 6th Floor, Mission	<ul style="list-style-type: none"> <li>Support Rasch research at AERA!</li> </ul>
Sunday, April 12	9:45 to 11:15am PDT	Rasch SIG Roundtable Session	JW Marriott Los Angeles L.A. LIVE, Floor: Ground Floor, Gold 4, Table 5	<ul style="list-style-type: none"> <li>Support Rasch research at AERA!</li> </ul>

## Rasch-Related Sessions at AERA 2026

### Wednesday, April 8, 2026

- Roundtable | 3:45 PM – 5:15 PM  
JW Marriott Los Angeles L.A.  
LIVE, Gold Level, Gold 3  
*Measuring Learning and Knowledge  
Coherence in Student Reasoning  
about Matter and Energy Using the  
MOMO Instrument*  
Austin Zuckerman, Ross H. Nehm,  
Gena Sbeglia
- Poster | 11:45 AM – 1:15 PM  
Los Angeles Convention Center,  
Level Two, Poster Hall – Exhibit  
Hall A  
*AI Literacy Proxy from PISA 2022  
Hong Kong: IRT and SEM  
Validation with ICT Capabilities*  
Linwei Yu, Yueru Li
- Poster | 1:45 PM – 3:15 PM  
Los Angeles Convention Center,  
Level Two, Poster Hall – Exhibit  
Hall A  
*Revisiting the Self-Report Altruism  
Scale in Higher Education: Rasch-  
Based Cross-Cultural Validation and  
Refinement*  
Talal Alzabidi, Reben Ramadhan
- Virtual Poster Session | April 8–12,  
7:45 AM – 3:00 PM  
Virtual Posters Exhibit Hall  
*Does Answer Option Positioning  
Lead to DIF in Reading  
Comprehension? An Analysis with  
Parametric Logistic Item Response*

*Theory Model Trees*  
Farshad Effatpanah

- Virtual Poster Session | April 8–12,  
7:45 AM – 3:00 PM  
Virtual Posters Exhibit Hall  
*A Rasch Analysis of the Couples  
Satisfaction Index*  
Colette A. Norgard, Tom Su

### Thursday, April 9, 2026

- Paper Session | 4:15 PM – 5:45 PM  
InterContinental Los Angeles  
Downtown, 6th Floor, Mission  
*Measuring the Stability of Rasch Fit  
Statistics Using Nonparametric  
Bootstrapping*  
Andrew Krist, Stefanie A. Wind
- Paper Session | 4:15 PM – 5:45 PM  
InterContinental Los Angeles  
Downtown, 6th Floor, Mission  
*Exploring the Relationship between  
Rater Effect Indicators from the  
Many-Facet Rasch Model and  
Network Analysis with Incomplete  
Scoring Designs*  
Stefanie A. Wind, Daniel O.  
Oyeniran
- Paper Session | 4:15 PM – 5:45 PM  
InterContinental Los Angeles  
Downtown, 6th Floor, Mission  
*Using Rasch-Based Indices to Detect  
Careless Responses in Surveys with  
Missing Data*  
Yuan Ge, Stefanie A. Wind, Eli  
Andrew Jones, Chia-Lin Tsai
- Roundtable | 2:15 PM – 3:45 PM  
JW Marriott, Ground Floor, Gold 4

*Developing the Everyday Quality Measure: A Transformative Approach to Measuring Quality in Family Child Care*

Alison Hooper, Stefanie A. Wind, Rena Hallam, Ekaterina Novikova, Kristin Johnson, Whitney Wahi

- Roundtable | 4:15 PM – 5:45 PM  
JW Marriott, Ground Floor, Gold 2  
*Extending the Short Critical Consciousness Scale: Measuring Critical Action Among K–8 In-Service Teachers*  
Shannon O Sampson, Susan Cantrell, Olukemi Olubunmi Kolawole, Kristen H. Perry
- Poster | 4:15 PM – 5:45 PM  
LA Convention Center, Poster Hall A  
*Measuring Whiteness-Informed Practices in K-12 Classrooms: Validation of the Classroom Whiteness Scale (ClAWS)*  
Jaylene Patterson

