ASVAB Psychometric Support

Development of ASVAB Forms 11–15

Presenter: **D. Matthew Trippe, HumRRO**

September 17, 2020

Overview

- Re-introduction of project objectives
- ASVAB form assembly goals
- Form assembly results
- Schedule
- Questions/Discussion

Project Objectives

- Goal: develop more ASVAB forms on a more aggressive schedule
- Begin with forms 11–15
- Revised goal
  - Developed one additional form over original goal of 4 forms
  - Replace operational forms & PiCAT
  - Expand items available for form assembly
    - Unused/unassigned items from forms 5–9 assembly
    - Additional item series (89800 & 89900)
- Forms 11–15 were assembled from ten experimental item "series," or sets, of 100 experimental items per test (i.e., AR, MK, PC, WK, GS, etc.)
- Each experimental item is reviewed for psychometric (e.g., model fit, information) and content quality
- Items that survive review process move on to form assembly
- Enemy groups are identified to mitigate local dependence

ASVAB Form Assembly

- CAT forms
  - CAT administration is based on forms from which a *potentially* unique set of items is administered to each examinee
  - Forms need to contain items from the full range of content and difficulty
  - Forms need to contain sufficient information/score precision across the full range of ability
- Form assembly goals
  - For each test (i.e., AR, MK, PC, etc.), assign each item to one of five forms (11, 12, 13, 14, 15)
  - Maximize conditional precision levels of each form
  - Constrain conditional precision levels to be comparable across forms
  - Account for “enemy” items—distribute them evenly across pools
  - Account for content taxonomies where applicable (GS, AO)

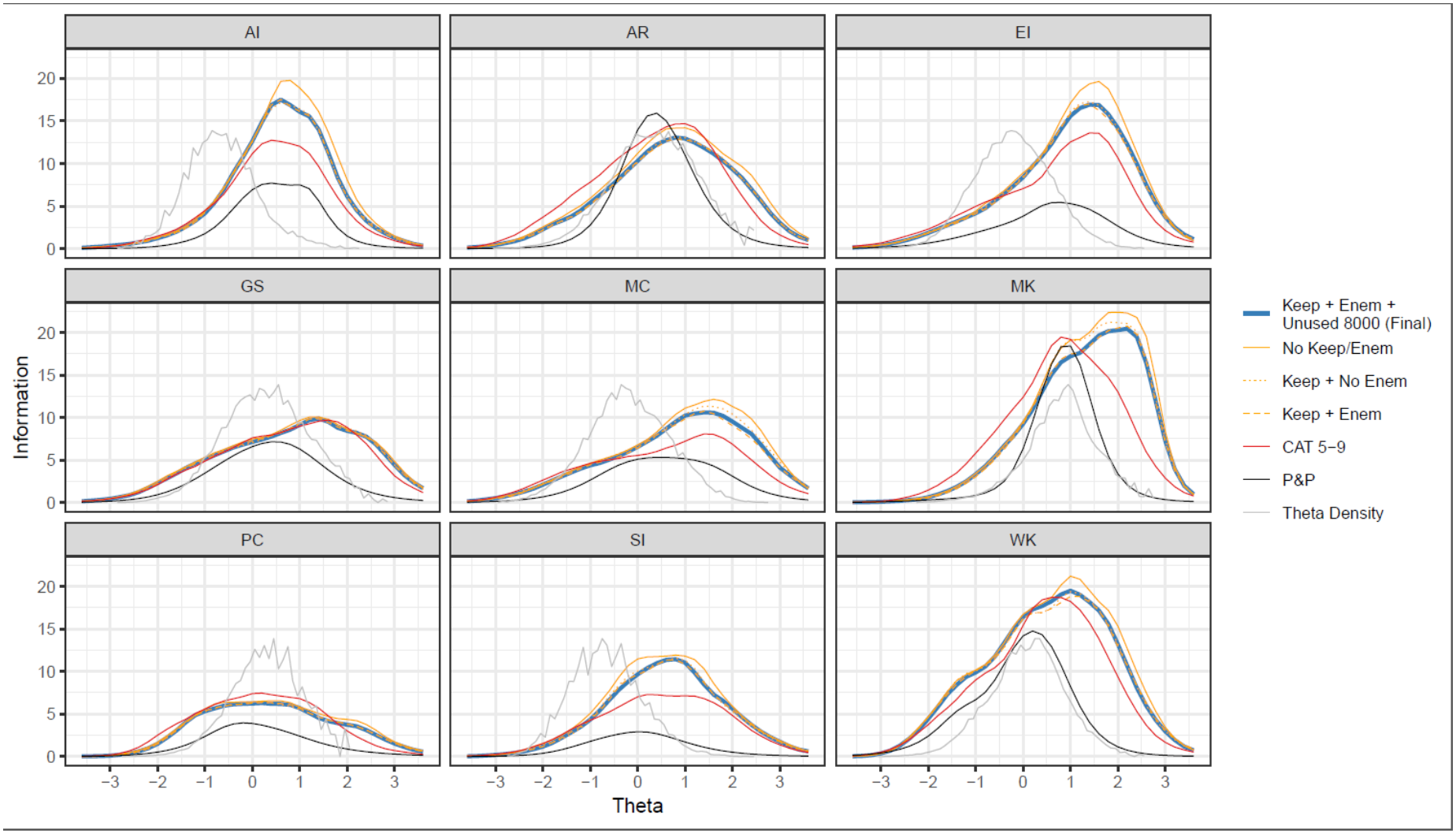
Form Assembly Results

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

ASVAB Form Assembly: Simulation Findings

- For most ASVAB tests (AI, EI, GS, MC, PC, SI, WK)
  - Information alignment is comparable to existing operational forms
  - Information levels are comparable to existing operational forms
- Arithmetic Reasoning (AR)
  - Information levels
    - Generally lower than current operational CAT forms
    - Lower than P&P information in the middle of the distribution
  - Reliability
    - Average slightly lower (.02) than forms 5–9
    - Virtually identical to P&P
- Math Knowledge (MK)
  - Information levels
    - Not well aligned with existing operational forms or observed applicant ability
    - May be able to influence in future by providing targeted guidance to item development teams
  - Reliability
    - Average slightly lower (.01–.03) than forms 5–9
    - Average slightly higher (.02–.03) than P&P

