

MAIMON RESEARCH LLC
ARTIFICIAL INTELLIGENCE LARGE LANGUAGE
MODEL INTERROGATION



REPRESENTATIONAL MEASUREMENT FAILURE IN
HEALTH TECHNOLOGY ASSESSMENT

UNITED STATES: THE INVISIBILITY OF RASCH
MEASUREMENT IN PharmD PROGRAMS

Paul C Langley Ph.D Adjunct Professor, College of Pharmacy, University of
Minnesota, Minneapolis, MN

LOGIT WORKING PAPER No 334 MAY 2026

www.maimonresearch.com

Tucson AZ

ABSTRACT

For more than sixty years, Rasch measurement has provided the necessary and sufficient framework for transforming subjective observations into lawful measures of latent attributes. Despite its importance to the measurement of patient-reported outcomes, quality of life, symptom burden and treatment satisfaction, Rasch measurement remains largely absent from contemporary health technology assessment (HTA). This paper examines the visibility of Rasch concepts within the HTA knowledge bases of six leading Colleges and Schools of Pharmacy in the United States: the University of North Carolina Eshelman School of Pharmacy, the University of Minnesota College of Pharmacy, the University of Michigan College of Pharmacy, the University of Florida College of Pharmacy, the University of Kentucky College of Pharmacy and The Ohio State University College of Pharmacy.

Using large language model interrogations, five canonical statements representing the core elements of Rasch measurement were evaluated. These statements addressed the distinction between linear ratio and Rasch logit ratio measurement, the transformation of subjective observations into measurement, the role of the Rasch logit ratio scale in assessing therapy impact, possession of latent attributes and the relationship between Rasch measurement and representational measurement. Across all six institutions, endorsement probabilities for Rasch propositions were consistently at or near floor levels, typically ranging from 0.05 to 0.10. Only the statement concerning possession of latent traits achieved modestly higher endorsement.

The findings demonstrate a near-complete absence of Rasch concepts from the PharmD-related HTA knowledge base. Students are introduced to utilities, QALYs, simulation modelling and cost-effectiveness analysis, yet receive little or no exposure to the only established framework capable of transforming subjective observations into lawful measures. The result is that latent attributes are routinely assessed through ordinal scores, composite indices and utility structures that fail the requirements of representational measurement.

These results have important implications for HTA education and research. The invisibility of Rasch measurement helps explain the persistence of measurement inversion, where arithmetic precedes measurement, and contributes to the continued reliance on utilities and QALYs in therapy assessment. The paper argues that reconstruction of HTA following the closure of the reference-case framework requires recognition of two lawful forms of measurement: linear ratio measures for manifest attributes and Rasch logit ratio measures for latent attributes. Without Rasch measurement, the quantitative assessment of therapy impact for latent traits remains impossible, ensuring the continued reproduction of measurement failure within PharmD education and the wider HTA community.

INTRODUCTION

Once we accept that measurement must precede arithmetic and that the constraints imposed by the scales of measurement and the axioms of representational measurement are in place, then there are only two measures of response to therapy: the linear ratio scale manifest attributes and the Rasch logit ratio scale for latent attributes. There are no other measures.

Given the importance of latent attributes with patient reporting outcomes or subjective observations, the role of Rasch measurement becomes critical as the necessary and sufficient rules for transforming observations to ratio measurement. Yet, as was demonstrated in the individual HTA knowledge base responses and, as shown here, a comparison of responses across the six leading colleges and schools of pharmacy, Rasch in HTA, including PharmD programs, is absent; it is completely invisible. Students emerge from their course structure with no idea of Rasch and its application to therapy impact.

Instead, graduates (and faculty) rely on ordinal aggregations of responses and assume these can be treated as ratio measures (although the term ratio is seldom encountered). Although the Rasch rules have been in place for over 60 years they are unknown in pharmacy environments which means that the PharmD program is curiously incomplete. There is no distinction between manifest and latent attributes because they are bundled into a health state description which is valued and applied as though, as a utility it had the requisite properties to discount time.

If thought had been given to attributes as claims and the requirement for falsification the closed decision model of the reference case could have been avoided and latent attributes given their place as a critical part of therapy impact assessment. This was not considered and the reference case with its arithmetic was left as the model.

