What are we missing in university admission models?

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Reality check…

- Various models exist which are based on some of the following approaches/instruments, or a combination of them:
  - Direct entry after graduation from High School (with or without demanding final exit exams)
  - General ability tests developed by a National Testing Center or testing company (i.e., SAT, SweSAT, etc.) (usually some combination of reasoning items, numerical ability, verbal ability, problem solving, etc.)
  - Achievement tests developed by a National Testing Center or by individual institutions of higher education
  - Data from high school performance, type of high school, relative standing in high school, etc.

State-of-the-art and achievements...

- Ample research on psychometric models for accurate estimation of item difficulties and student abilities.
- Careful equating designs achieving stable scales over relatively long periods of time.
- Well developed procedures for estimating DIF in items and unfair practices in programs.
- A fair amount of work on special accommodations for various disabilities and special conditions.
- Consideration of "non-cognitive" factors as predictors of higher education performance.
- Efforts at inclusion and equity in admission practices.

Results... Predicting GPA

- Some examples of the results obtained of some of the various instruments/schemes to predict university performance (approximate % of GPA variance explained, weighted averages, of those graduating between 1980-2000)*:

➢ SAT Verbal	16.0%		
➢ SAT Math	16.8%		
➢ SAT-V + SAT-M	14.4%		**12.25%
➢ High School GPA	17.6%		**12.96%
➢ SAT-V+SAT-M+HS	27.0%		
➢ SAT Reasoning Test (3) (females>males)		30.25%***	
➢ High School GPA	28.09%***		
➢ SAT Reasoning (3)+HS		38.44%***	

*Burton & Ramist (2001)

**Bridgeman et al. (2000)

*** Mattern et al., (2008)

Results… Predicting Graduation (Univ.)

- For the prediction of Graduation Expectancy of those that will graduate:

Correct Classification (logistic regression)

- SAT V + SAT M: 58%
- HS GPA: 59%
- SAT V + SAT M + HS GPA: 59%

Challenges for validity studies...

- Some of them are:
  - GRADES: Both, HS grades (used as predictors), and university grades (used as criteria) have serious problems of reliability and comparability (although they cover a broader range of academic and non-academic skills)
  - ADMISSION TESTS: are reliable and provide a common metric, but they cover a limited number of academic skills and very few non-academic skills.
  - Other problems: different grading standards, unreliability of criterion measure, range restriction, etc.
    - These and other problems tend to depress the observed correlations.

Results and challenges...

- In spite of all the research on the topic, we seem to have accepted that procedures and admissions processes that yield very dubious results:
- We carry out selection of students IGNORING approximately 70% to 80% of the sources of variance of first year performance,
- We accept the validity of admission processes with usually over 50% of misclassifications!
- These are not trivial problems, and they impact the validity of the procedures, as well as the fairness and equity of the admissions process.

What needs to be done…

- New methods that incorporate more recent advances using mathematical modeling techniques and artificial intelligence (machine learning approaches).
- Using predictive models that make use of large databases.
- National level validity studies which should cover the entire process and addresses major shared predictors and criteria.
- Institutional level validity studies that go beyond using common factors, and reflect the institutions' goals, practices and needs.
- There is a need for comparability across validity results.

Some experimental evidence...

Recent work in educational applications have demonstrated the power of mathematical modeling techniques and the advantage of using methods that allow:

- The study of the large number of variables which are necessary to be considered to encompass the complexity of educational outcomes.
- Methods that can make use of the analysis of the complex interactions between all those predictors
- And that can shed light on the participation of the categories of predictors involved, also yielding better predictions together with a greater understanding of the complex patterns that produce the desired outcomes (or not), allowing for positive interventions.

