

RMT

RASCH MEASUREMENT TRANSACTIONS

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Transactions of the Rasch Measurement SIG
American Educational Research Association

Overview of The Issue

The Fall 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 Jing Li and George Engelhard, Jr.

Next, we share news about the next IOMW conference, which will be held in Philadelphia, PA in April 2028.

After that, we share an update about the PROMS Lifetime Achievement Award, which was presented to Trevor Bond in Guangzho in Summer 2026. Trevor has also shared an update related to the recent release of the Chinese version of *Applying the Rasch Model*.

Finally, we present announcements and updates from the AERA Rasch Measurement Special Interest Group (SIG), highlighting new SIG leadership, upcoming activities, and award nominations.

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 December 1, 2026. We respectfully request that you use APA 7 to format your references. Please contact Stefanie at swind@ua.edu or Leigh at

leigh.williams@memphis.edu to submit something for inclusion.

Sincerely,
Stefanie A. Wind
& Leigh Harrell-Williams

Rasch Measurement Transactions

www.rasch.org/rmt

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Clustering Nonparametric Person Response Functions

*Jing Li & George Engelhard, Jr.
The University of Georgia*

Questionnaire-based assessments and large-scale testing programs are widely used to measure academic achievement, attitudes, and other psychological constructs. Ensuring the validity of the resulting inferences requires not only accurate item calibrations, but also careful evaluation of respondent behavior. One important diagnostic tool for examining respondent behavior in this context is Rasch person-fit analysis (Smith, 1986), which aims to detect aberrant or unexpected response patterns that deviate from model-based expectations. Such patterns may arise from a variety of sources, including careless responding, misunderstanding of items, random answering, or intentional misreporting (Meijer, 1996). Identifying these irregular patterns in person responses is important because they can threaten the validity of test score interpretations and distort parameter estimation.

In practice, person-fit statistics are commonly used as an initial screening tool to flag potentially misfitting respondents. However, once individuals are identified as misfitting, researchers often face the challenge of interpreting the underlying response behavior. A common recommendation is to inspect person response functions (PRFs), which display the relationship between item difficulty and a respondent's probability of endorsing items. PRFs provide a useful visual diagnostic that can reveal patterns such as unexpected successes on difficult items or failures on easy ones. Despite their interpretive value, PRFs are rarely used as a routine follow-up step

in large-scale assessment programs. One practical barrier is that reviewing PRFs for many flagged respondents quickly becomes overwhelming, making systematic interpretations difficult.

To address this challenge, the present study proposes several steps that integrate statistical screening, clustering, and visualization. First, person-fit statistics are used to identify a subset of respondents with potentially aberrant response patterns. Second, these flagged response vectors are grouped using a clustering method called Partitioning Around Medoids (PAM; Kaufman & Rousseeuw, 1990). PAM organizes similar response patterns into clusters and identifies a representative real case, or medoid, for each cluster. Third, nonparametric Hanning smoothing is applied to the medoid PRFs to produce interpretable visualizations of response behavior (Engelhard, 2013). By focusing on representative patterns within a cluster rather than individual cases, this procedure transforms a potentially overwhelming case-by-case review into a manageable pattern-based diagnostic strategy.

Methodology

PAM is a k -medoids algorithm that partitions respondents into clusters centered on representative observed cases (medoids). Compared with k -means, another popular clustering method, PAM accommodates arbitrary distance matrices and is more robust to outliers because cluster centers are restricted to actual respondents. Let C_k denote the set of respondents assigned to cluster k , the medoid of cluster k , denoted by m_k is the respondent within C_k that minimizes the total within-cluster dissimilarity:

$$m_k = \arg \min_{i \in C_k} \sum_{l \in C_k} d(i, l)$$

where $d(i, l)$ is the pairwise dissimilarity between respondents i and l . In this study, pairwise dissimilarity was computed using the scaled Manhattan distance, across items:

$$d(i, l) = \frac{1}{J} \sum_{j=1}^J |x_{ij} - x_{lj}|$$

where i and l represents respondents, j represents items, x_{ij} is the response of respondent i to item j , x_{lj} is the response of respondent l to item j , and J is the total number of items. Larger values of $d(i, j)$ indicate greater similarity between two respondents' response patterns.