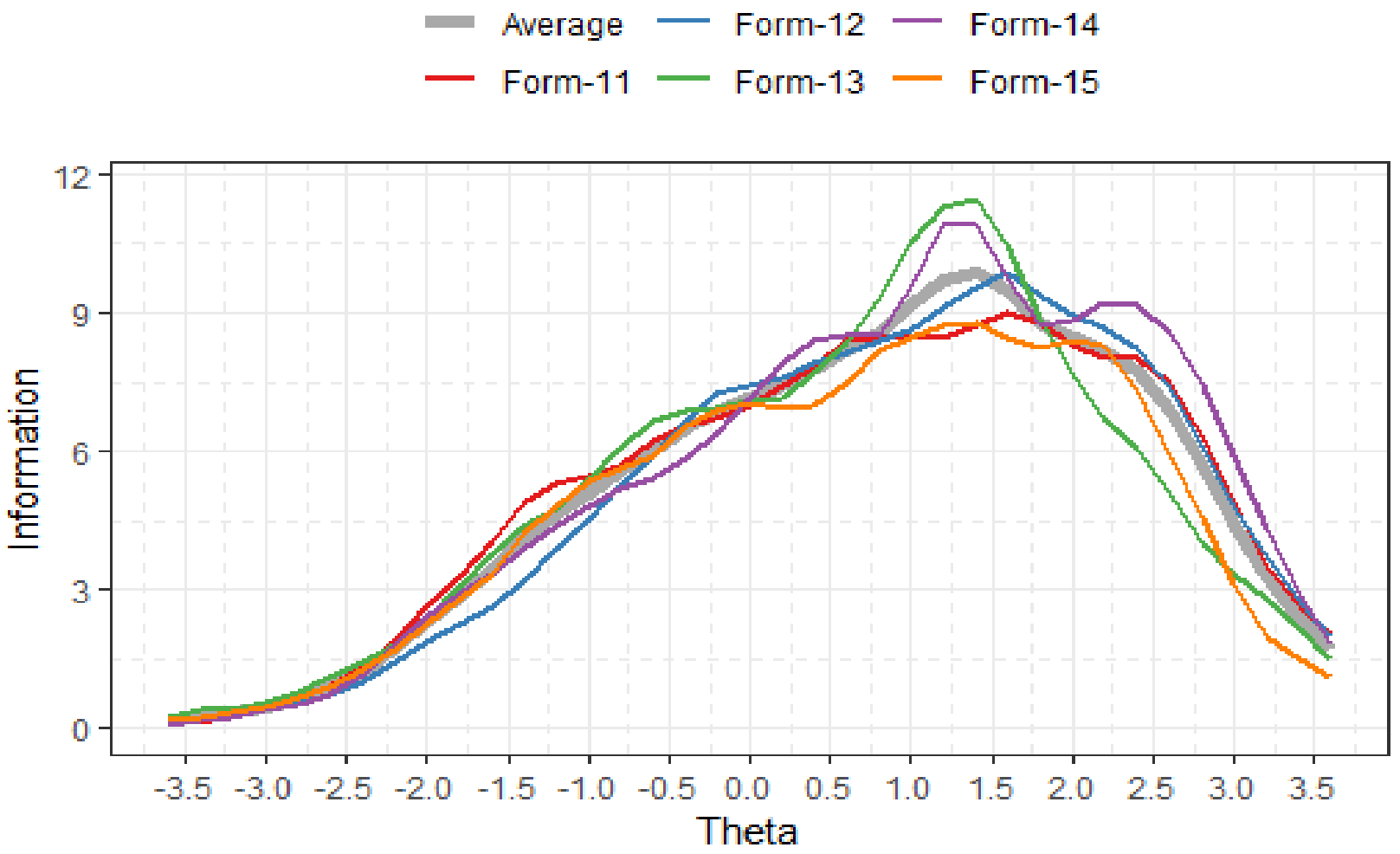
ASVAB Form Assembly: Summary Results



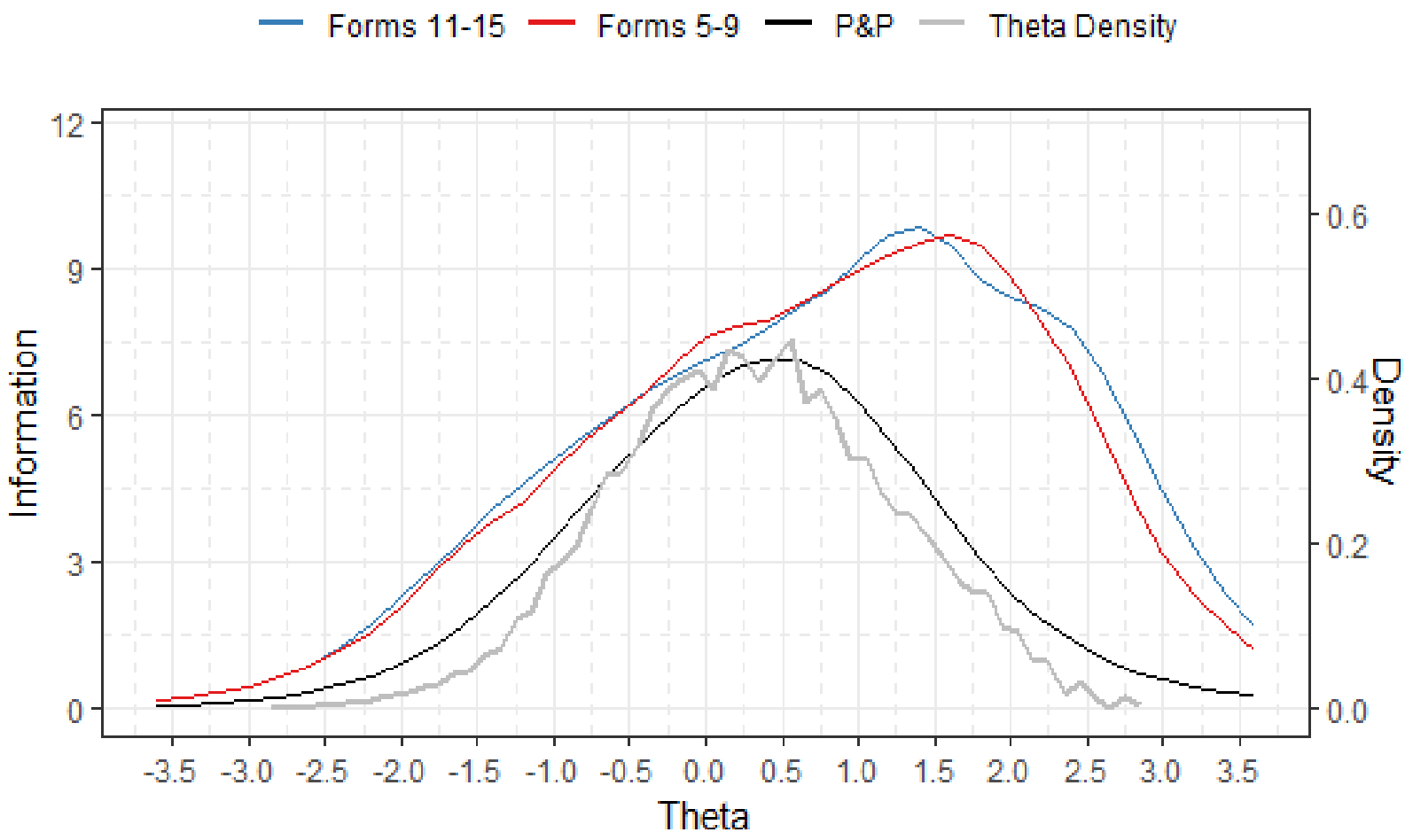
General Science

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

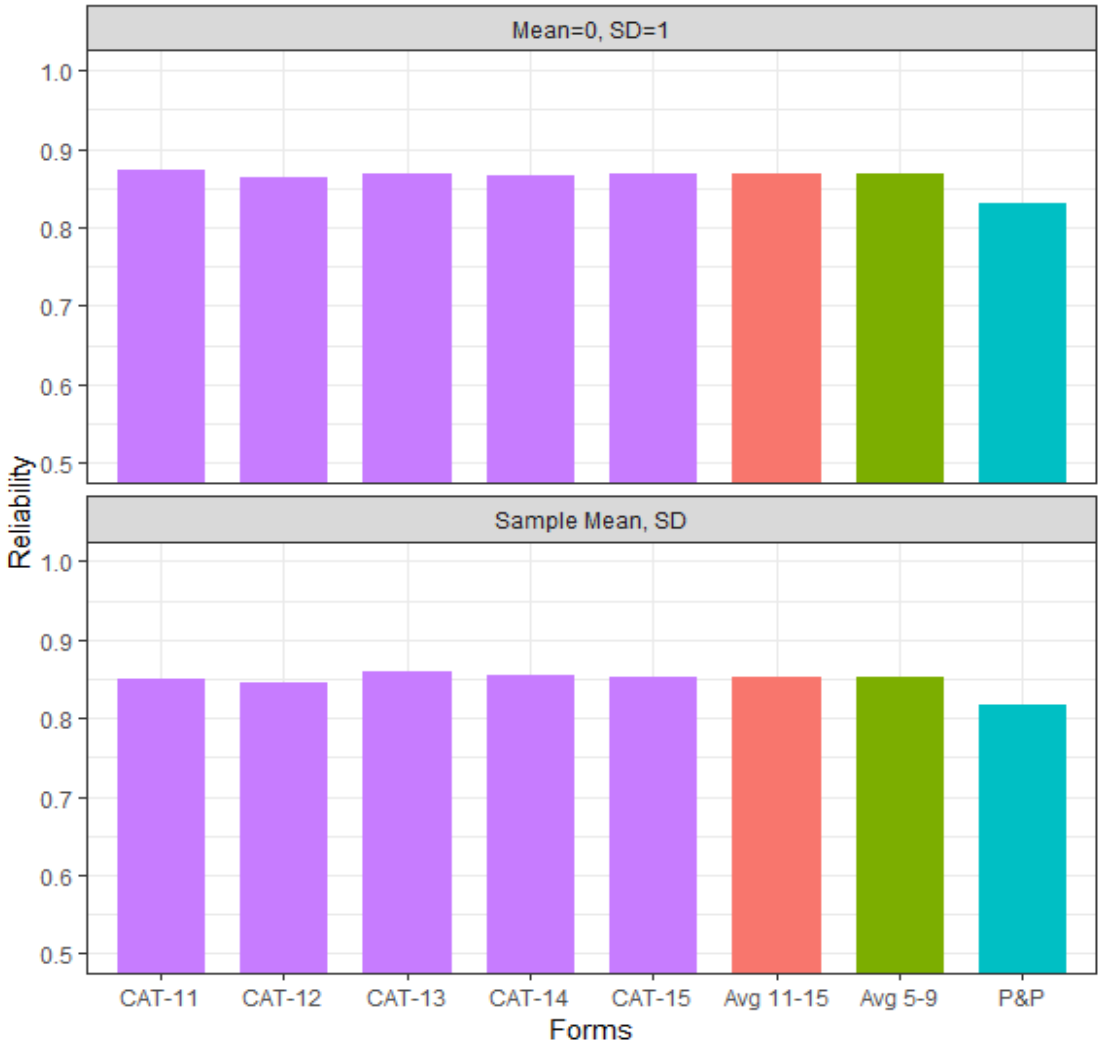
ASVAB Form Assembly: GS Simulation Results



ASVAB Form Assembly: GS Simulation Results



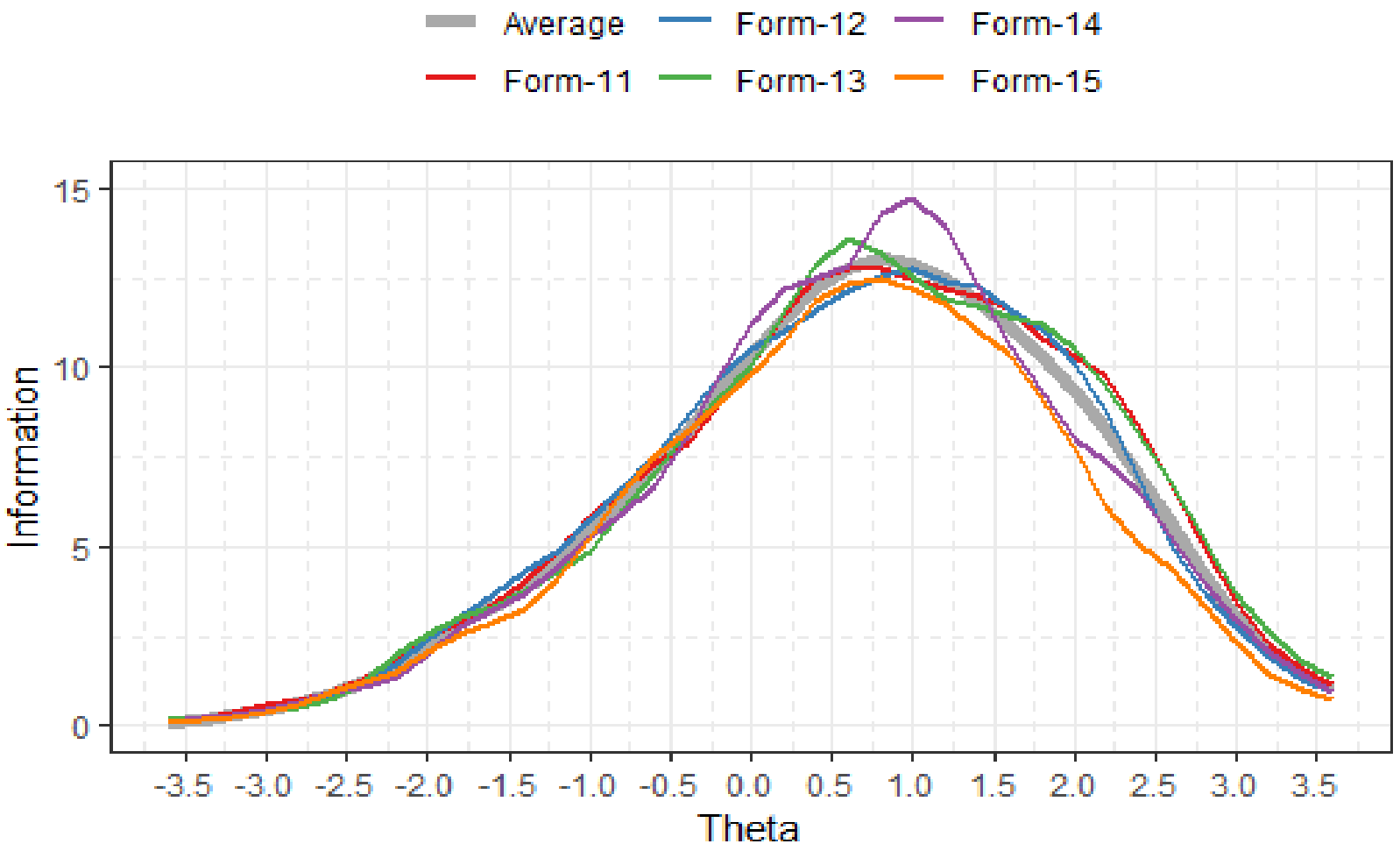
ASVAB Form Assembly: GS Simulation Results



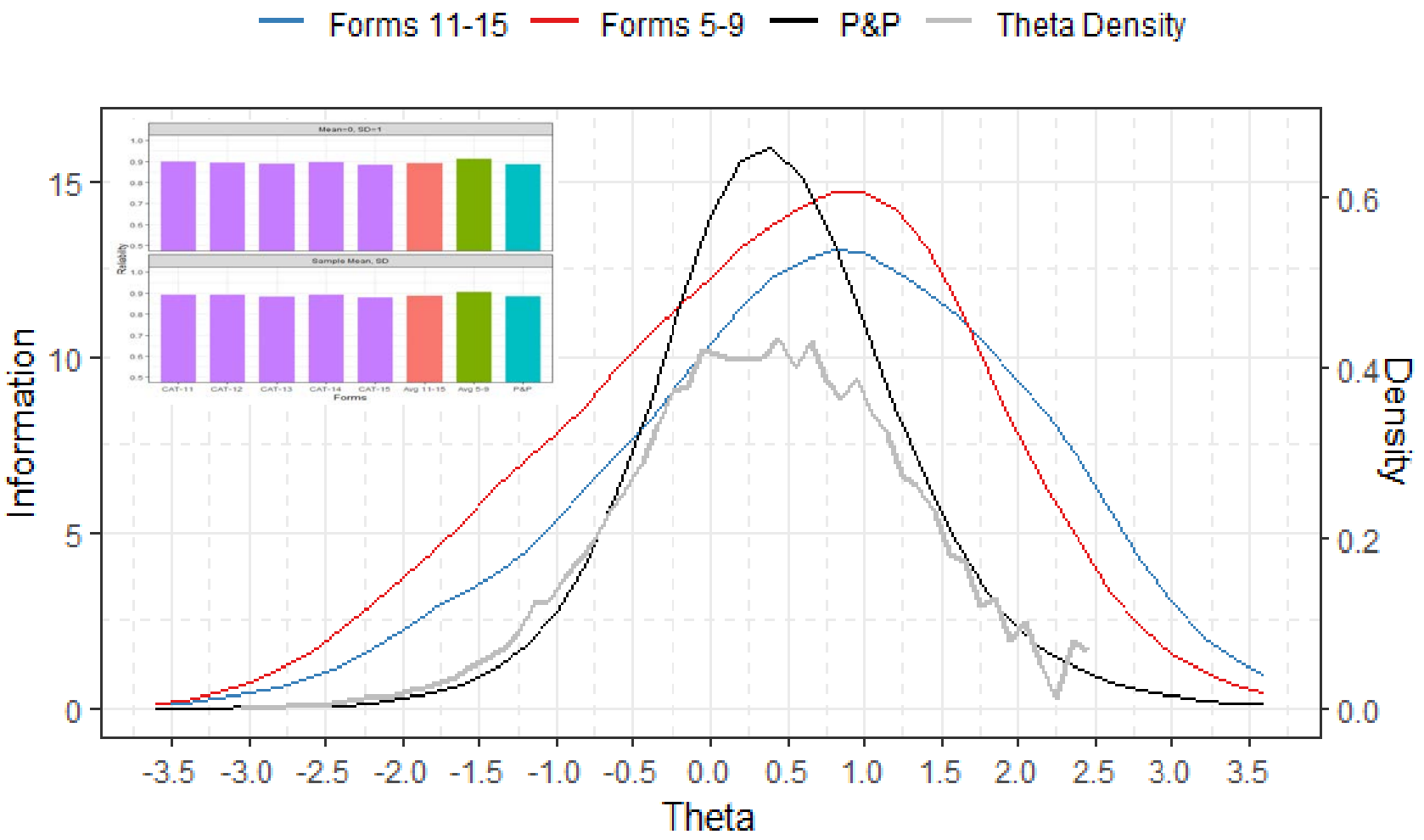
Arithmetic Reasoning (AR)