### **Friday, April 10, 2026**

- Roundtable | 7:45 AM – 9:15 AM  
JW Marriott, Ground Floor, Gold 4  
*Psychometric Evaluation of the Career Values Survey Among Middle School Students*  
Justice Dadzie, Daniel O. Oyeniran, Joni M. Lakin
- Roundtable | 7:45 AM – 9:15 AM  
JW Marriott, Ground Floor, Gold 4  
*A Rasch-Based Measurement of Social Media Globalization*

*Exposure in ASEAN Countries*  
Sungworn Ngudgratoke

- Roundtable | 7:45 AM – 9:15 AM  
JW Marriott, Ground Floor, Gold 4  
*Development and Validation of Vicarious Racism Survey for Graduate Students*  
Olukemi Olubunmi Kolawole, Jungmin Lee
- Roundtable | 1:45 PM – 3:15 PM  
JW Marriott, Ground Floor, Gold 4  
*Evaluating Longitudinal Change in STEM Identity: Explanatory Rasch Modeling*  
Justice Dadzie, Daniel O. Oyeniran, Joni M. Lakin
- Roundtable | 9:45 AM – 11:15 AM  
InterContinental Los Angeles Downtown, 7th Floor, Hollywood Ballroom I  
*When Cut Scores Impact Human Ratings: A Many-Facet Rasch Modeling Approach*  
Kuan-Yu Jin, Thomas Eckes
- Poster | 11:45 AM – 1:15 PM  
LA Convention Center  
*The Children's Interpersonal Mattering at School Scale: A Psychometric Exploration*  
Camila Polanco
- Roundtable | 3:45 PM – 5:15 PM  
JW Marriott, Gold Level, Gold 1  
*An Exploratory Analysis of How Civic Online Reasoning Develops During College*  
Enrique Eduardo Valencia Lopez, Jeffrey M. DeVries

### **Saturday, April 11, 2026**

- Paper Session | 11:45 AM – 1:15 PM  
InterContinental Los Angeles  
Downtown, 6th Floor, Mission  
*Comparing Rating Quality between GenAI and Human Raters for ELL Writing Assessment*  
Wei Huang, Jujia Li
- Paper Session | 11:45 AM – 1:15 PM  
InterContinental Los Angeles  
Downtown, 6th Floor, Mission  
*Judging the Judges: A Rasch Analysis of Human and Large Language Model Raters*  
Cheng Tang, Jing Li, Jiawei Xiong, George Engelhard
- Paper Session | 11:45 AM – 1:15 PM  
InterContinental Los Angeles  
Downtown, 6th Floor, Mission  
*Modeling Rater Judgments on AI-Aided Rubrics: A Rasch-Based Mixed Methods Study*  
Beyza Aksu-Dunya, Talip Guile, Mehmet Can Demir
- Poster | 9:45 AM – 11:15 AM  
LA Convention Center  
*Partnering with Youth to Reimagine Math Engagement*  
Samantha E. Holquist, Ta-yang Hsieh, Alyssa Scott, Marisa K. Crowder, Mark Vincent, Claire Kelley, Olivia Reyes

- Paper Session | 9:45 AM – 11:15 AM  
JW Marriott, Platinum J  
*Searching for Stages of Effective Teaching in Pre-Primary Schools*  
Leonidas Kyriakides, Victoria Michaelidou

- Paper Session | 3:45 PM – 5:15 PM  
LA Convention Center, Room 303B  
*Capturing Mattering in the Elementary School Classroom*  
Camila Polanco, Roderick L. Carey, Tracy Waasdrop, Nicholas S. Bell, Valerie Earnshaw, Tia Navelene Barnes

### **Sunday, April 12, 2026**

- Roundtable | 9:45 AM – 11:15 AM  
JW Marriott, Ground Floor, Gold 4  
*Psychometric Evaluation of Test Item Reading Load Scale*  
Christopher Adah Ocheni, Emmanuel Agada Onoja
- Roundtable | 9:45 AM – 11:15 AM  
JW Marriott, Ground Floor, Gold 4  
*Using Rasch Methodology to Identify Maximally Efficient Items*  
Christine DiStefano, Ruiqin Gao, Fred Greer, Fang Wang, Huijuan Wang