Machine-Learning Predictive Systems

- **Predicting First-Year University GPA:**

  - **Study 1:** (Cognitive, Self-Regulation, Background)
    - Low 25%: 100% High 25%: 100%
    - Classification Accuracy

  - **Study 2:** (Cognitive, Motivation, Learning Styles, Background)
    - Low 25%: 100% High 25%: 94%
    - Classification Accuracy

Machine-Learning Predictive Systems

- **Predicting MATH performance in First-Year University Students**

➢ **Study 1:** (Cognitive, Self-Regulation, Background)

- Low 25%: 100% High 25%: 100%
- Classification Accuracy

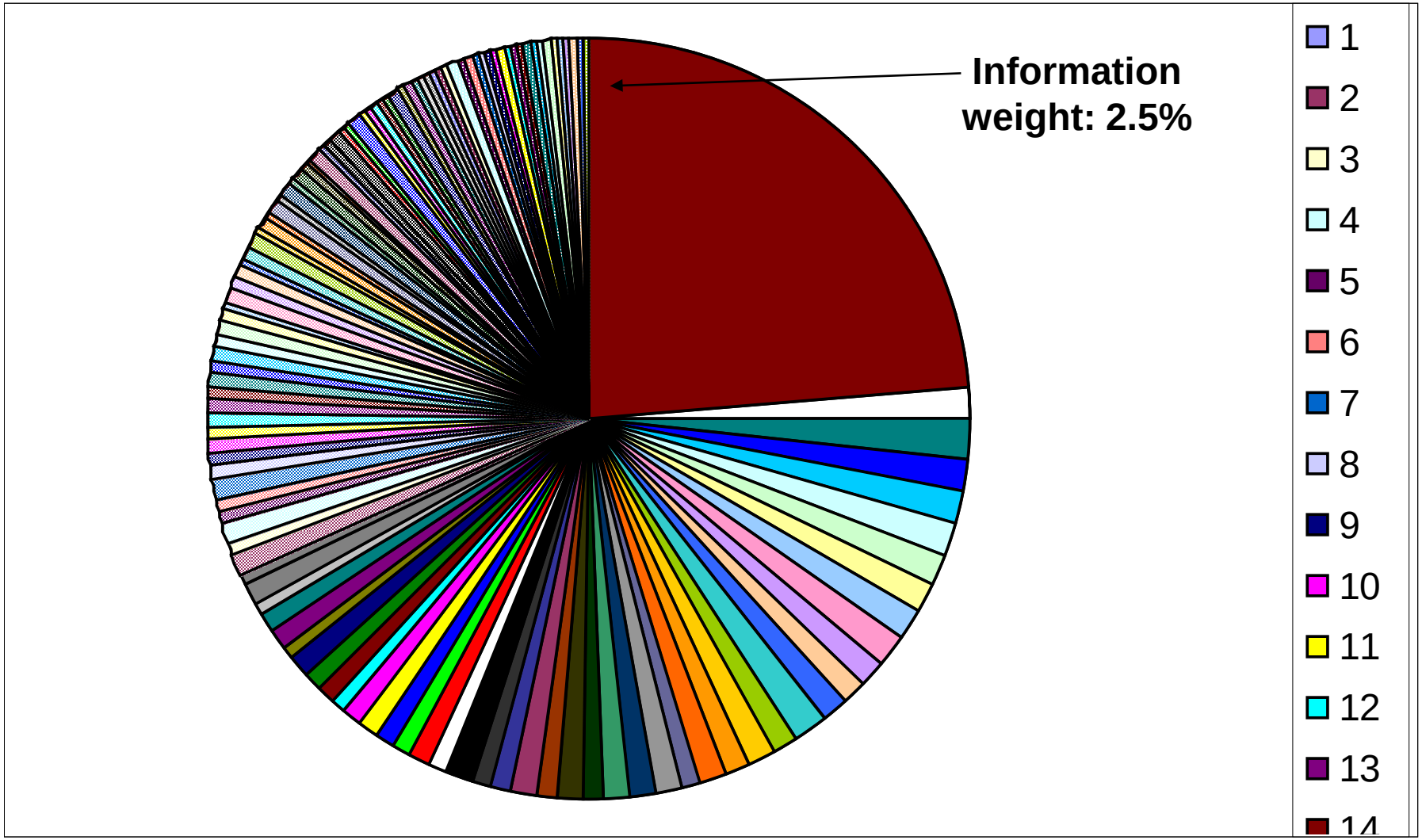
- **Predicting Complex Problem Solving performance in First-Year University Students**