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

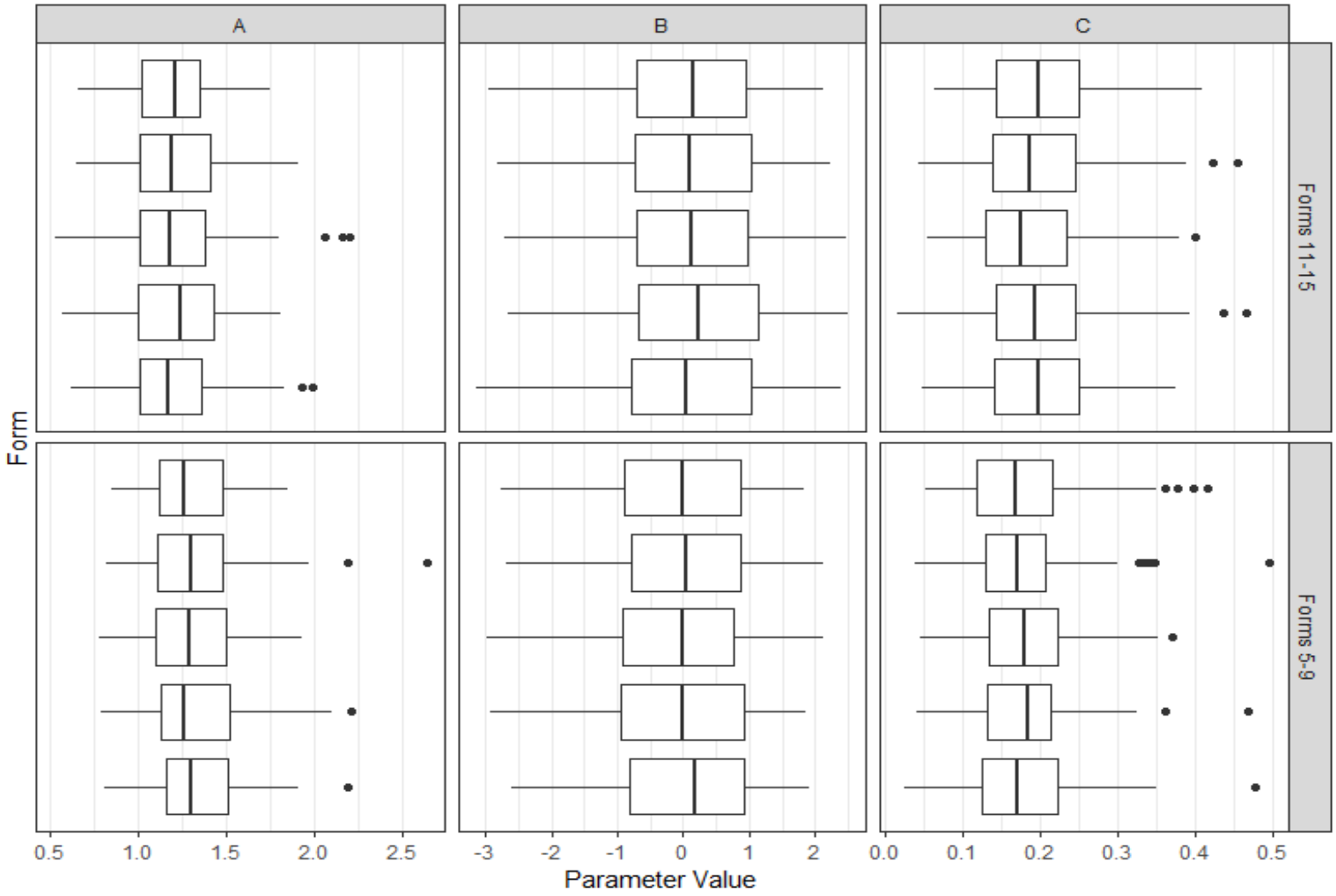
ASVAB Form Assembly: AR Simulation Results



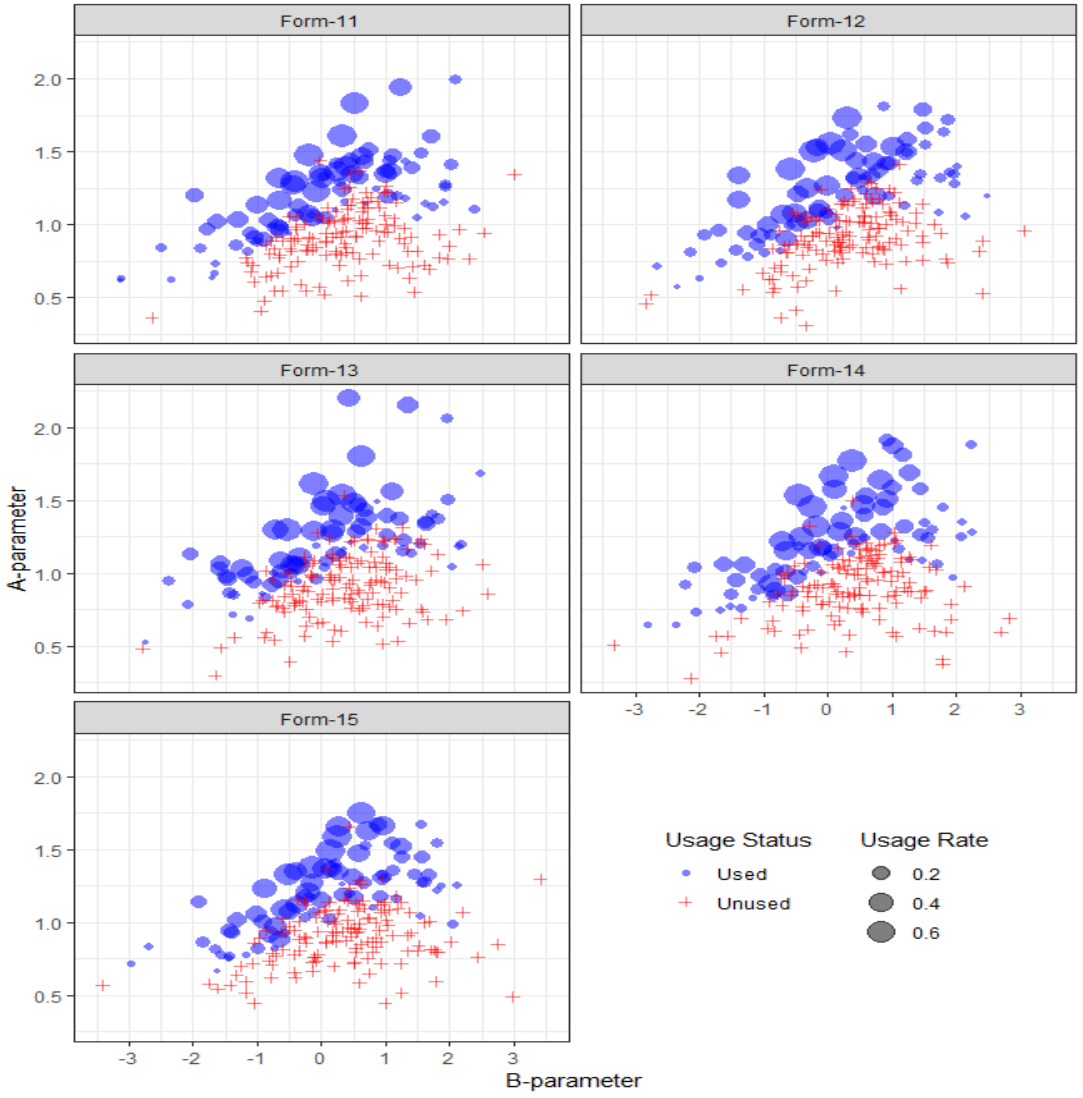
ASVAB Form Assembly: AR Simulation Results



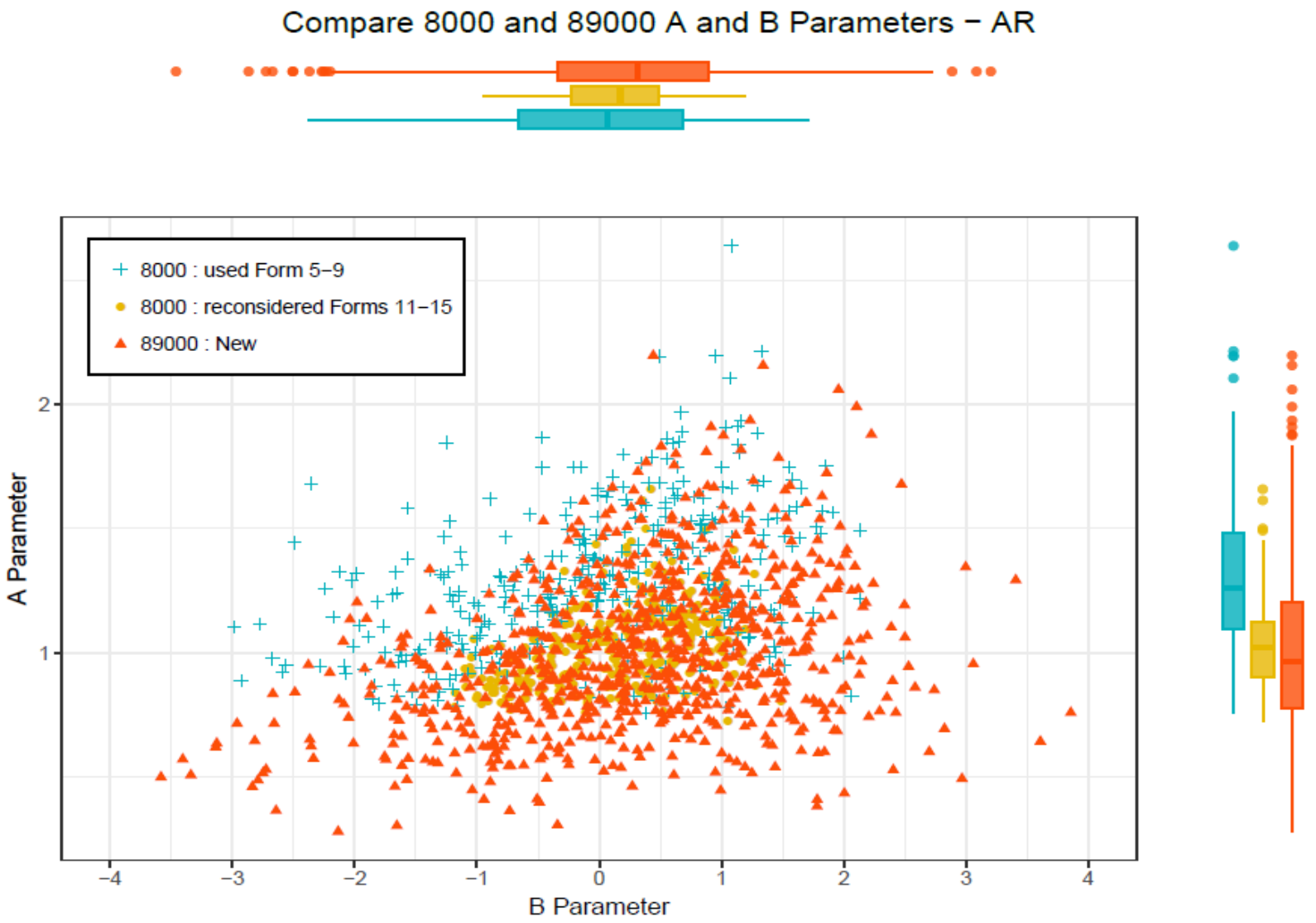
ASVAB Form Assembly: AR Simulation Results



ASVAB Form Assembly: AR Simulation Results



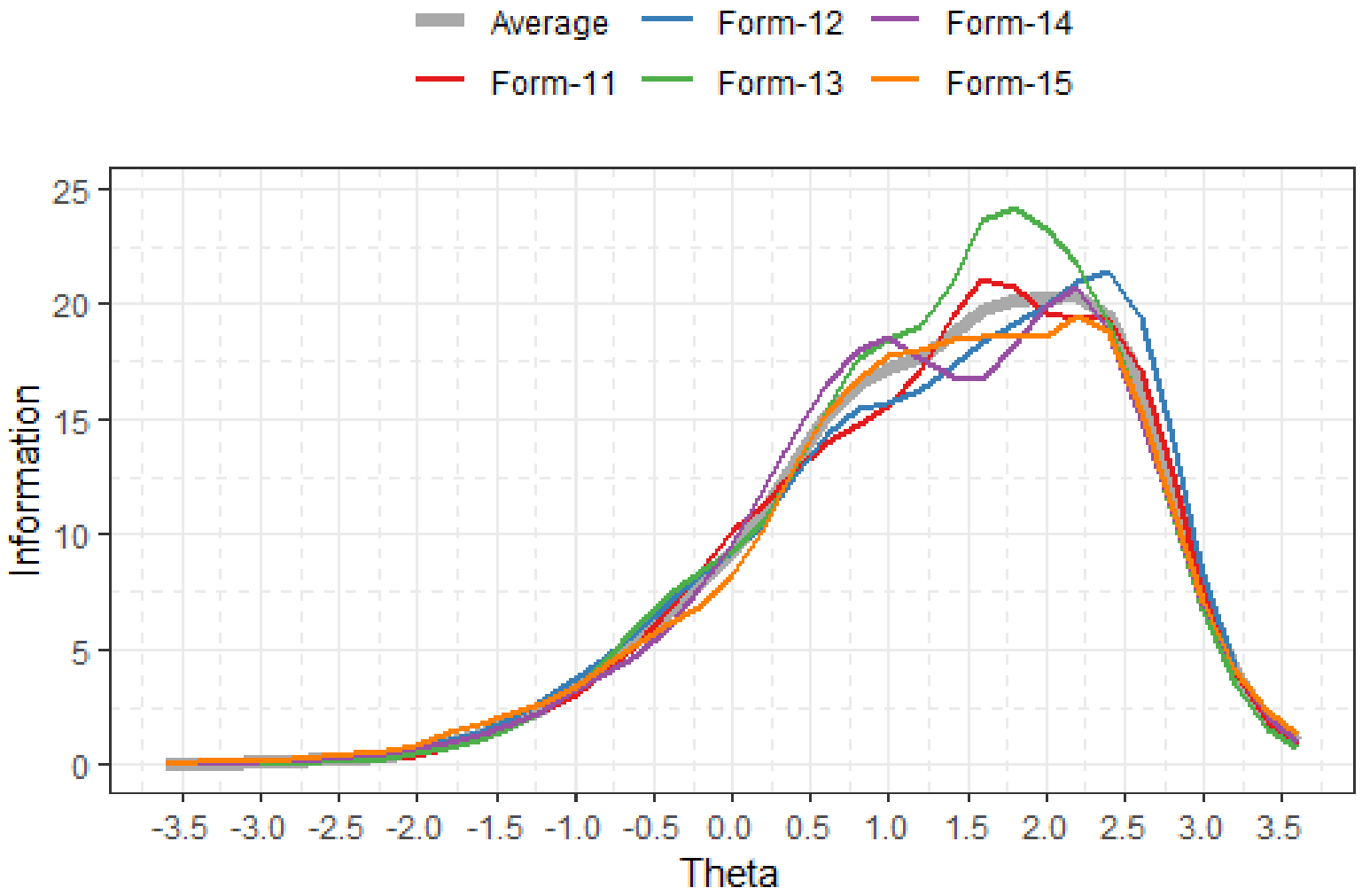
ASVAB Form Assembly: AR Simulation Results