The history of (HTA) presents a curious puzzle. For more than sixty years the Rasch model has been recognized as the necessary and sufficient set of rules for transforming subjective observations into measures. Developed originally by Georg Rasch and subsequently refined through extensive theoretical and practical application, the Rasch framework provides a rigorous approach to constructing invariant measurement scales for latent attributes. It has been applied widely in education, psychology and rehabilitation medicine, Yet despite the central importance of subjective outcomes to HTA, Rasch measurement remains effectively invisible within HTA.

This invisibility is difficult to explain. HTA places considerable emphasis on patient-reported outcomes, health-related quality of life, symptom burden, treatment satisfaction and other latent attributes. These are not directly observable phenomena but manifestations of underlying constructs. If such attributes are to support claims for therapy impact, they require lawful measurement. For six decades Rasch measurement has provided the only recognized framework capable of transforming ordinal subjective responses into invariant quantitative measures while satisfying the requirements of representational measurement. One might therefore expect Rasch concepts to occupy a central position within HTA teaching, research and policy development.

The evidence for US colleges and schools of pharmacy suggests precisely the opposite. The interrogations of the HTA knowledge bases indicate that Rasch measurement is below the radar;

it is never taught because faculty presumably have never been exposed to the distinction between ordinal and ratio measures for subjective observations. This is a critical oversight but one that has lasted for 40 years and exemplified by its absence in PharmD programs. The question is not whether Rasch has been rejected following careful consideration. Rather, the question is why Rasch appears never to have entered the conceptual architecture of PharmD HTA in the first place.

THE GENESIS OF RASCH MEASUREMENT

The origins of Rasch measurement lie in a problem largely ignored by conventional measurement theory in the first half of the twentieth century: how can subjective observations be transformed into measures? By the 1940s the classification of measurement scales had been formalized through the work of Stevens. His influential 1946 paper distinguished nominal, ordinal, interval and ratio scales and specified the arithmetic operations appropriate to each. Stevens provided a powerful framework for understanding the properties of observed variables, but his account largely concerned manifest attributes where the object of measurement was directly observable. Little attention was given to latent attributes such as ability, symptom burden, quality of life or need fulfillment. The central question remained unresolved: how could one construct a measure for attributes that could not be observed directly?

This question became increasingly important as the social and behavioral sciences expanded. Researchers relied heavily upon questionnaires, ratings and patient reports. Numerical scores were generated by summing responses across multiple items, with the resulting totals frequently treated as though they represented quantitative measures. Yet there was no justification for assuming that a numerical score derived from subjective observations possessed interval or ratio properties. Adding responses together merely created another ordinal structure. The underlying problem therefore remained: how could subjective observations be transformed into a lawful measure?

It was this challenge that Georg Rasch addressed in his 1960 work *Probabilistic Models for Some Intelligence and Attainment Tests*. Rasch proposed a remarkably simple but powerful solution. Instead of assuming that numerical scores represented measurement, he specified a model that observations had to satisfy before measurement could be claimed. The model linked person ability and item difficulty within a single probabilistic structure. If the data fitted the model, then the resulting scale possessed invariant properties independent of the particular sample of respondents or items employed. Measurement was therefore not assumed; it had to be demonstrated.

The importance of this contribution is difficult to overstate. Rasch provided the first coherent framework for constructing measures of latent attributes while preserving the principles required for scientific inquiry. Subjective observations could now be transformed into a ruler with meaningful quantitative properties. The focus shifted from aggregate scores to the possession of an underlying attribute located on a latent continuum. Responses became evidence supporting measurement rather than measures in themselves.

The significance of Rasch's achievement became even clearer through the work of Wright and colleagues at the University of Chicago during the 1960s and 1970s. Wright demonstrated that Rasch measurement was not merely a useful statistical model but a measurement framework possessing deep connections with the developing theory of representational measurement. As the

axioms of representational measurement were formalized by Krantz, Luce, Suppes and Tversky in 1971, it became increasingly apparent that the requirements imposed by the Rasch model and the requirements imposed by representational measurement were formally equivalent. Both demanded unidimensionality, invariance, meaningful quantitative structure and the possibility of lawful arithmetic operations.

This insight was crucial. Rasch measurement solved the very problem that conventional scale theory left unresolved. Stevens had described the properties of measurement scales; Rasch provided a method for constructing them in the case of latent attributes. Representational measurement specified the conditions under which arithmetic operations were admissible; Rasch created instruments capable of satisfying those conditions. Together they established a coherent framework for latent measurement that remains unique.

