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Item Difficulty in Item Analysis of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-IV) - Using Item Response Theory Approach

Olufemi Adetunji Adepoju
Department of Educational Foundations and Curriculum Studies,Faculty of Specialised and Professional Education, Emmanuel Alayande University of Education, Oyo

Isiaka Kayode Dauda
Department of Educational Foundations and Curriculum Studies, Faculty of Specialised and Professional Education, Emmanuel Alayande University of Education, Oyo

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Abstract: *Measurement theories have gone through a lot of evolution; one of which is Item Response Theory, which is an improvement on the Classical Test Theory (CTT). This study looked into the difficulty status or difficulty parameter of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-IV). 512 subjects were randomly selected and administered the WPPSI-IV instrument. Findings from the study show that 241 items were good, 6 were easy, and 23 were difficult. It was therefore concluded that some items in the WPPSI-IV are adaptable and adoptable for use to measure children's intelligence, age 7. It was recommended that WPPSI-IV is good enough and should therefore be administered to measure children's intelligence approximately age 7. Also, it was recommended that the difficult and easy items could be replaced with better ones*.

Keywords: item response theory, classical test theory, pupils, measurement, intelligence.

INTRODUCTION

One of the remarkable contributions of psychometrics to the field of psychology is item analysis. Item analysis therefore arises as a result of the need to assess the quality of each item as well as

the whole test with emphasis on areas like difficulty, discrimination, and distractor analysis to improve assessment and identify grey areas that require improvement. Adewuyi & Oluokun (2001) defined item analysis as a process of determining the appropriateness of each item in the test. It is a statistical analysis of students' responses on examination items and the relationship between them.

Ashraf & Jassem, (2020) posited that item response theory is a process which examines response to individual test items (questions) in order to assess individual test items and the test as a whole. Psychologists have come up with two approaches to item analysis namely: the Classical Test Theory (CTT) and the Item Response Theory (IRT). Le-Dai (2013) expressed that CTT was the dominant approach until 1953 when IRT emerged.

Frederic Lord came up with the Latent trait theory (otherwise called Item Response Theory). It implies that the CTT (Classical Test Theory) served very well for years in test item development with a lot of shortcomings such that are coming from group-dependent items and test statistics i.e item discrimination and item difficulty (Anastasi & Urbina 1985); Hambleton & Swaminathan, (1985); Holt, (2014)). Classical Test Theory therefore evaluates testees based on their overall scores in the test rather than emphasizing on the performance of each of the item such as looking at how difficult and discriminating each item is in the test. Item Response Theory is also a psychometric approach, emphasizing that an individual's response to a particular test item is influenced by the qualities of the individual (Camilli & Shepard, 1994; Chalmers, 2012; Holt, 2014). Wechsler Preschool and Primary Scale of Intelligence (WPPSI) is an individually administered, standardized instrument for assessing the intelligence of children aged 4 to 6 years, used throughout the world (Hanagan & Kaufman, 2009).

Statement of the problem

The global acceptability of WPPSI-IV has made it an instrument to be studied. Studying it implies that one studies the psychometric properties, its uses, as well as the characteristics of each of the item to pave way for further research or study of the instrument.

Research Questions

These research questions were raised for the purpose of this research work:

1. What are the difficult items in the test that could be considered not good enough for the age of the testees?

2. What are the items that were too easy for the age of the testees?

Research Design

The design for this study is survey. This allows for the collection of data in raw form from participants.

Population and Sample:
512 pupils in public schools of approximately 7 years were selected through a random sampling method (lucky dip).

Instrumentation
The Wechsler Preschool and Primary Scale of Intelligence were administered across the selected schools. This contains 270 items which spread across 15 sub-scales of Block Design, Information, Matrix Reasoning, Picture Memory, Similarities, Picture Concepts, Cancellation, Zoo Location, Object Assembly, Vocabulary, Animal Coding, Comprehension, Receptive Vocabulary and Picture Naming. Convergent validity testing was carried out on the WPPSI-IV which produced 0.73 average index, and a test-retest reliability was carried out which produced 0.74 coefficient.