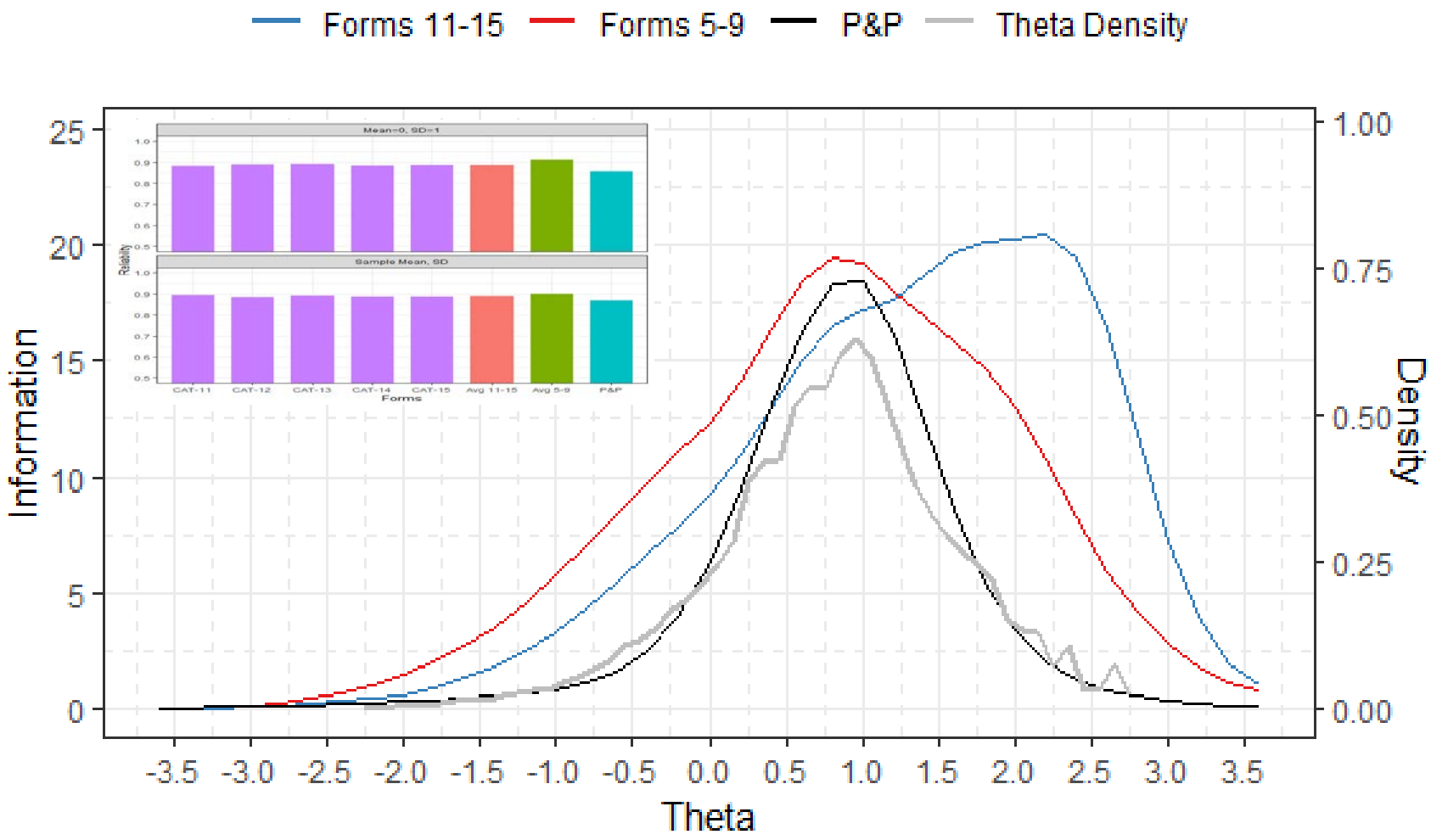
Math Knowledge (MK)

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

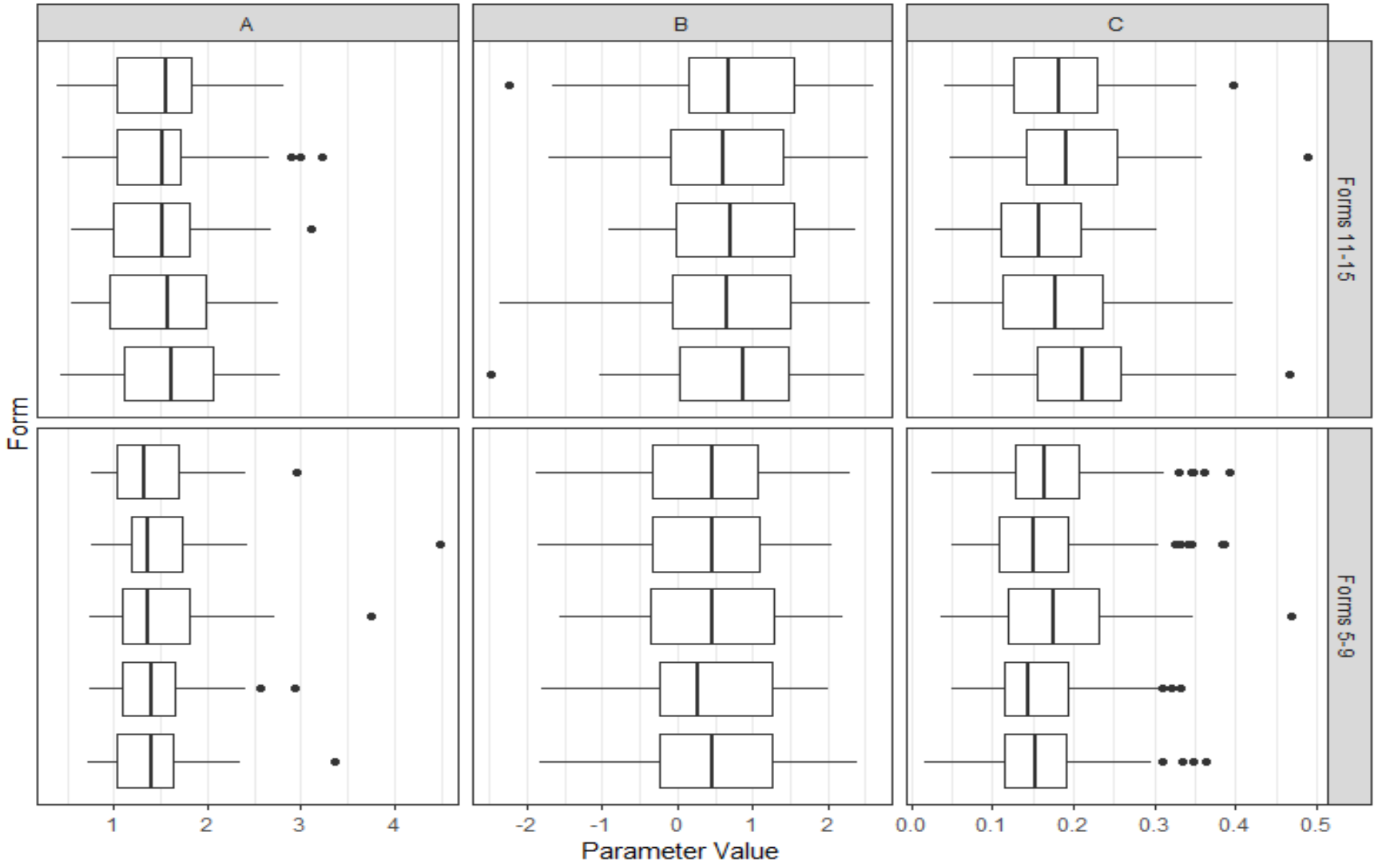
ASVAB Form Assembly: MK Simulation Results



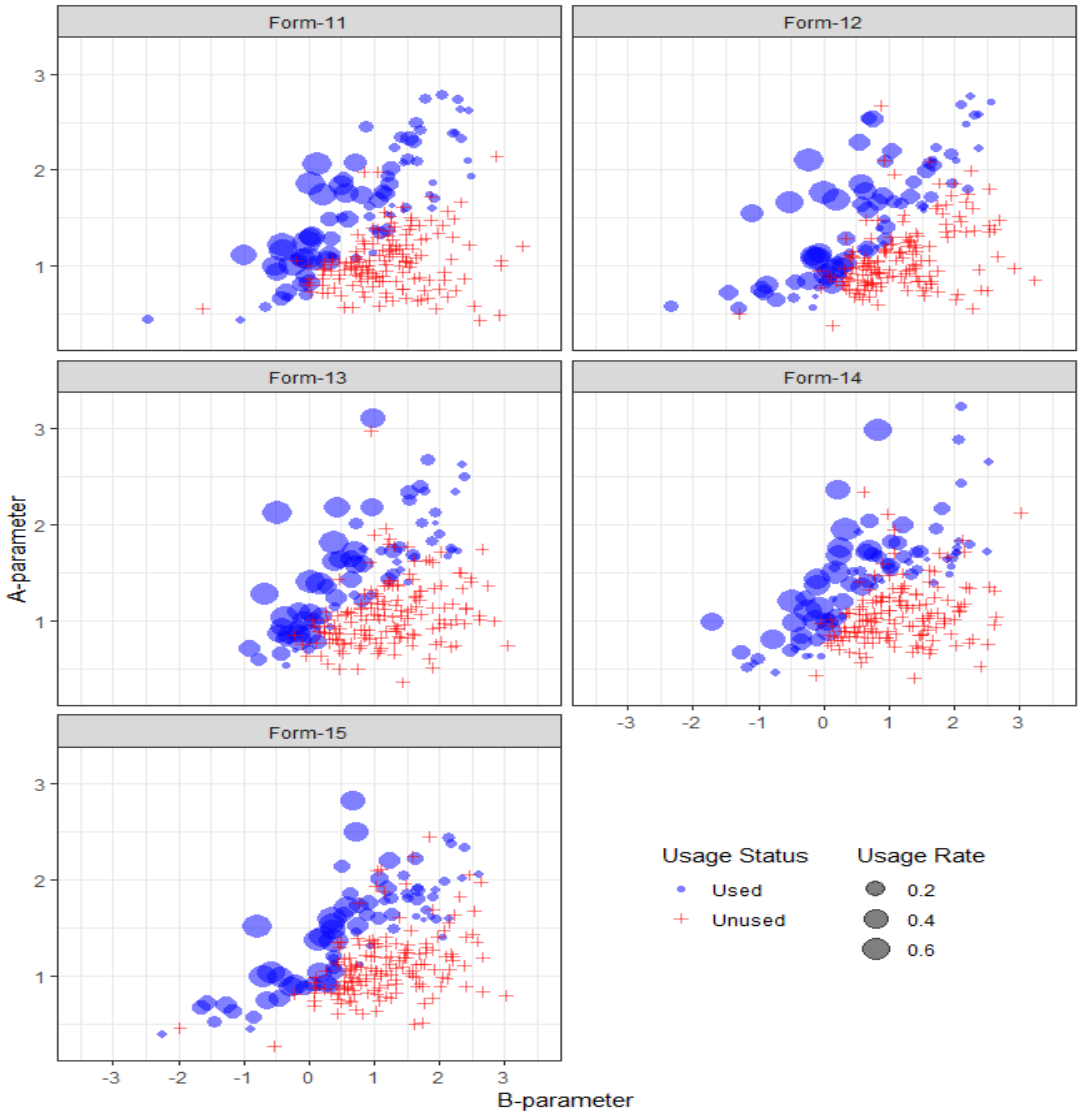
ASVAB Form Assembly: MK Simulation Results