The number of clusters was determined using the average silhouette width (Rousseeuw, 1987). For respondent i , the silhouette value is defined as

$$S(i) = \frac{b(i) - a(i)}{\max\{a(i), b(i)\}}$$

where $a(i)$ is the average distance from respondent i to all other respondents in the same cluster, and $b(i)$ is the smallest average distance from respondent i to respondents in any other cluster. Thus, $a(i)$ measures within-cluster cohesion, whereas $b(i)$ measures separation from the nearest alternative cluster. The average silhouette width is obtained by averaging $S(i)$ across all respondents included in the clustering analysis. Values near 1 indicate well-separated clusters, values near 0 indicate overlap, and negative values suggest potential misassignment.

This criterion was used only to evaluate the quality of the clustering

solution. Mean silhouette values above 0.50 indicate good separation, 0.25-0.50 moderate structure, and below 0.25 weak clustering (Rousseeuw, 1987).

Next, we applied the three-point Hanning smoother, commonly attributed to Tukey (1977) and tracing back to the three-point running weighted average of Von Hann and Ward (1903). We used the representative response pattern from each cluster in order to construct nonparametric PRFs and reduce random noise. Let j denote the ordered item position, where items are arranged by their Rasch-calibrated difficulty. For the representative respondent from a given cluster, let y_i denote the observed responses at item position j . The Hanning smoothed value at position j , denoted by s_j is computed as

$$s_j = \frac{y_{j-1} + 2y_j + y_{j+1}}{4}$$

where y_{j-1} is the observed response to the preceding item, y_j is the observed response to the focal item, and y_{j+1} is the observed response to the following item.

Thus, the smoother assigns the greatest weight to the focal item while borrowing information from its neighboring items. Plotting the smoothed values s_i against calibrated item difficulty makes local irregularities easier to see, highlighting "hills" (unexpected correct answers on harder items) and "valleys" (unexpected misses on easier items), as illustrated in Engelhard (2013). This visualization can reveal person-level anomalies that may be obscured by parametric curves or global fit statistics.