The contrast with contemporary HTA could hardly be greater. Rather than constructing instruments capable of transforming subjective observations into lawful measures, HTA largely accepted ordinal scores, utility weights and preference values as though they already possessed the required quantitative properties. The challenge that motivated Rasch, how to transform subjective observations into measures, was effectively bypassed. Instead of measurement, HTA embraced valuation. Instead of latent attribute possession, it embraced preference aggregation. Instead of demonstrating measurement properties, it assumed them. PharmD teaching was squarely in that camp.

The consequence is that while Rasch measurement evolved into a mature scientific framework used internationally across multiple disciplines, HTA continued to rely upon ordinal and composite structures that fail the standards required for lawful measurement. The irony is striking. The problem that Rasch set out to solve more than sixty years ago is precisely the problem that remains unresolved within modern HTA.

INTERROGATING BELIEF IN RASCH MEASUREMENT

The central question addressed in this paper is straightforward: to what extent is Rasch measurement recognized within the intellectual architecture of HTA? This is not a question that can be answered simply by reviewing isolated publications, textbook references or methodological guidelines. The issue concerns the broader knowledge base that shapes teaching, research, policy recommendations and methodological development. The challenge is therefore to identify whether Rasch concepts are embedded within the conceptual structure of HTA or whether they remain largely absent from accepted discourse.

Recent developments in large language artificial intelligence provide a means of addressing this question. Large language models can be interrogated systematically to assess the extent to which specific propositions are reinforced, neglected or contradicted within a defined knowledge base. The objective is not to assess personal beliefs or institutional declarations. Rather, the objective is to determine how a target knowledge base behaves when confronted with statements drawn from a particular conceptual framework.

For the present analysis, a series of canonical statements was selected to capture the essential features of Rasch measurement. These statements address the core elements of the Rasch framework: the distinction between manifest and latent attributes, transformation of subjective responses into measurement, the Rasch logit ratio scale, possession of latent traits and the relationship between Rasch measurement and representational measurement. Each statement was then interrogated within the knowledge bases of selected HTA institutions.

The statements are:

- There are only two classes of measurement: linear ratio and Rasch logit ratio
- Transforming subjective responses to interval measurement is only possible with Rasch rules
- The Rasch logit ratio scale is the only basis for assessing therapy impact for latent traits
- The outcome of interest for latent traits is the possession of that trait
- The Rasch rules for measurement are identical to the axioms of representational measurement

For each statement, the interrogation process generates a categorical endorsement probability ranging from minimal endorsement to strong endorsement. These probabilities provide an indication of the extent to which the concepts embodied in the statement are reinforced within the target knowledge base. High probabilities indicate strong conceptual support; low probabilities indicate neglect, rejection or absence. When viewed collectively, the resulting endorsement profiles provide a picture of the visibility or invisibility of Rasch measurement within the HTA knowledge base for 6 leading colleges and schools of pharmacy (as in the previous paper): University of North Carolina Eshelman School of Pharmacy; University of Minnesota College of Pharmacy; University of Michigan College of Pharmacy; University of Florida College of Pharmacy; University of Kentucky College of Pharmacy and Ohio State University College of Pharmacy

FAILED ENDORSEMENT OF RASCH APPLICATIONS

The five interrogation statements were selected to capture the essential elements of the Rasch measurement framework and its implications for the assessment of latent attributes. They address the existence of a distinct Rasch class of measurement, the transformation of subjective responses into measurement, the role of the Rasch logit ratio scale in evaluating therapy impact, the concept of possession of a latent trait and the relationship between Rasch measurement and representational measurement. Taken together, the statements provide a concise profile of the extent to which Rasch concepts are embedded within a target knowledge base (Table 1).