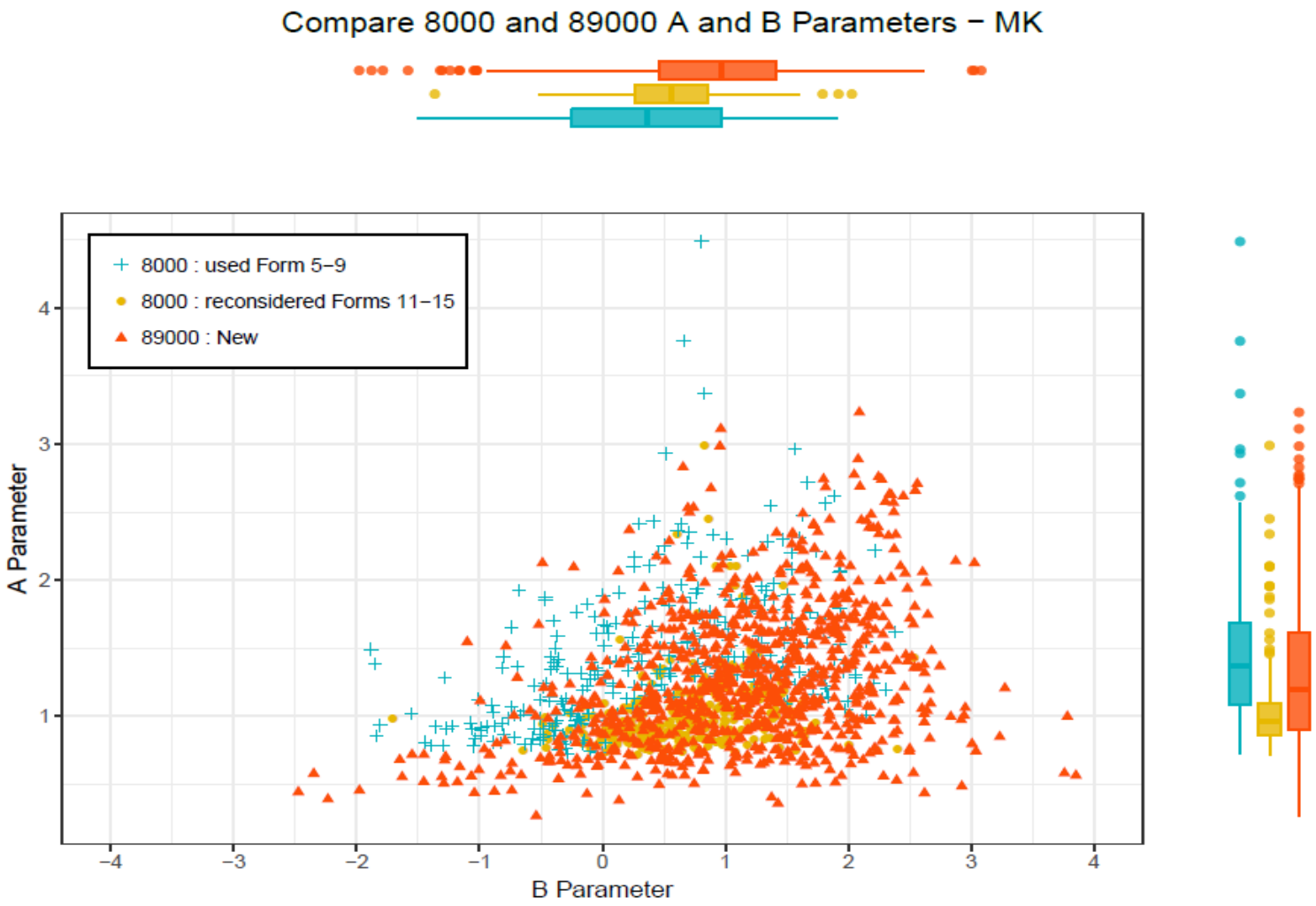
ASVAB Form Assembly: MK Simulation Results



ASVAB Form Assembly: MK Simulation Results



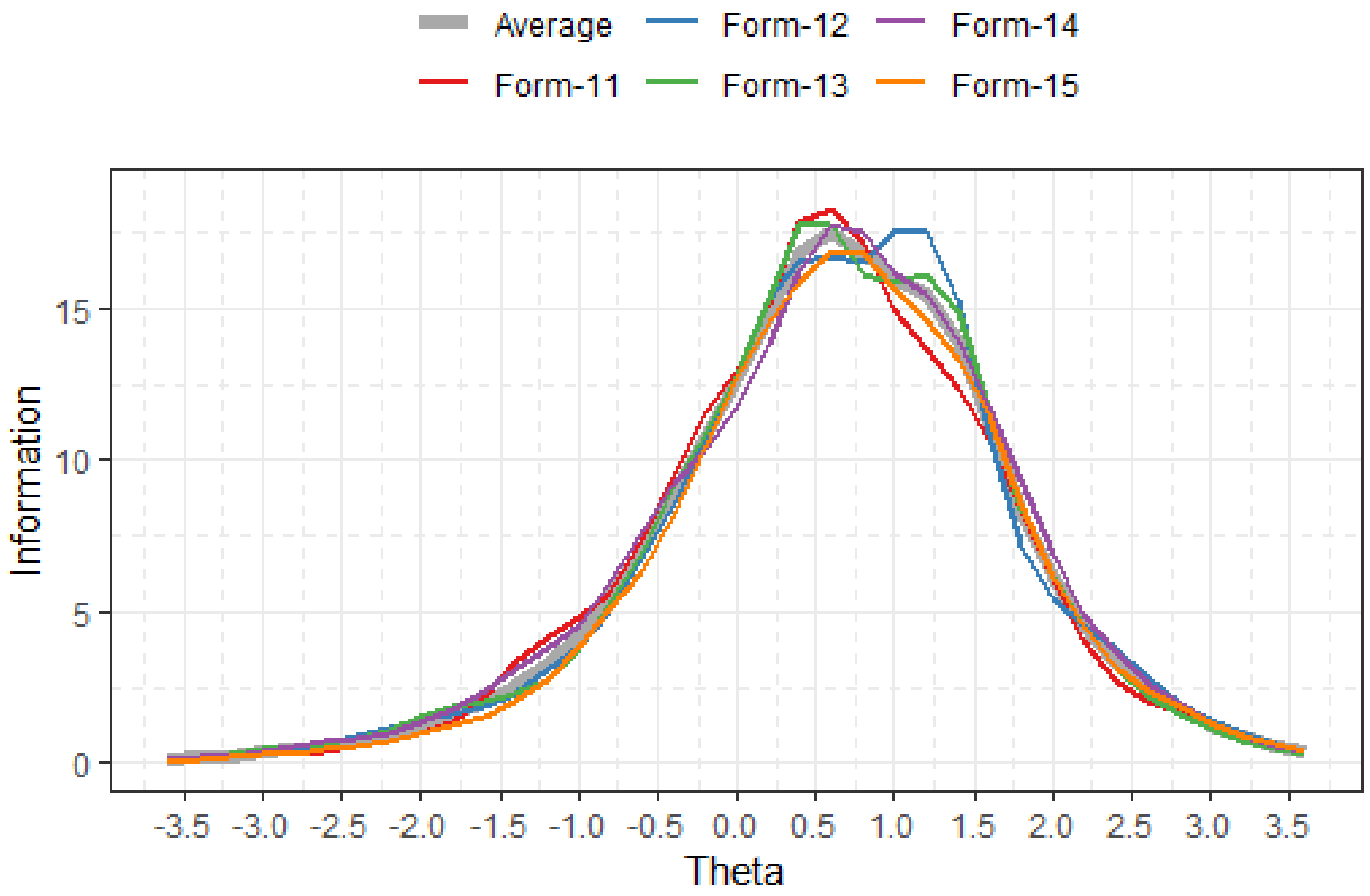
ASVAB Form Assembly: MK Simulation Results