Results

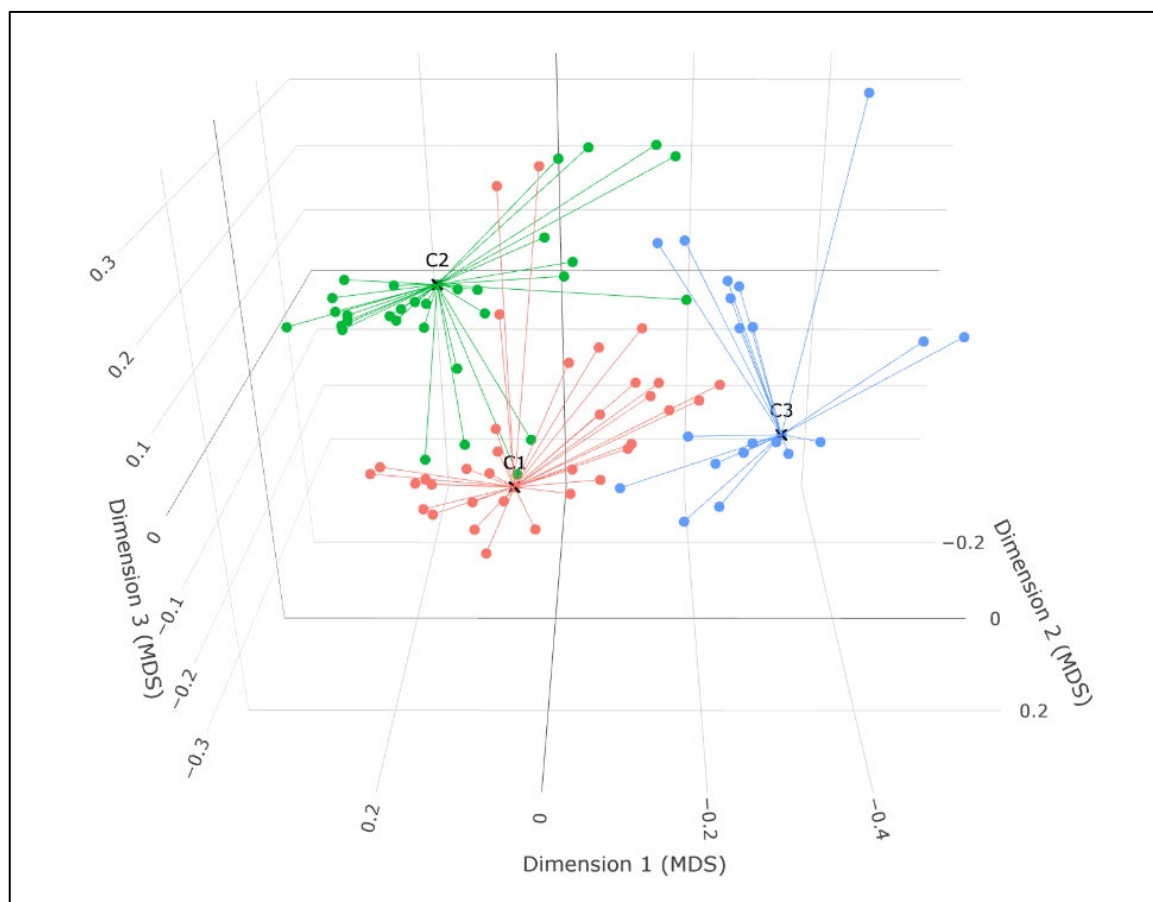
We demonstrated our proposed approach with 18 items from the Household Food Security Survey Module (HFSSM) with a sample of 2,582 respondents (Li et al., 2024). Using Rasch person fit statistics, specifically infit and outfit mean square error (MSE), were used to screen respondents, and cases whose infit or outfit MSE fell into Category C ($1.50 \leq \text{MSE} < 2.00$) or Category D ($\text{MSE} \geq 2.0$) were flagged as misfitting (Wright and Linacre, 1994). Using this criterion, we flagged 114 cases (4.4%) for follow-up clustering with PAM to examine misreporting patterns.

For the clustering analysis, the silhouette results showed modest differences across candidate PAM solutions, with the overall mean

silhouette increasing from $k = 3$ ($M = .299$) to $k = 4$ ($M = .312$) and $k = 5$ ($M = .327$). Although the five-cluster solution achieved the highest overall mean, it contained a clearly weak cluster (Cluster 5, $M = .167$), suggesting over-partitioning and reduced interpretability; by contrast, the three-cluster solution produced consistently moderate cluster separation (Cluster means = $.233 - .349$) and offered the most parsimonious and interpretable structure, so we selected $k = 3$ for subsequent analyses and pattern diagnosis.

Figure 1 presents a three-cluster PAM solution in a 3D multidimensional scaling (MDS) space, with each dot representing a misfitting respondent identified using person fit statistics. Dot colors

Figure 1. Misfit Person Clustering using PAM ($k=3$)