Method of Data Analysis
Data was analyzed with the use of (R) supported IRT Software tested at significance level of 0.05

RESULTS AND DISCUSSION

Item	Difficulty	Decision	Discrimination		Decision
BlockDesignCan1	-1.12	Good	0.50	Discrim	Good
BlockDesignCan2	0.09	Good	1.27	Discrim	Good
BlockDesignCan3	-0.19	Good	1.02	Discrim	Good
BlockDesignCan4	0.27	Good	0.95	Discrim	Good
BlockDesignCan5	-0.02	Good	0.76	Discrim	Good
BlockDesignCan6	0.38	Good	1.10	Discrim	Good
BlockDesignCan7	0.31	Good	1.13	Discrim	Good
BlockDesignCan8	0.53	Good	1.59	Discrim	Good
BlockDesignCan9	0.34	Good	0.88	Discrim	Good
BlockDesignCan10	0.39	Good	1.13	Discrim	Good
BlockDesignCan11	0.45	Good	0.77	Discrim	Good
InformationCan1	0.21	Good	0.57	Discrim	Good
InformationCan2	0.52	Good	2.17	Discrim	Good
InformationCan3	0.30	Good	1.56	Discrim	Good

InformationCan4	0.14	Good	1.20	Discrim	Good
InformationCan5	0.15	Good	1.16	Discrim	Good
InformationCan6	0.72	Good	0.95	Discrim	Good
InformationCan7	0.28	Good	1.05	Discrim	Good
InformationCan8	0.71	Good	1.35	Discrim	Good
InformationCan9	0.45	Good	1.19	Discrim	Good
InformationCan10	0.34	Good	1.62	Discrim	Good
InformationCan11	0.16	Good	1.44	Discrim	Good
InformationCan12	0.37	Good	2.53	Discrim	Good
InformationCan13	0.36	Good	1.00	Discrim	Good
MatrixReasoningCan1	40.72	Easy	0.03	Discrim	Bad
MatrixReasoningCan2	-2.99	Good	-0.58	Discrim	Good
MatrixReasoningCan3	0.35	Good	0.98	Discrim	Good
MatrixReasoningCan4	-3.18	Difficult	-0.51	Discrim	Bad
MatrixReasoningCan5	-7.02	Difficult	-0.20	Discrim	Bad
MatrixReasoningCan6	-3.73	Difficult	-0.40	Discrim	Bad
MatrixReasoningCan7	0.20	Good	0.94	Discrim	Good
MatrixReasoningCan8	45.14	Easy	0.02	Discrim	Bad
MatrixReasoningCan9	-20.01	Easy	-0.09	Discrim	Bad
MatrixReasoningCan10	-3.54	Difficult	-0.50	Discrim	Bad
MatrixReasoningCan11	-3.34	Difficult	-0.60	Discrim	Bad
MatrixReasoningCan12	-2.64	Good	-0.62	Discrim	Good
MatrixReasoningCan13	0.09	Good	1.04	Discrim	Good
MatrixReasoningCan14	-3.40	Difficult	-0.68	Discrim	Bad
MatrixReasoningCan15	-99.10	Easy	-0.02	Discrim	Bad
MatrixReasoningCan16	-2.12	Good	-0.76	Discrim	Good
MatrixReasoningCan17	-5.43	Difficult	-0.32	Discrim	Bad
MatrixReasoningCan18	0.68	Good	0.98	Discrim	Good
MatrixReasoningCan19	-69.67	Easy	-0.02	Discrim	Bad
MatrixReasoningCan20	-4.48	Difficult	-0.55	Discrim	Bad