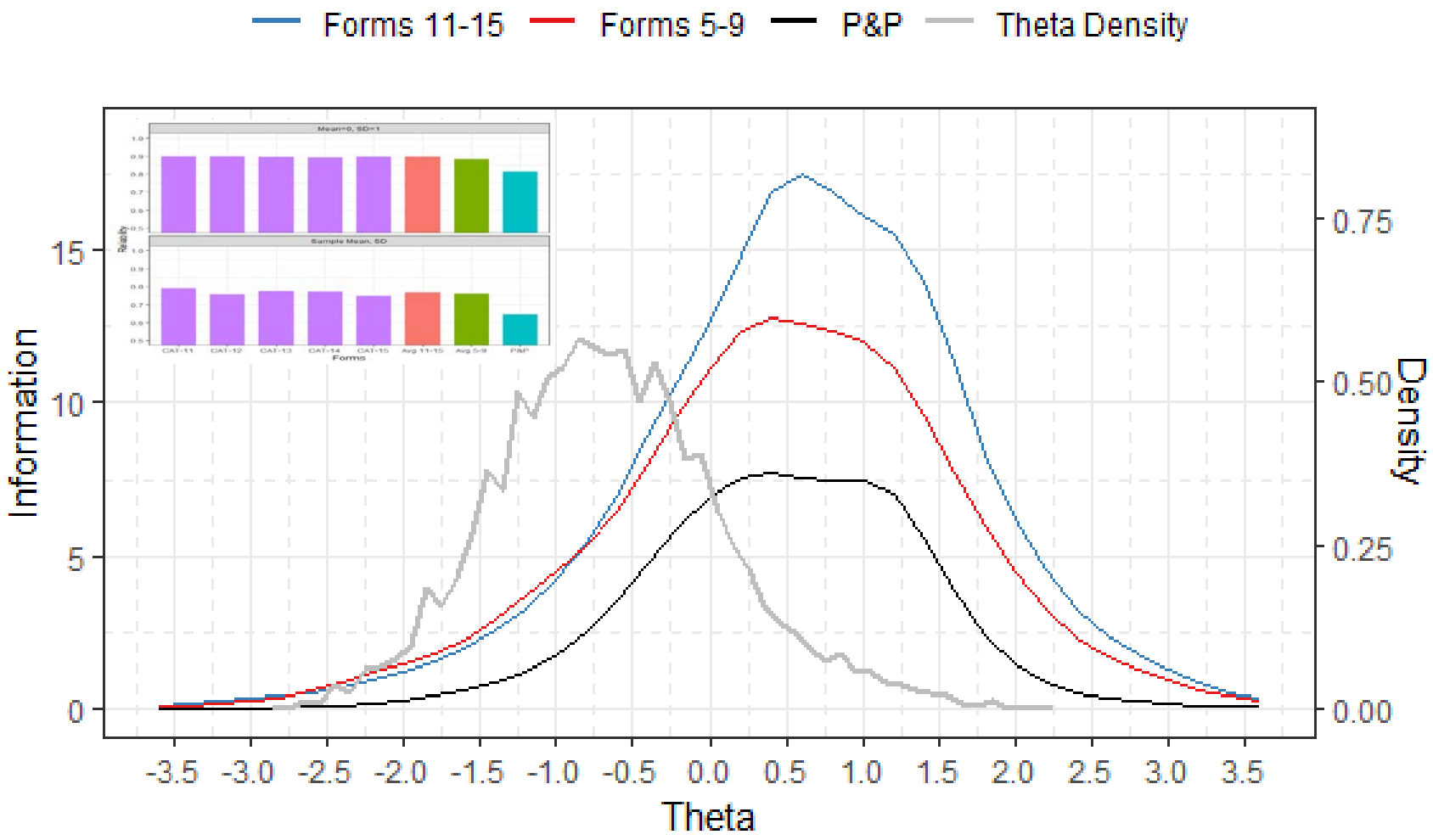
Automotive Information

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

ASVAB Form Assembly: AI Simulation Results



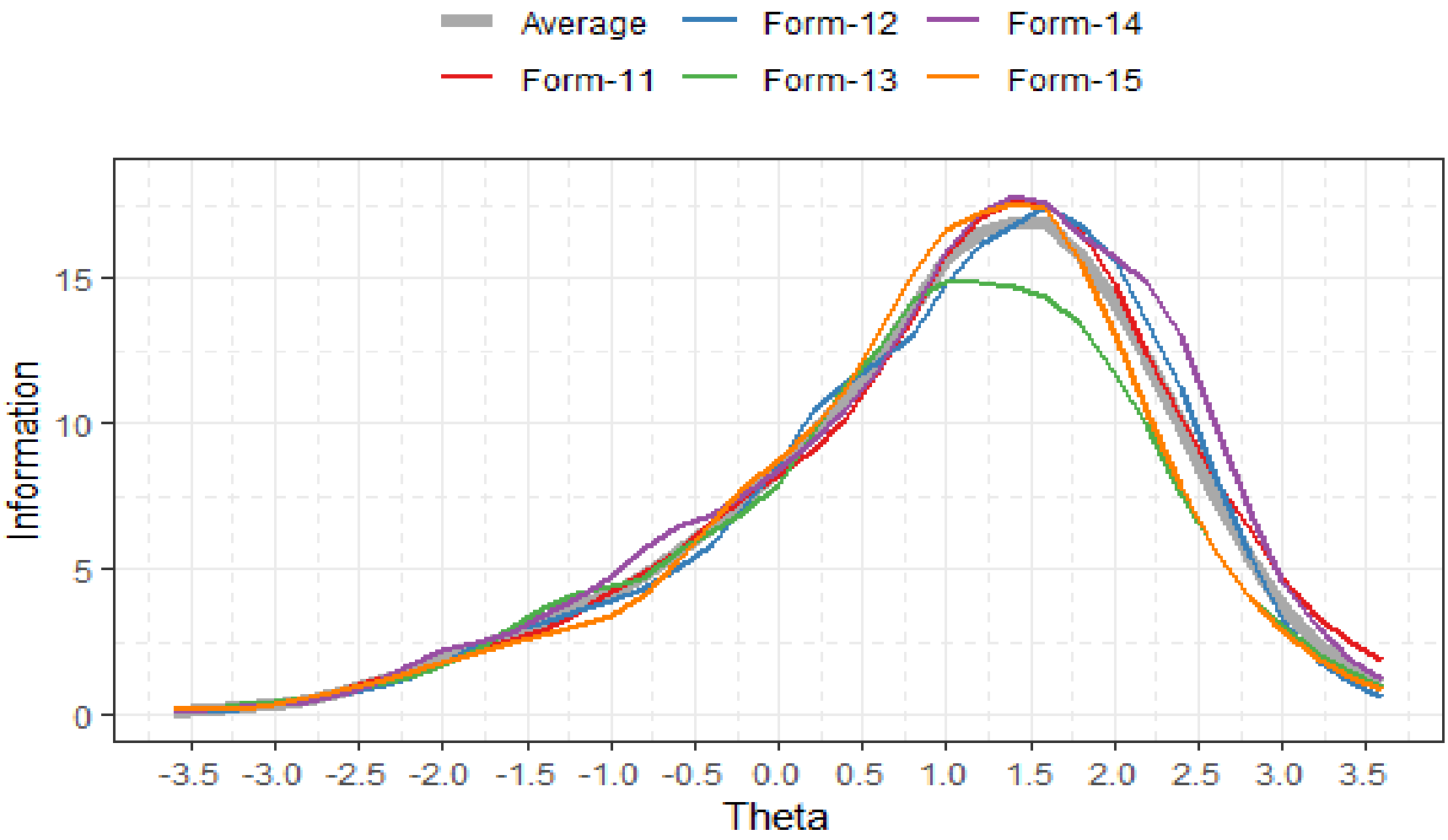
ASVAB Form Assembly: AI Simulation Results