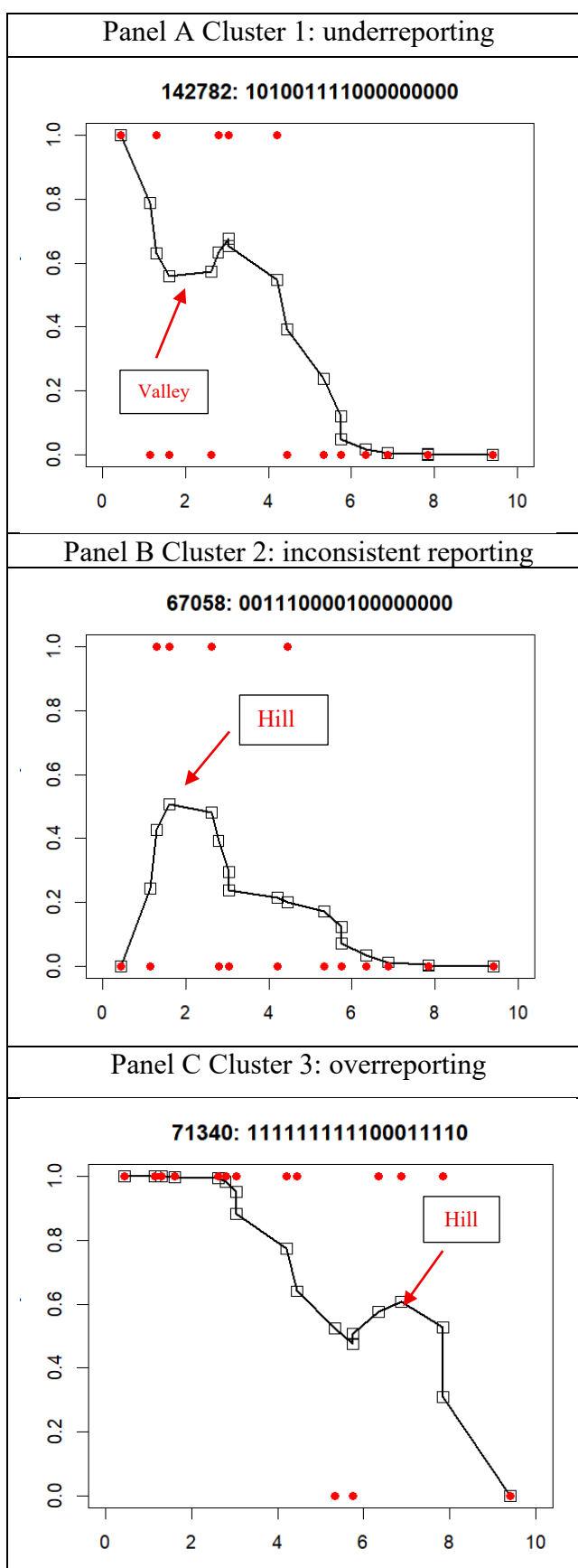
indicate cluster membership, and the “X” markers labeled C1, C2, and C3 denote the cluster medoids. The line segments connect each respondent to the medoid of the cluster, illustrating within-cluster dispersion. Overall, they appear reasonably distinct in the 3D projection. A limitation of this figure is that it represents only a static screenshot of an interactive 3D visualization. The cluster solution itself is fixed, but different reviewing perspectives can change the apparent spacing and separation among clusters. Therefore, the image should be interpreted as one perspective on the same solution.

Next, the medoid of each cluster was visualized using nonparametric PRFs (Hanning smoothed) in Figure 2. Three misreporting patterns occur: underreporting (Cluster 1) with selective non-endorsement of items that would typically be endorsed given the respondents’ overall level; inconsistent reporting (Cluster 2) with responses that don’t follow the expected item-difficulty ordering very closely; and overreporting (Cluster 3) with responses endorsed across many items and are even more likely to endorse on harder items, suggesting over-endorsement of relatively severe or rare experiences. The nonparametric PRFs help visualize misfitting response behaviors that parametric PRFs mask.

Discussion

The proposed approach combines the interpretive strengths of PRF visualization with the organizational benefits of clustering. As a result, it offers a practical framework for diagnosing misreporting behaviors and supporting follow-up investigation in large-scale

Figure 2. *PRFs of Nonparametric Medoids*



testing contexts. This approach involves several steps, beginning with the use of person-fit statistics to screen and flag potentially aberrant response patterns. Next, the approach applies PAM/k-medoids to cluster and organize flagged response vectors into a smaller set of response patterns that reduce the burden of individualized, case-by-case evaluations of aberrant responses. Finally, Hanning-smoothed nonparametric PRFs can aid in improving the interpretability of distinct misfitting patterns within clusters. This procedure can be readily implemented using standard tools in R, making it accessible for applied researchers and practitioners.