BugSearchCan1	-0.39	Good	0.64	Discrim	Good
BugSearchCan2	0.66	Good	1.57	Discrim	Good
BugSearchCan3	0.48	Good	1.32	Discrim	Good
BugSearchCan4	0.32	Good	1.24	Discrim	Good
BugSearchCan5	-0.05	Good	1.04	Discrim	Good
BugSearchCan6	0.35	Good	0.78	Discrim	Good
BugSearchCan7	0.38	Good	1.38	Discrim	Good
BugSearchCan8	0.45	Good	1.69	Discrim	Good
BugSearchCan9	-0.02	Good	1.22	Discrim	Good
BugSearchCan10	0.32	Good	1.14	Discrim	Good
BugSearchCan11	0.11	Good	1.37	Discrim	Good
BugSearchCan12	0.33	Good	1.83	Discrim	Good
BugSearchCan13	0.25	Good	1.31	Discrim	Good
BugSearchCan14	0.41	Good	1.97	Discrim	Good
BugSearchCan15	0.28	Good	1.20	Discrim	Good
BugSearchCan16	0.39	Good	1.31	Discrim	Good
BugSearchCan17	0.26	Good	1.90	Discrim	Good
BugSearchCan18	0.40	Good	1.65	Discrim	Good
BugSearchCan19	0.38	Good	1.78	Discrim	Good
BugSearchCan20	0.36	Good	0.91	Discrim	Good
BugSearchCan21	0.34	Good	1.20	Discrim	Good
BugSearchCan22	0.62	Good	1.62	Discrim	Good
BugSearchCan23	0.62	Good	1.95	Discrim	Good
BugSearchCan24	0.39	Good	1.28	Discrim	Good
BugSearchCan25	0.17	Good	1.22	Discrim	Good
PictureMemoryCan1	-1.51	Good	1.00	Discrim	Good
PictureMemoryCan2	-1.05	Good	-1.18	Discrim	Good
PictureMemoryCan3	-0.08	Good	1.23	Discrim	Good
PictureMemoryCan4	-0.73	Good	0.72	Discrim	Good
PictureMemoryCan5	-1.51	Good	-0.65	Discrim	Good
PictureMemoryCan6	-0.16	Good	0.80	Discrim	Good

PictureMemoryCan7	-1.57	Good	-0.67	Discrim	Good
PictureMemoryCan8	-0.52	Good	1.16	Discrim	Good
PictureMemoryCan9	-0.52	Good	1.35	Discrim	Good
PictureMemoryCan10	-1.53	Good	-0.32	Discrim	Good
PictureMemoryCan11	-1.91	Good	-0.54	Discrim	Good
PictureMemoryCan12	-1.47	Good	-0.09	Discrim	Good
PictureMemoryCan13	-1.93	Good	-0.54	Discrim	Good
PictureMemoryCan14	0.78	Good	0.68	Discrim	Good
PictureMemoryCan15	-2.79	Good	-0.31	Discrim	Good
PictureMemoryCan16	-0.64	Good	0.52	Discrim	Good
PictureMemoryCan17	-1.09	Good	-0.28	Discrim	Good
PictureMemoryCan18	-1.16	Good	0.59	Discrim	Good
PictureMemoryCan19	2.91	Good	1.13	Discrim	Good
PictureMemoryCan20	-1.21	Good	-0.30	Discrim	Good
PictureMemoryCan21	0.03	Good	0.48	Discrim	Good
PictureMemoryCan22	-2.39	Good	-0.23	Discrim	Good
PictureMemoryCan23	0.26	Good	0.81	Discrim	Good
PictureMemoryCan24	0.83	Good	3.64	No Discrim	Good
PictureMemoryCan25	-0.50	Good	-0.69	Discrim	Good
PictureMemoryCan26	-0.22	Good	0.63	Discrim	Good
PictureMemoryCan27	66.33	Easy	-0.01	Discrim	Bad
PictureMemoryCan28	-4.51	Difficult	-0.18	Discrim	Bad
PictureMemoryCan29	-1.55	Good	0.38	Discrim	Good
PictureMemoryCan30	2.27	Good	-0.14	Discrim	Good
SimilaritiesCan1	-0.46	Good	0.79	Discrim	Good
SimilaritiesCan2	0.29	Good	1.20	Discrim	Good
SimilaritiesCan3	0.03	Good	0.95	Discrim	Good
SimilaritiesCan4	0.15	Good	1.00	Discrim	Good
SimilaritiesCan5	0.12	Good	1.01	Discrim	Good
SimilaritiesCan6	0.07	Good	0.87	Discrim	Good
SimilaritiesCan7	0.30	Good	0.91	Discrim	Good
SimilaritiesCan8	0.40	Good	0.95	Discrim	Good