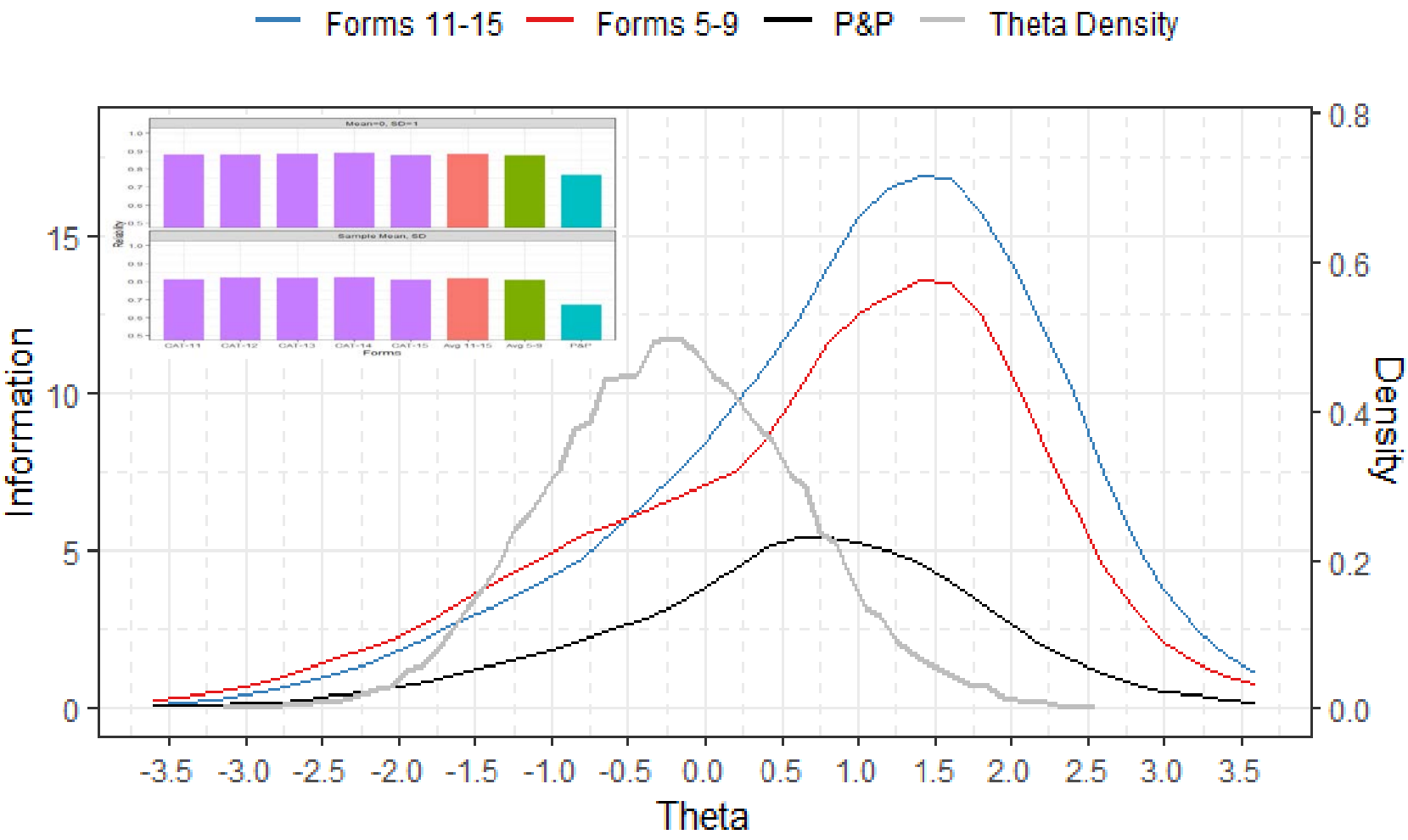
Electronics Information

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

ASVAB Form Assembly: EI Simulation Results

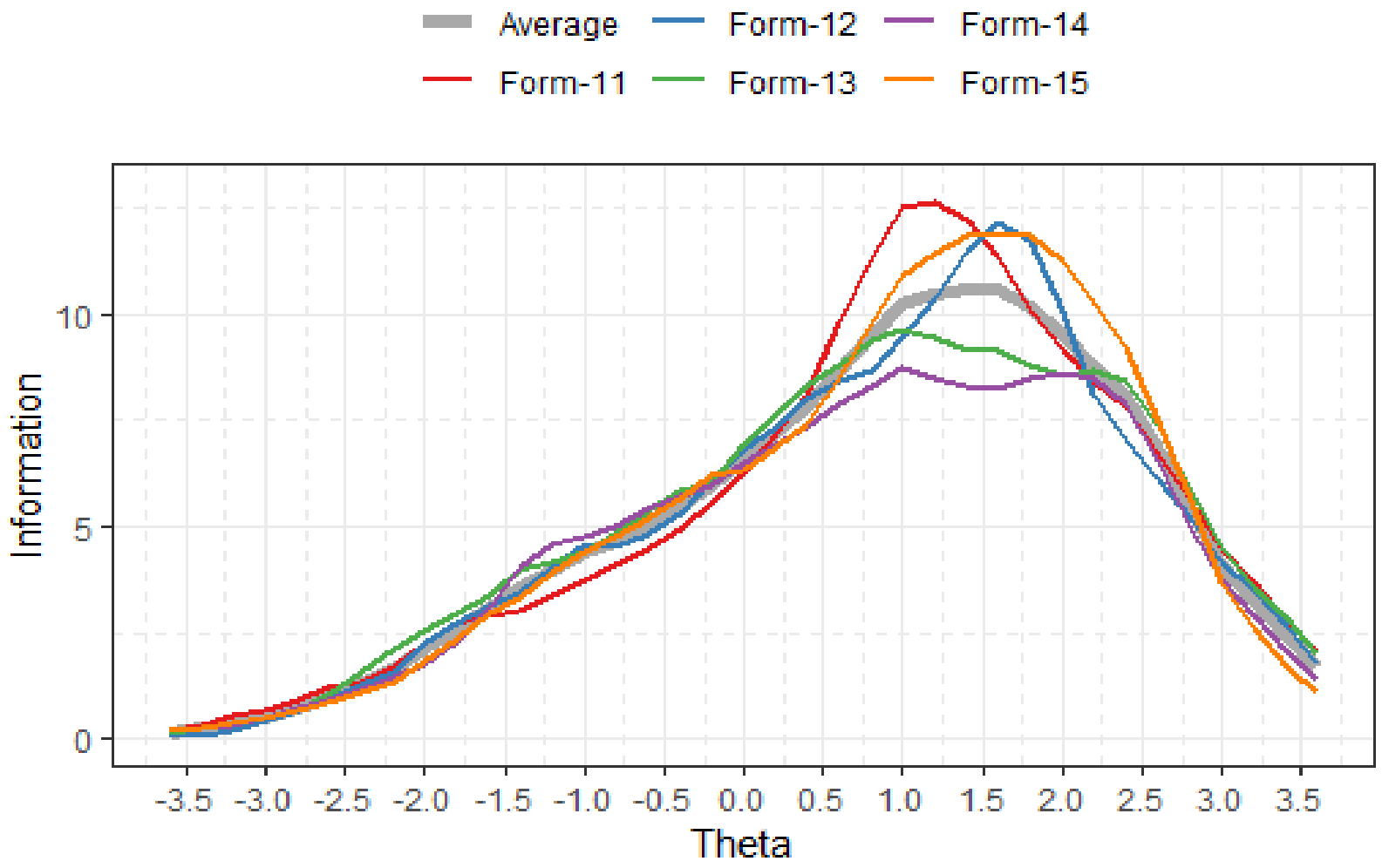


ASVAB Form Assembly: EI Simulation Results

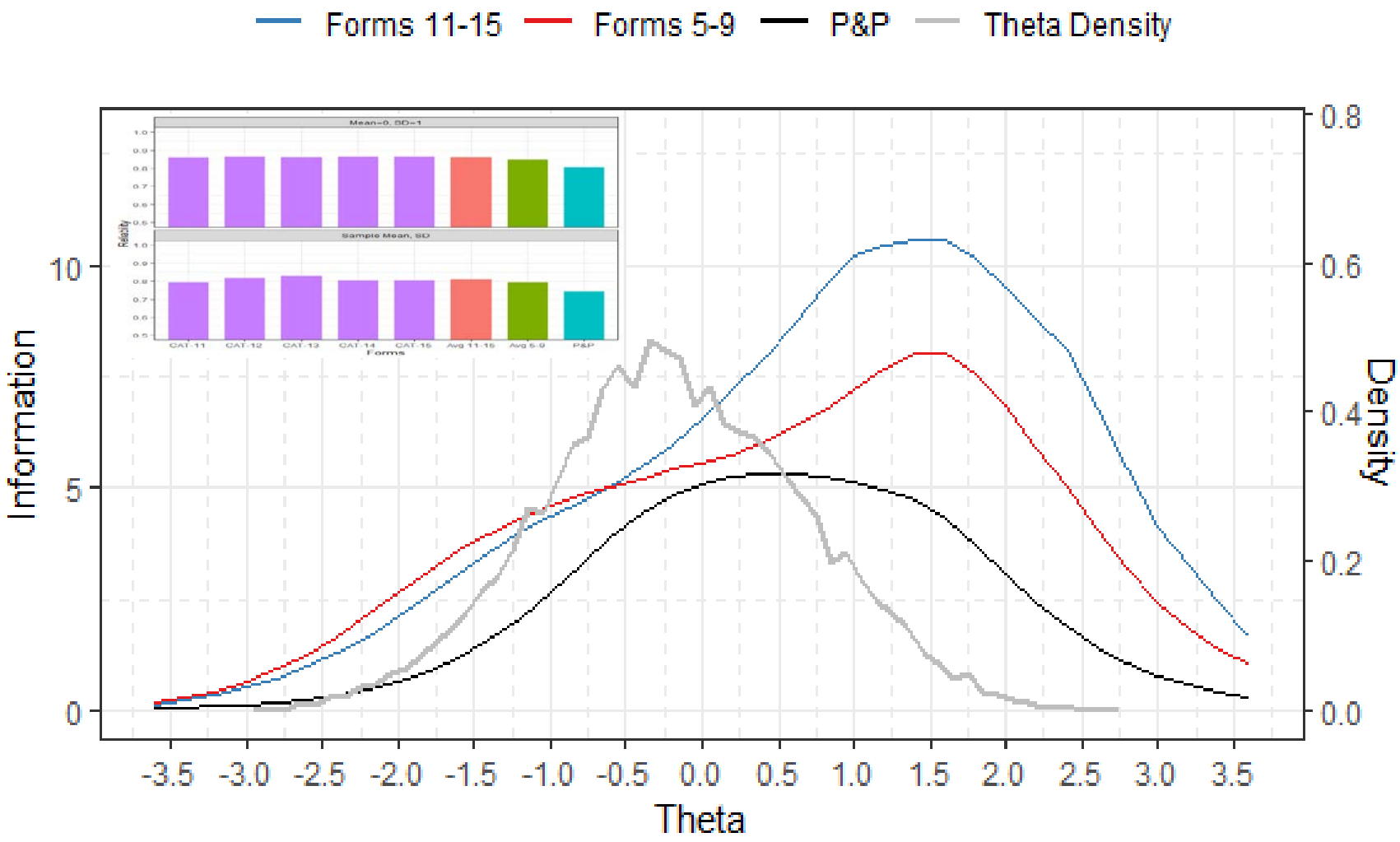


Mechanical Comprehension

ASVAB Form Assembly: MC Simulation Results

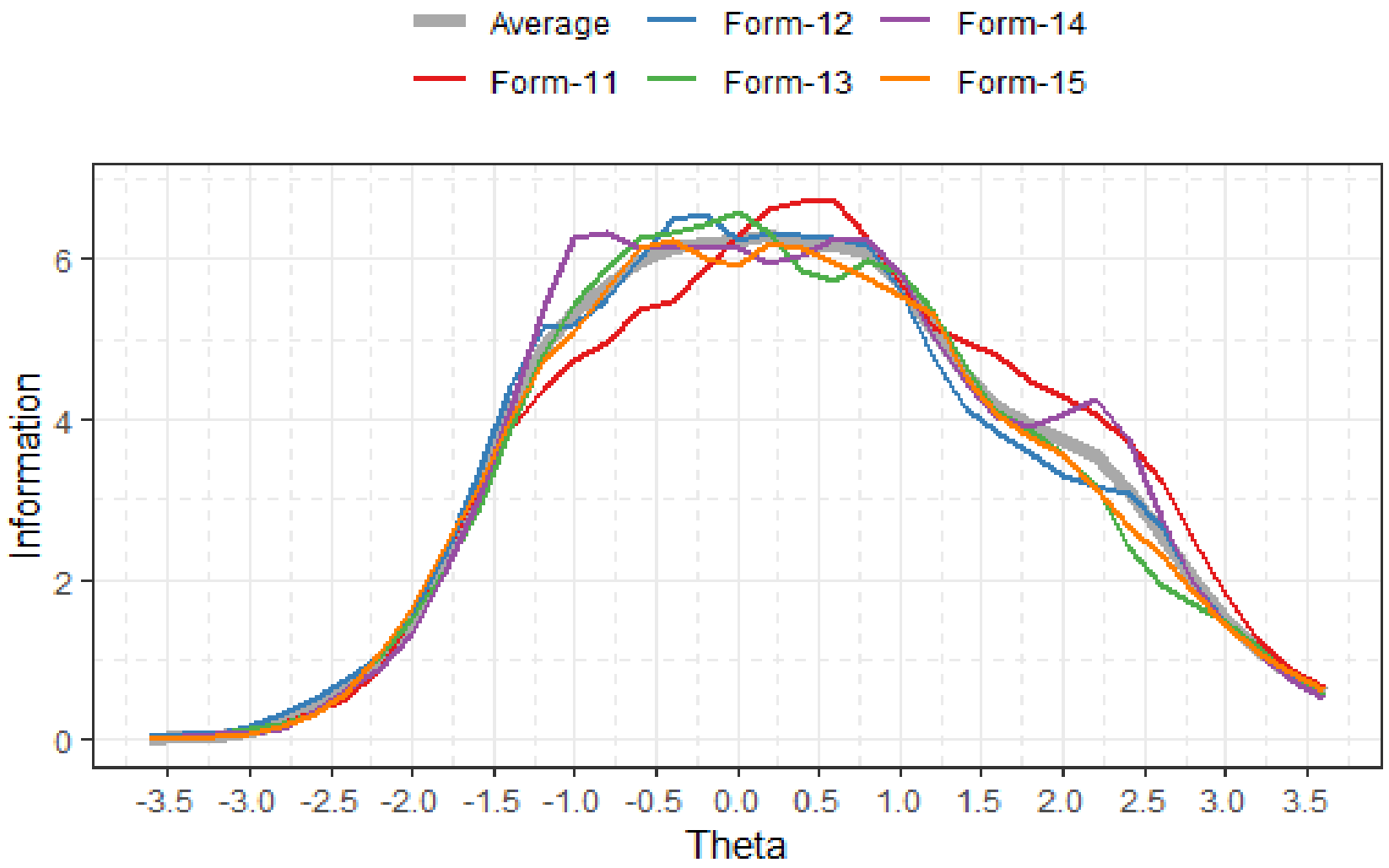


ASVAB Form Assembly: MC Simulation Results

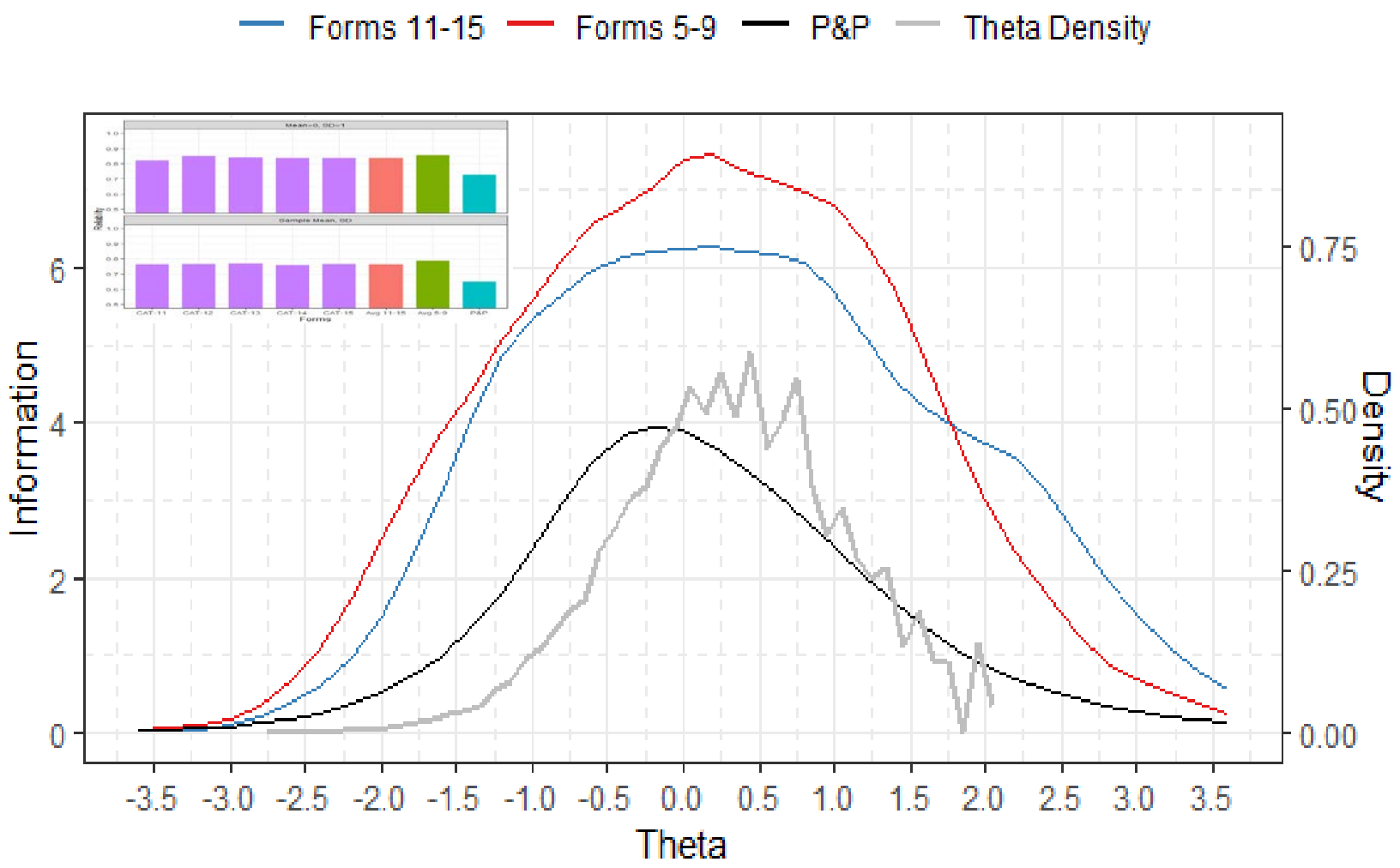


Paragraph Comprehension

ASVAB Form Assembly: PC Simulation Results



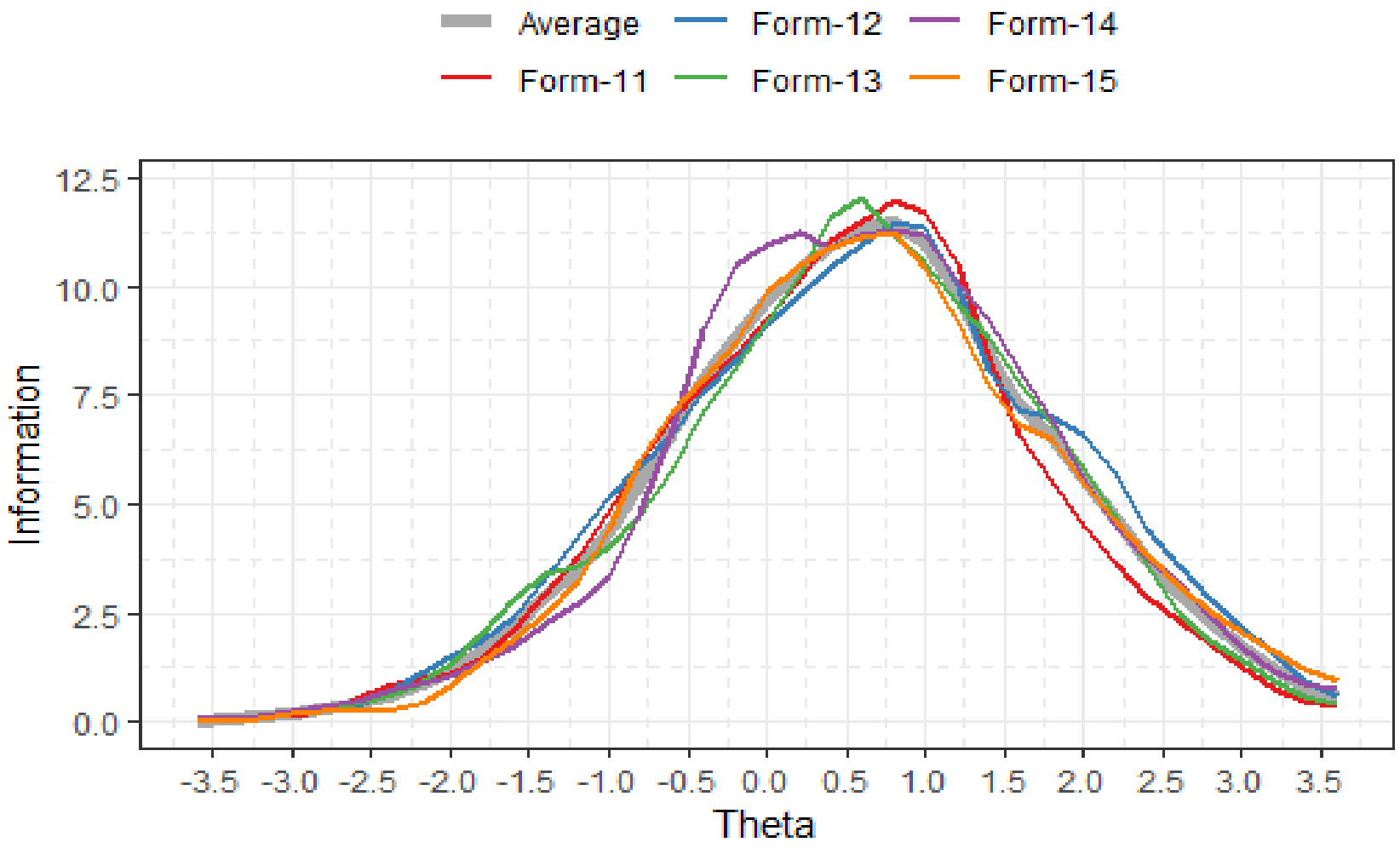
ASVAB Form Assembly: PC Simulation Results