References

- Engelhard, G., Jr. (2013). Hanning (smoothing) of person response functions. *Rasch Measurement Transactions*, 26(4), 1392–1393.
- Kaufman, L., & Rousseeuw, P. J. (1990). *Finding groups in data: An introduction to cluster analysis*. Wiley.
- Li, J., Kim, S.-H., & Engelhard, G. (2024). Validation of the Household Food Security Survey Module (HFSSM) using factor analysis and Rasch measurement theory. In H. Hwang, H. Wu, & T. Sweet (Eds.), *Quantitative psychology* (pp. 233–240). Springer. https://doi.org/10.1007/978-3-031-55548-0_22
- Meijer, R. R. (1996). Person-fit research: An introduction. *Applied Measurement in Education*, 9(1), 3–8. https://doi.org/10.1207/s15324818ame0901_2
- Rousseeuw, P. J. (1987). Silhouettes: A graphical aid to the interpretation and validation of cluster analysis. *Journal of Computational and Applied Mathematics*, 20, 53–65. [https://doi.org/10.1016/0377-0427\(87\)90125-7](https://doi.org/10.1016/0377-0427(87)90125-7)
- Smith, R. M. (1986). Person fit in the Rasch model. *Educational and Psychological Measurement*, 46(2), 359–372. <https://doi.org/10.1177/001316448604600210>
- Tukey, J. W. (1977). *Exploratory data analysis*. Addison-Wesley Publishing Company.
- Von Hann, J., & Ward, R. D. (1903). *Handbook of climatology*. MacMillan.
- Wright, B. D., & Linacre, J. M. (1994). Reasonable mean-square fit values. *Rasch Measurement Transactions*, 8, 370–371.

Update on International Objective Measurement Workshop (IOMW) Conference

Stefanie A. Wind and Mark Wilson

The IOMW committee has decided to postpone the next meeting of the IOMW conference until April 2028, when we can convene alongside the AERA and NCME conferences in Philadelphia, PA. Planning is underway and details are forthcoming.

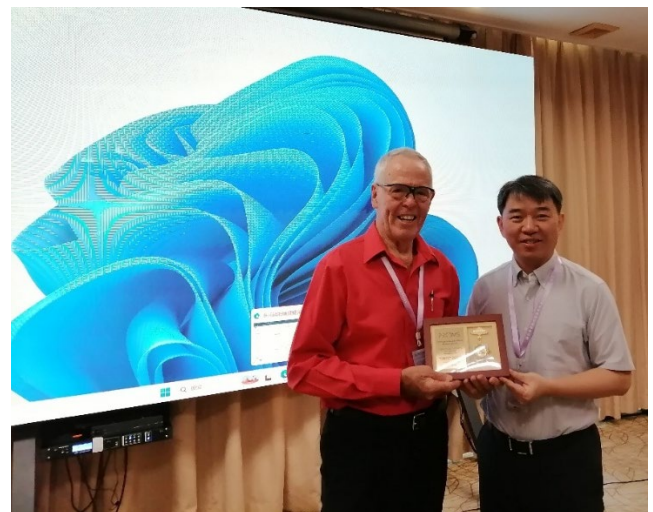
If you are interested in helping to organize the IOMW conference for 2028, please reach out to Stefanie A. Wind at swind@ua.edu.

PROMS Lifetime Achievement Award presented in Guangzhou

Instigator of the annual Pacific Rim Objective Measurement Symposium, Professor Trevor Bond, was presented with a PROMS Lifetime Achievement Award in Guangzhou in July 2026. The award plaque was inscribed, “This award is presented in recognition of the outstanding and sustained contribution to Rasch measurement by Professor Trevor Bond. With sincere appreciation from PROMS for his exemplary leadership, lifelong dedication and enduring impact as an advocate mentor, researcher and educator.”



In his presentation address to the meeting, current PROMS President, Professor Yan Zi of the Education University of Hong Kong, said: “Professor Bond has long championed practical application of the Rasch model in the human sciences, demystifying complex psychometric ideas and making evidence-based measurement accessible to researchers across disciplines. Beyond methodology, he helped build measurement capacity through instigating PROMS in 2005, creating an enduring international network that elevates research standards and supports societal wellbeing.”