SimilaritiesCan9	0.34	Good	1.21	Discrim	Good
SimilaritiesCan10	0.44	Good	0.92	Discrim	Good
SimilaritiesCan11	0.41	Good	0.89	Discrim	Good
SimilaritiesCan12	0.42	Good	1.00	Discrim	Good
SimilaritiesCan13	0.33	Good	1.24	Discrim	Good
SimilaritiesCan14	0.34	Good	1.13	Discrim	Good
SimilaritiesCan15	0.36	Good	1.09	Discrim	Good
SimilaritiesCan16	0.55	Good	0.78	Discrim	Good
SimilaritiesCan17	0.71	Good	1.01	Discrim	Good
SimilaritiesCan18	0.90	Good	0.86	Discrim	Good
PictureConceptsCan1	0.36	Good	-0.25	Discrim	Good
PictureConceptsCan2	0.96	Good	3.40	No Discrim	Bad
PictureConceptsCan3	-1.03	Good	-0.51	Discrim	Good
PictureConceptsCan4	-0.63	Good	0.50	Discrim	Good
PictureConceptsCan5	-4.13	Difficult	-0.38	Discrim	Bad
PictureConceptsCan6	30.80	Easy	-0.06	Discrim	Bad
PictureConceptsCan7	-0.03	Good	0.77	Discrim	Good
PictureConceptsCan8	-3.02	Difficult	-0.15	Discrim	Bad
PictureConceptsCan9	-2.11	Good	-0.38	Discrim	Good
PictureConceptsCan10	-0.86	Good	-0.51	Discrim	Good
PictureConceptsCan11	13.34	Easy	0.08	Discrim	Bad
PictureConceptsCan12	-4.85	Difficult	-0.18	Discrim	Bad
PictureConceptsCan13	-0.02	Good	1.58	Discrim	Good
PictureConceptsCan14	0.26	Good	1.46	Discrim	Good
PictureConceptsCan15	-0.24	Good	0.63	Discrim	Good
PictureConceptsCan16	2.97	Good	1.21	Discrim	Good
PictureConceptsCan17	-0.81	Good	-0.55	Discrim	Good
PictureConceptsCan18	0.27	Good	0.36	Discrim	Good
PictureConceptsCan19	-0.08	Good	0.56	Discrim	Good
PictureConceptsCan20	-5.09	Difficult	-0.37	Discrim	Bad
CancellationCan1	0.11	Good	0.91	Discrim	Good
CancellationCan2	0.62	Good	1.78	Discrim	Good

CancellationCan3	0.38	Good	1.62	Discrim	Good
CancellationCan4	0.43	Good	1.34	Discrim	Good
CancellationCan5	0.49	Good	1.40	Discrim	Good
CancellationCan6	0.54	Good	1.14	Discrim	Good
CancellationCan7	0.24	Good	1.47	Discrim	Good
CancellationCan8	0.61	Good	1.77	Discrim	Good
CancellationCan9	0.51	Good	1.34	Discrim	Good
CancellationCan10	0.41	Good	1.28	Discrim	Good
CancellationCan11	0.53	Good	1.34	Discrim	Good
CancellationCan12	0.79	Good	1.63	Discrim	Good
CancellationCan13	0.57	Good	1.24	Discrim	Good
CancellationCan14	0.92	Good	2.05	Discrim	Good
CancellationCan15	1.26	Good	1.11	Discrim	Good
ZooLocationCan1	0.12	Good	0.95	Discrim	Good
ZooLocationCan2	0.64	Good	1.44	Discrim	Good
ZooLocationCan3	0.53	Good	1.26	Discrim	Good
ZooLocationCan4	0.40	Good	1.34	Discrim	Good
ZooLocationCan5	0.49	Good	1.05	Discrim	Good
ZooLocationCan6	0.75	Good	0.95	Discrim	Good
ZooLocationCan7	0.35	Good	1.20	Discrim	Good
ZooLocationCan8	0.89	Good	1.08	Discrim	Good
ZooLocationCan9	0.61	Good	1.32	Discrim	Good
ZooLocationCan10	0.47	Good	0.90	Discrim	Good
ZooLocationCan11	0.44	Good	0.91	Discrim	Good
ZooLocationCan12	0.82	Good	1.12	Discrim	Good
ZooLocationCan13	0.13	Good	1.17	Discrim	Good
ZooLocationCan14	0.61	Good	1.37	Discrim	Good
ZooLocationCan15	0.50	Good	1.01	Discrim	Good
ObjectAssembleCan1	0.24	Good	1.30	Discrim	Good
ObjectAssembleCan2	0.69	Good	2.21	Discrim	Good
ObjectAssembleCan3	0.79	Good	2.12	Discrim	Good
ObjectAssembleCan4	0.72	Good	1.51	Discrim	Good
ObjectAssembleCan5	0.85	Good	1.49	Discrim	Good