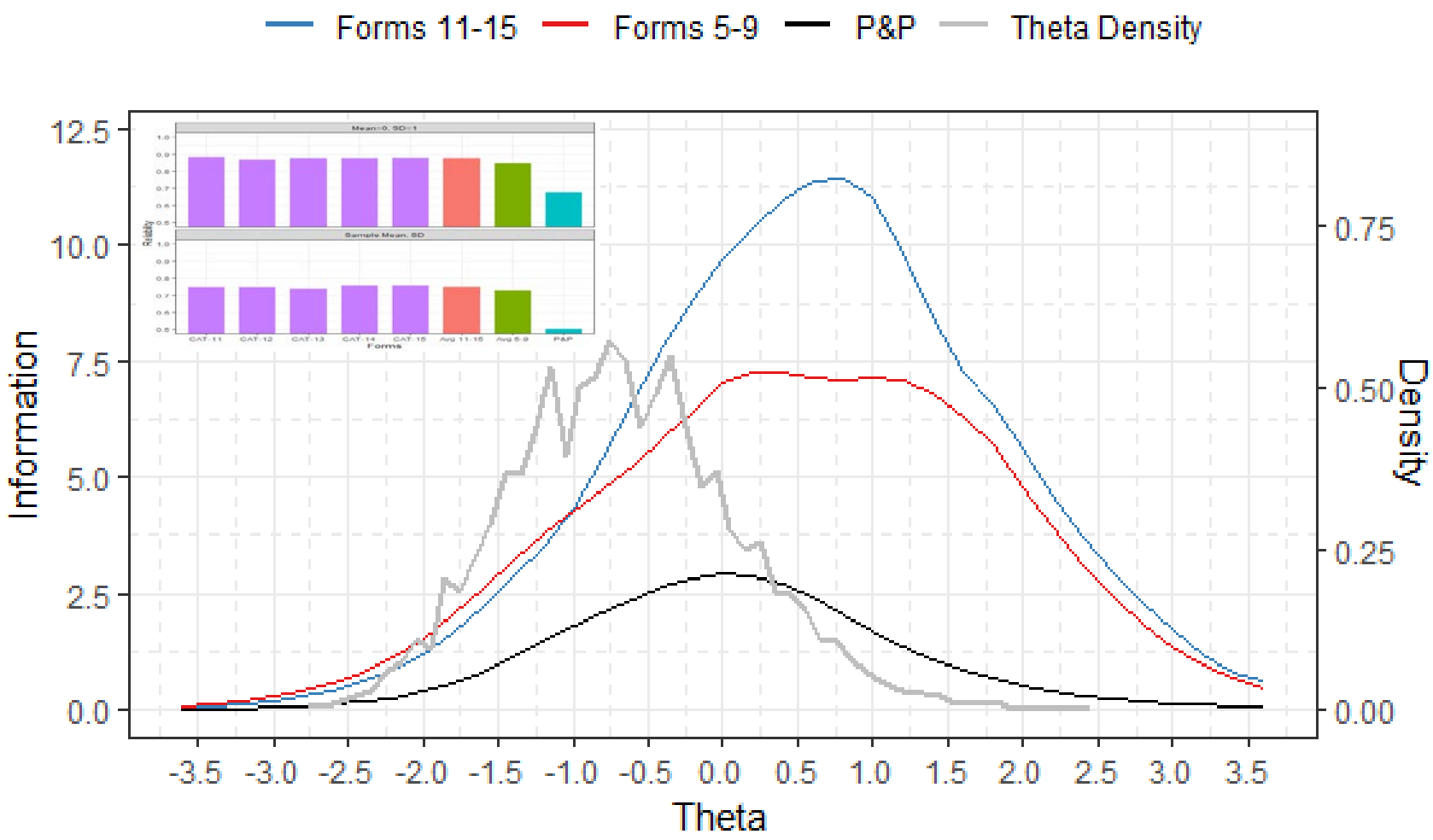
Shop Information

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

ASVAB Form Assembly: SI Simulation Results



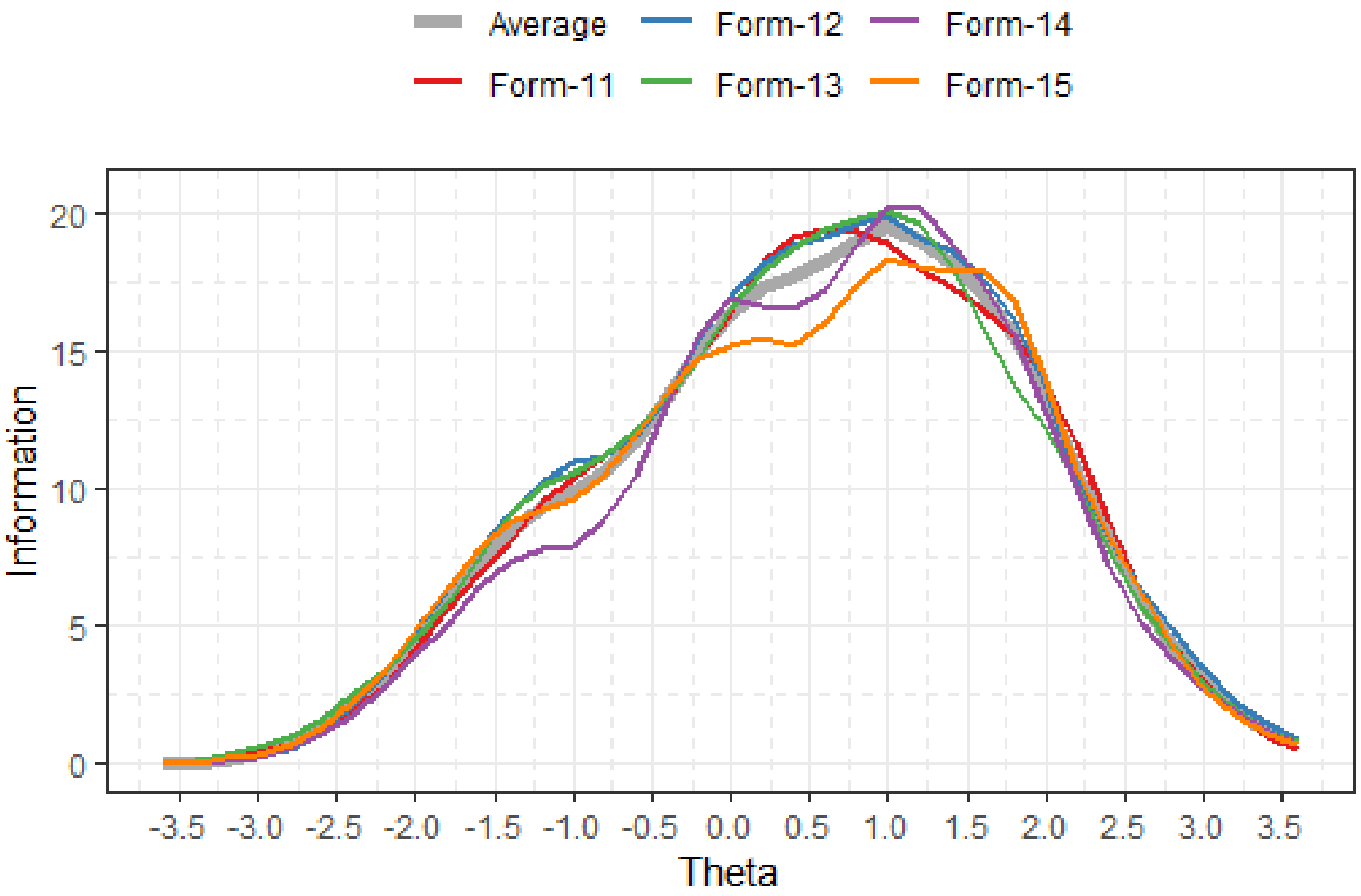
ASVAB Form Assembly: SI Simulation Results



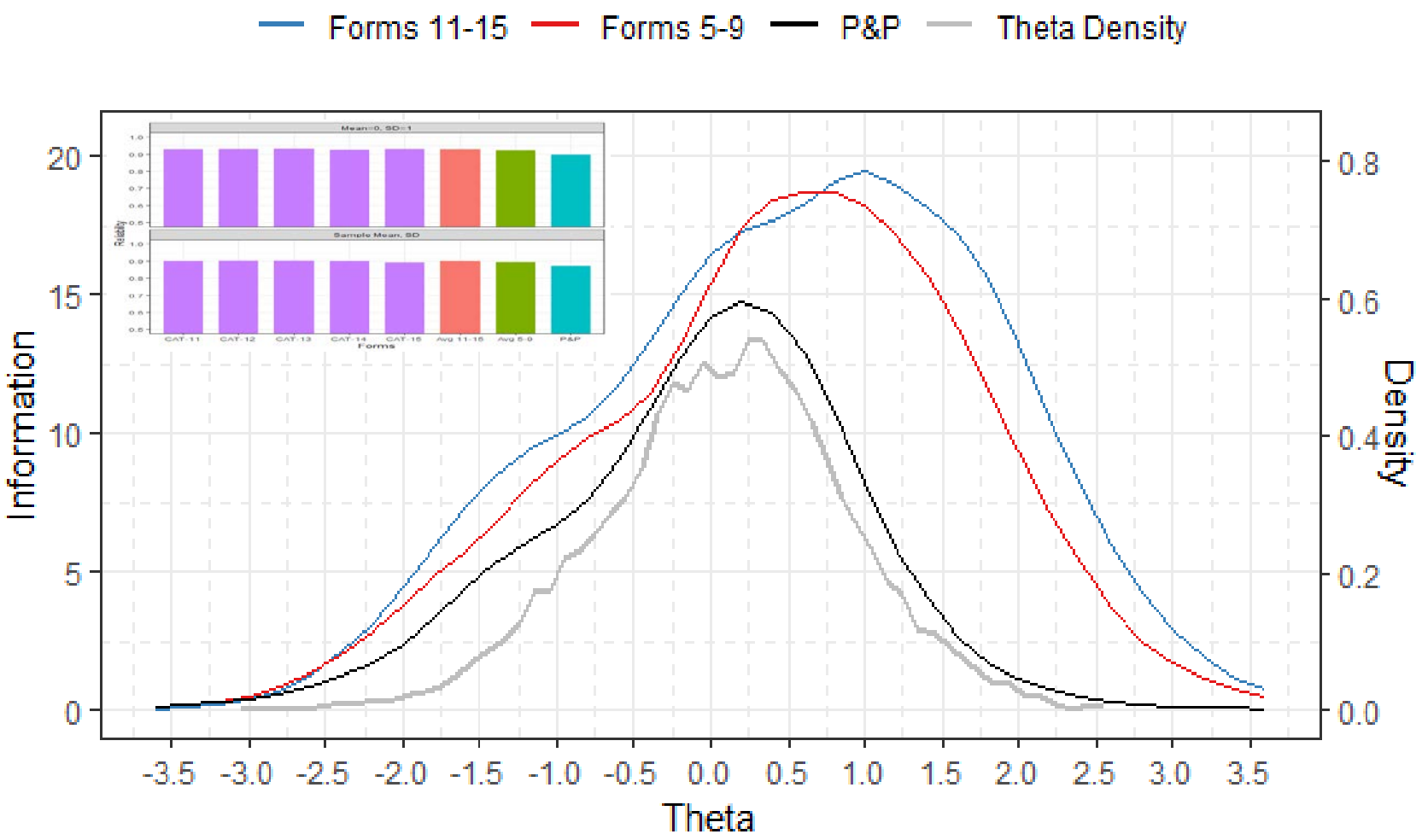
Word Knowledge

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

ASVAB Form Assembly: WK Simulation Results



ASVAB Form Assembly: WK Simulation Results



Schedule

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

Schedule

- Tasks ahead
  - Equating and equating analyses/evaluation
    - Completed equating on form 10; ahead of the learning curve for equating forms 11–15
    - Refer to Sep 2018 DAC briefing for equating details
  - Develop two* P&P forms from form-assembly-eligible items not assigned to a CAT form
    - P&P forms 29–30 intended for CEP use
  - Begin processing seed items for next set of CAT forms under projected yearly form-development rates
    - Eight forms: WK
    - Four forms: GS, AR, PC, MK
    - Two forms: EI, AI, SI, MC, AO

*29A, 29B, 30A, 30B where A and B represent scrambled item order

Questions?

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

HumRRO Team

- Adam Beatty
- Maura Burke
- Jeff Dahlke
- Ted Diaz
- Peter Ramsberger
- Rivka Revivo
- Matthew Reeder
- Matthew Trippe

Backup Slides

HumRRO
HUMAN RESOURCES RESEARCH ORGANIZATION

ASVAB Form Assembly: Simulation Analyses

- Assemble forms algorithmically to optimize stated goals
  - Assemble main analytic functions in Fortran as dynamic-link library (DLL)
  - Develop R package to wrap Fortran functions and to implement CAT analyses
  - Best of both worlds approach, combining speed of Fortran and flexibility of R, facilitates changes to problem configurations, analysis of results, and promotes QC
- Compute test information using CAT simulations
  - Partition entire item pool into four or five candidate forms
  - Calculate item exposure parameters using preliminary CAT simulations
  - Generate large sample of scored responses using another round of CAT simulations
  - Approximate test information based on sample of scored responses
  - Trim items not administered in the second round of CAT simulations
- Compare information to
  - Original P&P ASVAB
  - Current operational forms (5–9)
  - Observed theta density

Enemy Item Identification Recap

- Mitigating local dependence (LD) requires identification of item enemy groups
  - Items likely to trigger LD if administered to the same person
  - Two or more items that measure similar or highly related content

- MC & MK items categorized into enemy groups defined by content framework
  - Augmented by machine learning analyses
    - unsupervised classification analysis
    - supervised classification analysis

Enemy Item Identification

- All other tests (AI, AR, EI, GS, PC, SI, WK)
  - Unsupervised classification analysis/heatmap analysis
  - Documentation provided by item editors
- Content review of preliminary form assembly solutions
  - First develop operational definition of item enemy for each test
  - Two raters independently review content of each preliminary form
  - Discuss findings
    - Update enemy groups, redo form assembly, review revised solution
    - Determine preliminary solution includes no new enemies and is final
- Content review ranged from one (PC) to eight + (EI) iterations