Trevor Bond (Left) and Yan Zi (Right)

In his rather emotional response to the presentation, Professor Bond thanked long-term supporters of the PROMS venture including George Engelhard, a quietly spoken hero of the Rasch measurement world, Margaret Wu, and those representative delegates from each of the participating countries in the region who have worked in support of the PROMS concept.

“In 2005, I was regarded by many in the region as the father of PROMS. More than two decades later, PROMS has matured, and I guess that I must now be the grandfather of PROMS”, Bond remarked, as he confirmed his retirement from active participation in future PROMS meetings.

This was the second such presentation, the only other PROMS lifetime achievement award having been made posthumously to Professor Wang Wen Chung in 2017 to recognize his singular contribution to Rasch measurement and his devotion to PROMS.

Applying the Rasch Model now published in Chinese

Trevor Bond

After an overlong gestation period of more than a decade, the most influential publication in the field, *Applying the Rasch Model* (Bond & Fox - ARM2) has been published in Chinese by prestige publisher, Shanghai Foreign Language Education Press - SFLEP. The recent Symposium, conducted by the Pacific Rim Objective Measurement Society in Guangzhou saw the release of this long-awaited tome to researchers and students in China. Local PROMS organizer Professor John Quan Zhang presented senior author, Professor Trevor Bond with the first copy off the press.

This was a fitting occasion for the book's release as the inspiration for the translation and publication was realised at an earlier PROMS meeting China, in 2012. Subsequently, a group of Bond's young academic associates and students worked on the preparation of the manuscript under the supervisory coordination of Professor Yan Zi (EdUHK). The translation team consisted of John Quan Zhang, Lan Rong Li, Wai Fong Chan, Yuan Yuan Guan, Fang Fang, Hui Lan Shen, Chow Kui Foon, Xu Wang, and Kai Jia Zeng, and more recently benefited from the addition of Dr Jason Fan (Fudan University, China) to the team.

While the preparation of the manuscript in Chinese and the team's reviews of those translations were undertaken as anticipated, the editorial work of the SFLEP editor took considerably longer than expected. Professor Yan Zi maintained the quality assurance and liaison roles required of this work over that period of time. It was only after the academic world started to recover from the interruption of the international pandemic that PROMS meetings resumed and the impetus for publication was regained. The appointment of Professor Ding Yi as the new director of SFLEP in 2025 paved the way for a new licensing agreement between that publisher and Taylor & Francis, allowing the final aspects of the review and publication processes to move ahead in a timely manner.

Professor Bond has held a strong commitment to supporting Chinese language Rasch measurement research since his appointment in Hong Kong in 2005 and the subsequent development of PROMS in the region. He anticipated that the dissemination of these important research ideas via the publication of ARM2 in Chinese would provide further impetus for the adoption of

晏子主译



Updates and Announcements from the AERA Rasch Measurement SIG

Dear Rasch Measurement Colleagues,

I have a few quick updates to share with you regarding the Rasch Measurement SIG of AERA and a call for award nominations.

New SIG Board Members

We have a new configuration of the Rasch Measurement SIG Board! I am honored to serve as the new Chair of the Rasch SIG. I have been presenting with the SIG consistently since 2016 and served as the conference co-chair from 2019-2021 and 2025-2026. Dr. Stefanie A. Wind will be our Treasurer, and Dr. Audrey Roberts will serve as Secretary. Drs. Kaiwen Man and Cheng Hua are serving as the 2027 conference co-chairs.

Update on SIG Membership: Urgent Call for Renewal

Over the past few years, participation in our Rasch Measurement SIG has steadily declined, putting our official AERA status at risk. We currently have 56 active members, but we need at least 75 to remain a viable SIG according to AERA. Therefore, we expect to be in a probationary year with AERA. To preserve this wonderful, welcoming community, I kindly ask you to renew your membership for the coming year and invite your students and colleagues to join us. A huge thank you to everyone who has recently stepped up to renew! While many historically rejoin during conference registration, renewing as soon as possible will give us peace of mind that our SIG is safe.