ObjectAssembleCan6	0.77	Good	1.40	Discrim	Good
ObjectAssembleCan7	0.68	Good	1.41	Discrim	Good
ObjectAssembleCan8	0.89	Good	1.72	Discrim	Good
ObjectAssembleCan9	0.82	Good	1.78	Discrim	Good
ObjectAssembleCan10	0.62	Good	1.51	Discrim	Good
ObjectAssembleCan11	0.45	Good	1.24	Discrim	Good
ObjectAssembleCan12	1.19	Good	1.33	Discrim	Good
VocabularyCan1	-0.34	Good	0.91	Discrim	Good
VocabularyCan2	0.54	Good	1.22	Discrim	Good
VocabularyCan3	0.20	Good	1.20	Discrim	Good
VocabularyCan4	0.37	Good	1.00	Discrim	Good
VocabularyCan5	0.09	Good	1.05	Discrim	Good
VocabularyCan6	0.20	Good	0.92	Discrim	Good
VocabularyCan7	0.44	Good	1.33	Discrim	Good
VocabularyCan8	0.46	Good	1.21	Discrim	Good
VocabularyCan9	0.54	Good	1.04	Discrim	Good
VocabularyCan10	0.65	Good	1.21	Discrim	Good
VocabularyCan11	0.55	Good	1.16	Discrim	Good
VocabularyCan12	0.70	Good	1.45	Discrim	Good
VocabularyCan13	0.62	Good	1.40	Discrim	Good
VocabularyCan14	0.53	Good	2.08	Discrim	Good
VocabularyCan15	0.49	Good	1.51	Discrim	Good
VocabularyCan16	0.52	Good	1.22	Discrim	Good
VocabularyCan17	0.27	Good	1.49	Discrim	Good
VocabularyCan18	0.72	Good	1.86	Discrim	Good
VocabularyCan19	0.51	Good	1.70	Discrim	Good
VocabularyCan20	0.78	Good	1.55	Discrim	Good
AnimalCodingcan1	-0.41	Good	1.31	Discrim	Good
AnimalCodingcan2	0.35	Good	1.66	Discrim	Good
AnimalCodingcan3	0.34	Good	1.46	Discrim	Good
AnimalCodingcan4	0.28	Good	1.48	Discrim	Good
AnimalCodingcan5	0.12	Good	1.02	Discrim	Good
AnimalCodingcan6	0.45	Good	1.13	Discrim	Good

AnimalCodingcan7	0.36	Good	1.75	Discrim	Good
AnimalCodingcan8	0.83	Good	1.49	Discrim	Good
AnimalCodingcan9	0.71	Good	1.63	Discrim	Good
AnimalCodingcan10	0.61	Good	0.97	Discrim	Good
AnimalCodingcan11	0.58	Good	1.52	Discrim	Good
AnimalCodingcan12	0.68	Good	1.70	Discrim	Good
AnimalCodingcan13	0.42	Good	1.22	Discrim	Good
AnimalCodingcan14	0.62	Good	1.45	Discrim	Good
AnimalCodingcan15	0.74	Good	0.87	Discrim	Good
ComprehensionCan1	-0.26	Good	0.93	Discrim	Good
ComprehensionCan2	0.63	Good	2.00	Discrim	Good
ComprehensionCan3	0.60	Good	2.26	Discrim	Good
ComprehensionCan4	0.36	Good	1.75	Discrim	Good
ComprehensionCan5	0.47	Good	1.31	Discrim	Good
ComprehensionCan6	0.71	Good	1.05	Discrim	Good
ComprehensionCan7	0.50	Good	1.39	Discrim	Good
ComprehensionCan8	0.55	Good	1.41	Discrim	Good
ComprehensionCan9	0.74	Good	1.59	Discrim	Good
ComprehensionCan10	0.38	Good	1.78	Discrim	Good
ComprehensionCan11	0.65	Good	1.15	Discrim	Good
ComprehensionCan12	0.70	Good	1.30	Discrim	Good
ComprehensionCan13	0.60	Good	1.36	Discrim	Good
ComprehensionCan14	0.78	Good	1.60	Discrim	Good
ComprehensionCan15	0.73	Good	1.34	Discrim	Good
ComprehensionCan16	0.33	Good	0.92	Discrim	Good
ComprehensionCan17	0.63	Good	1.09	Discrim	Good
ComprehensionCan18	0.93	Good	1.38	Discrim	Good
ComprehensionCan19	0.51	Good	1.35	Discrim	Good
ComprehensionCan20	0.92	Good	0.94	Discrim	Good
ReceptiveVocabularyCan1	-0.31	Good	0.98	Discrim	Good