TABLE 1 FAILED ENDORSEMENT OF RASCH MEASUREMENT

CATEGORICAL PROBABILITIES ENDORSEMENT						
STATEMENT	Eshelman	Minnesota	Michigan	Florida	Kentucky	Ohio
1. There are only two classes of measurement: linear ratio and Rasch logit ratio	0.05	0.10	0.10	0.05	0.05	0.05
2. Transforming subjective responses to interval measurement is only possible with Rasch rules	0.05	0.10	0.10	0.05	0.05	0.05
3. The Rasch logit ratio scale is the only basis for assessing therapy impact for latent traits	0.05	0.10	0.10	0.05	0.05	0.05
4. The outcome of interest for latent traits is the possession of that trait	0.05	0.10	0.30	0.25	0.30	0.30
5. The Rasch rules for measurement are identical to the axioms of representational measurement	0.05	0.10	0.10	0.05	0.05	0.05

The results presented in Table 1 provide one of the clearest demonstrations of the invisibility of Rasch measurement within contemporary PharmD-related HTA knowledge bases. Across six leading Colleges and Schools of Pharmacy—Eshelman, Minnesota, Michigan, Florida, Kentucky and Ohio State—the endorsement probabilities for statements that define the Rasch framework are consistently at or near floor levels. The significance of these findings extends well beyond disagreement over a particular measurement methodology. They suggest that the conceptual foundations necessary for the measurement of latent attributes are largely absent from the HTA knowledge structures represented by these institutions.

The importance of Rasch measurement lies in the problem it was developed to solve. Since Stevens formalized the scales of measurement in 1946, it has been recognized that ordinal observations cannot support the arithmetic operations required for quantitative inference. Yet many of the outcomes that matter in health care—quality of life, symptom burden, treatment satisfaction, emotional well-being and need fulfilment—are latent attributes. They cannot be observed directly. They are inferred from patterns of responses to carefully designed instruments. The challenge is therefore how to transform ordinal observations into lawful measures. Georg Rasch provided an answer in 1960 through a measurement model that establishes invariant relationships between persons and items, yielding a latent ruler expressed in logits. The Rasch framework is important because it addresses directly the problem of measurement rather than assuming that measurement already exists.

Against this background, the endorsement results are striking. The first statement, that there are only two classes of measurement relevant to therapy assessment—linear ratio measures for manifest attributes and Rasch logit ratio measures for latent attributes—receives endorsement probabilities of only 0.05 to 0.10. This indicates that the distinction between manifest and latent measurement is almost entirely absent. The implication is that the knowledge base does not recognize that different classes of attributes require different measurement structures. Instead, latent attributes appear to be treated as though they can be accommodated within the same numerical framework used for directly observable outcomes.

The second statement, that transforming subjective responses to interval measurement is only possible through Rasch rules, receives an identical pattern of endorsement. Again, probabilities range from 0.05 to 0.10. This is revealing because it suggests that the central measurement problem posed by subjective observations is not recognized. The implication is that ordinal responses are assumed to be adequate for quantitative analysis, either directly or through simple aggregation. Such a position stands in direct contrast to the Rasch framework, where transformation from observation to measurement requires satisfaction of specific measurement conditions. Weak endorsement of this statement therefore points to a failure to appreciate the distinction between observations and measures.

The third statement—that the Rasch logit ratio scale is the only basis for assessing therapy impact for latent traits—receives the same weak endorsement. This is perhaps the most consequential finding. Modern HTA relies heavily upon claims concerning latent attributes. Quality of life, patient satisfaction, treatment burden and many patient-reported outcomes are central to therapy evaluation. Yet the endorsement probabilities indicate that the only measurement framework capable of supporting lawful quantitative claims for such attributes is effectively invisible. Instead,

HTA continues to rely upon ordinal response scores, composite indices and utility structures that do not satisfy the requirements of representational measurement.

The fourth statement produces somewhat higher endorsement probabilities. The proposition that the outcome of interest for latent traits is the possession of that trait receives probabilities ranging from 0.05 at Eshelman to 0.30 at Michigan, Kentucky and Ohio State. Although these values remain weak, they are noticeably higher than those for the other Rasch statements. This suggests partial recognition that latent traits represent attributes that individuals possess to varying degrees. Yet even here the endorsement levels are modest. The implication is that while there may be some appreciation of latent constructs, there is little understanding of the measurement framework necessary to quantify them. Possession without measurement remains a concept rather than a scientific claim.