Opportunities to Contribute to the SIG

To foster a more connected community of Rasch scholars, the Rasch Measurement SIG is currently focusing its efforts on four key areas: 1.) mentoring; 2.) in person activities at AERA 2027, 3.) discovering ways to connect during the year, and 4.) collaborations with the other smaller quantitative SIGs. If you are interested in contributing to any of these efforts, please reach out to me directly via email: Courtney.Donovan@ucdenver.edu.

Upcoming In-person Rasch Measurement SIG Activities at AERA 2027

We are excited to share that the Rasch Measurement SIG received numerous exceptional submissions for AERA 2027, setting the stage for a wonderful lineup of presentations. For those heading to the conference, we would love for you to attend our presentation sessions and add your voice to the conversation. Don't forget to add our Business Meeting to your itinerary as well! The full schedule will be announced in mid-January, and I will update you with our exact times and locations just as soon as we have them.

Nominations for The Benjamin Drake Wright Senior Scholar Award due November 1st

The Benjamin Drake Wright Senior Scholar Award honors an individual senior scholar whose contributions over a career have had a widespread positive impact on the field of Rasch measurement. There will be an invited presentation by the award recipient at the business meeting of Rasch Measurement SIG. Please send nominations to Dr. Kaiwen Man, kman@ua.edu by November 1st, 2026.

Potential nominees will have designed and carried out programmatic research that originates in Rasch measurement and helps understand crucial phenomena in model definition, parameter estimation, fit assessment, construct specification, novel applications, the place of Rasch measurement in the history and philosophy of science, etc., as represented in a corpus of writings and research projects that have contributed to the theoretical development of the field as well as having been grounded empirically; and 2.) developed the research capacity of the field, as attested to by the existence of a “school of thought” or intellectual heritage associated with the scholar’s name, a heritage that includes other individuals whom the scholar has had a direct influence in encouraging and helping become productive in Rasch measurement research or an identifiable domain of Rasch measurement research within which the nominee’s constructs and results are used regularly by other researchers.

Call for Nominations for Georg William Rasch Early Career Publication Award

In January 2027, we will begin accepting nominations for The Georg William Rasch Early Career Publication Award. This AERA sanctioned award celebrates outstanding research in Rasch measurement published within ten years of completing a doctoral degree. We will present the award to the winner during the AERA 2028 Annual Conference, which includes a monetary stipend, a plaque, and the invitation to present their work at the Business Meeting. The main goal of this award is to support and celebrate our early-career researchers as they dive into high-quality Rasch measurement work. If you know a fantastic early-career scholar whose work fits the criteria, we would love to hear

from you! Self-nominations are also very welcome.

Eligibility Criteria:

- The publication must include a Rasch measurement focus.
- The publication may be based on the dissertation work of the nominee or other recent research the nominee has conducted.
- The nominee should be either the single author or the lead author (in the case of a jointly authored paper) of the article.
- The article must have been published within two (2) calendar years (April 2025 – April 2027) prior to the Rasch Measurement SIG’s business session at the 2028 AERA Conference.
- Only peer-reviewed research publications that are published or in press (accepted for publication) are eligible for nomination.
- The nominee should have received his/her doctoral degree no earlier than ten years prior to the **nomination deadline (November 31, 2027)**.
- The nominee must be a member of the Rasch SIG or must become a member by the time the award is presented at the annual meeting.

Nominations are submitted by sending an email to the SIG Secretary Audrey Conway Roberts at audrobe@bgsu.edu.

Completed nominations should include the following:

- (1) A letter nominating the author of an early career publication. Please include the name of the author, the date he/she received the doctoral degree, and the name of the

institution that conferred the degree. The nominator's letter must include reasons that the paper is an example of an outstanding Rasch measurement research publication

(2) A copy of the published paper, including complete bibliographic information

(3) A copy of the Table of Contents of the journal or other peer reviewed research publication in which the paper appeared OR an acceptance letter from the journal will be acceptable if it is currently in press

(4) A current CV for the nominee.

Sincerely,
Courtney Donovan
Chair, Rasch Measurement SIG