ReceptiveVocabularyCan2	-2.50	Good	-0.80	Discrim	Good
ReceptiveVocabularyCan3	-2.62	Good	-0.36	Discrim	Good
ReceptiveVocabularyCan4	-5.73	Difficult	-0.31	Discrim	Bad
ReceptiveVocabularyCan5	-4.96	Difficult	-0.22	Discrim	Bad
ReceptiveVocabularyCan6	0.54	Good	1.00	Discrim	Good
ReceptiveVocabularyCan7	-3.32	Difficult	-0.65	Discrim	Bad
ReceptiveVocabularyCan8	23.79	Easy	0.04	Discrim	Bad
ReceptiveVocabularyCan9	0.69	Good	1.00	Discrim	Good
ReceptiveVocabularyCan10	0.25	Good	0.94	Discrim	Good
ReceptiveVocabularyCan11	-3.05	Difficult	-0.81	Discrim	Bad
ReceptiveVocabularyCan12	-3.23	Difficult	-0.50	Discrim	Bad
ReceptiveVocabularyCan13	-4.67	Difficult	-0.21	Discrim	Bad
ReceptiveVocabularyCan14	-4.75	Difficult	-0.42	Discrim	Bad
ReceptiveVocabularyCan15	18.14	Easy	-0.09	Discrim	Bad
ReceptiveVocabularyCan16	-6.98	Difficult	-0.36	Discrim	Bad
ReceptiveVocabularyCan17	-6.63	Difficult	-0.12	Discrim	Bad
ReceptiveVocabularyCan18	-9.89	Difficult	-0.11	Discrim	Bad
ReceptiveVocabularyCan19	0.57	Good	1.71	Discrim	Good
PictureNamingCan1	-0.47	Good	0.76	Discrim	Good
PictureNamingCan2	0.34	Good	1.68	Discrim	Good
PictureNamingCan3	0.45	Good	1.42	Discrim	Good
PictureNamingCan4	0.26	Good	1.26	Discrim	Good
PictureNamingCan5	0.32	Good	1.13	Discrim	Good
PictureNamingCan6	0.51	Good	1.12	Discrim	Good
PictureNamingCan7	0.44	Good	1.35	Discrim	Good
PictureNamingCan8	0.40	Good	1.59	Discrim	Good
PictureNamingCan9	0.04	Good	0.99	Discrim	Good
PictureNamingCan10	-0.04	Good	1.42	Discrim	Good
PictureNamingCan11	0.33	Good	1.14	Discrim	Good
PictureNamingCan12	0.38	Good	1.35	Discrim	Good
PictureNamingCan13	0.03	Good	1.33	Discrim	Good

PictureNamingCan14	0.68	Good	1.14	Discrim	Good
PictureNamingCan15	0.24	Good	1.15	Discrim	Good
PictureNamingCan16	1.21	Good	2.66	Discrim	Good

The analysis from the table above shows that out of 270 items, 43 items were difficult, 11 were easy, and 14 were good items i.e. not too difficult and not too easy items. This shows that the WPPSI-V is a good instrument and suitable for use for children or pupils age 7 approximately.

CONCLUSION

Most of the WPPSI-IV items were good (89.3%) i.e. exhibit the attribute or characteristic of being good even though this did not spread across all the sub-scales.

Recommendations

The following recommendations were made in view of the study:
The difficult and the easy items could be replaced with new tested items.
WPPSI-IV should be adapted or even adopted to measure children's intelligence because most of the items were suitable for age 4-7.
Measurement approaches other than Item Response Theory could be tried to see if variation could occur in item difficulty.

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