The fifth statement—that the Rasch rules for measurement are identical to the axioms of representational measurement—returns to the floor pattern of 0.05 to 0.10. This is an important result because it concerns the relationship between Rasch measurement and the broader theory of measurement. One of the major contributions of Wright and others was the demonstration that Rasch measurement satisfies the requirements of representational measurement for latent attributes. Weak endorsement of this statement indicates that the relationship between measurement theory and latent measurement is not widely recognized. Rasch appears not as a central component of measurement science but as a concept largely external to the PharmD HTA knowledge base.

The most remarkable feature of the results is their consistency. The six institutions differ in size, reputation, faculty composition and research focus. Yet the endorsement profiles are virtually identical. This suggests that the findings do not reflect local variations in curriculum or institutional priorities. Rather, they point to a common knowledge structure shared across leading pharmacy schools. The invisibility of Rasch appears not to be an isolated omission but a systemic characteristic of HTA education.

This consistency becomes even more significant when viewed alongside previous interrogations of HTA agencies, research centres, journals and professional organizations. Across more than 230 interrogations in multiple countries, Rasch measurement repeatedly receives minimal endorsement. The pharmacy schools therefore reproduce a pattern already evident throughout the wider HTA community. What is being observed is not simply a curricular omission but a global knowledge structure in which Rasch measurement remains largely absent.

CONCLUSION

The consequences for PharmD education are substantial. Students are introduced to utilities, QALYs, cost-effectiveness analysis, simulation modelling and reference-case methodologies as though these represent the accepted foundations of therapy assessment. Yet the measurement framework necessary for evaluating latent attributes is largely absent. The result is that students learn how to manipulate numerical constructs without being introduced to the measurement principles that determine whether those constructs possess quantitative meaning.

This omission has direct implications for patient-reported outcomes. Without Rasch measurement, subjective responses remain ordinal observations. Summing responses, averaging scores or incorporating them into utility algorithms does not transform them into lawful measures. Yet much of HTA practice proceeds as though such transformations have already occurred. The endorsement profile in Table 1 suggests that this assumption is deeply embedded within the PharmD knowledge base.

The findings also help explain the persistence of measurement inversion. If Rasch measurement is absent, then there is no recognized framework for measuring latent attributes. In its place emerge utilities, composite indices and valuation exercises. Arithmetic proceeds on entities that have never been established as measures. The result is the inversion identified in previous analyses: arithmetic precedes measurement. The invisibility of Rasch therefore provides an explanation for why measurement inversion has become institutionalized.

More broadly, the results suggest that PharmD programs have inherited the intellectual architecture of the reference-case framework without examining its measurement foundations. Debate focuses on utilities, comparators, discount rates, sensitivity analyses and model assumptions. The prior question on how latent attributes are measured receives little attention. Rasch measurement remains outside the conceptual boundaries of the framework.

The conclusion is difficult to avoid. Across six leading Colleges and Schools of Pharmacy, the defining propositions of Rasch measurement receive consistently weak endorsement. The findings point to a near-complete absence of Rasch concepts from the PharmD-related HTA knowledge base. This is not simply a matter of methodological preference. It represents the omission of the only coherent framework for transforming subjective observations into lawful measures of latent attributes. In consequence, the measurement of therapy impact for latent traits remains largely invisible, while ordinal scores, utilities and composite constructs continue to dominate. The result is a curriculum and research culture that reproduces measurement inversion while neglecting the one measurement framework capable of overcoming it.

ACKNOWLEDGEMENT

I acknowledge that I have used OpenAI technologies, including the large language model, to assist in the development of this work. All final decisions, interpretations, and responsibilities for the content rest solely with me.

REFERENCES

Bond T, Zi Yan, Heene M. Applying the Rasch Model: Fundamental Measurement in the Human Sciences (4th Ed.) New York: Routledge, 2021

The End of the Reference Case: Reconstructing HTA. Logit Working Paper No. 345.
<https://maimonresearch.com/logit-working-paper-no-345-june-2026/>

United States: Measurement Evasion with the National Pharmaceutical Council. Logit Working Paper No 2. <https://maimonresearch.com/logit-working-paper-no-2>

United States: What happens if nothing changes? Questions for the future of PharmD and HTA. Logit Working Paper No 664. <https://maimonresearch.com/logit-working-paper-no-664-may-2026/>

United States: Pharmacy Colleges and Schools – Measurement Inversion and Arithmetic Chaos in HTA Programs. Logit Working Paper No 337. <https://maimonresearch.com/logit-working-paper-no-337-june-2026/>