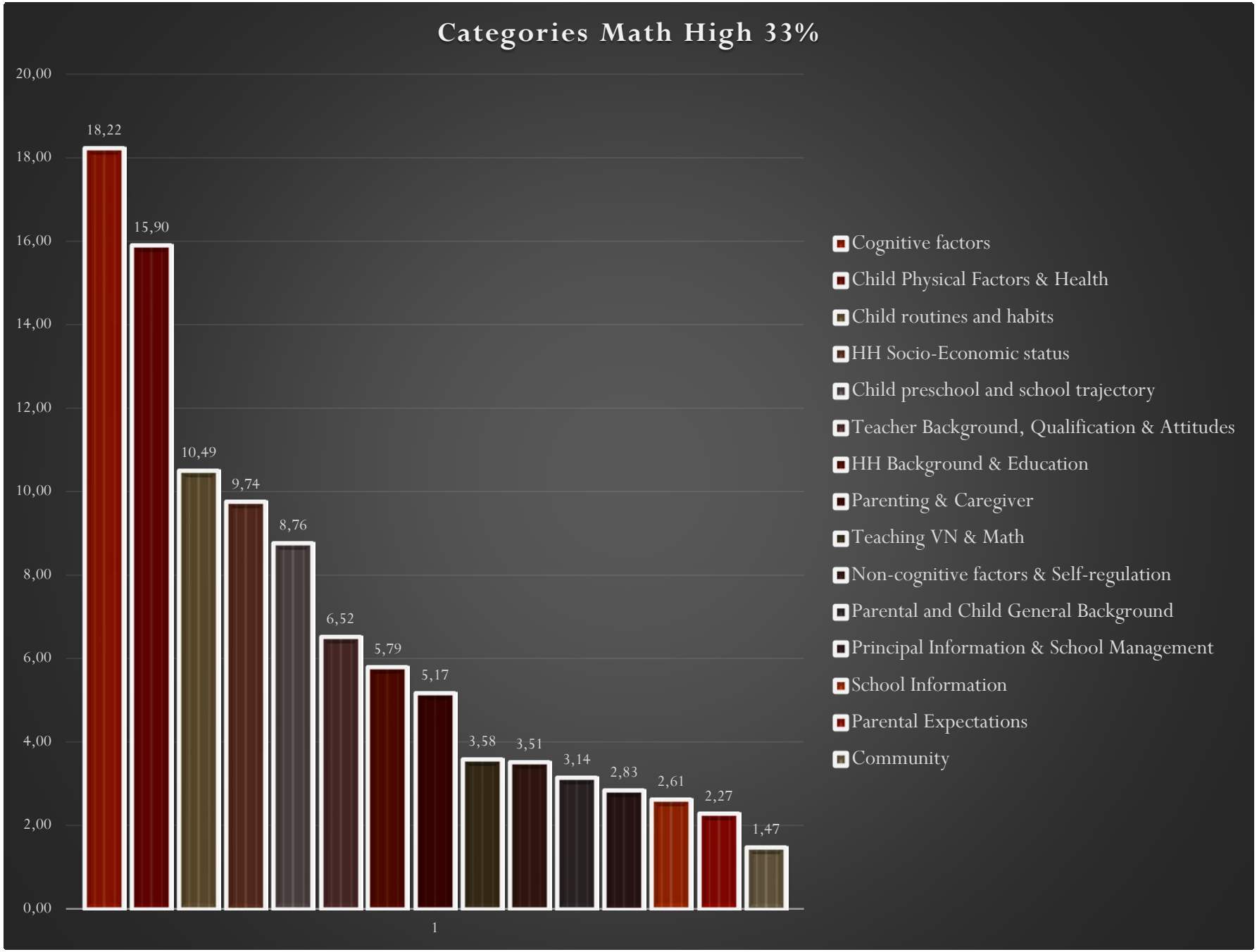
➢ **Study 2:** (Cognitive, Motivation, Persistence, Openness, Background)

- Low 25%: 100% High 25%: 100%
- Classification Accuracy

Predictive weight of several categories for outcomes in Mathematics and Language Tests

Variables in the predictive classification analysis and their information weights

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16,00
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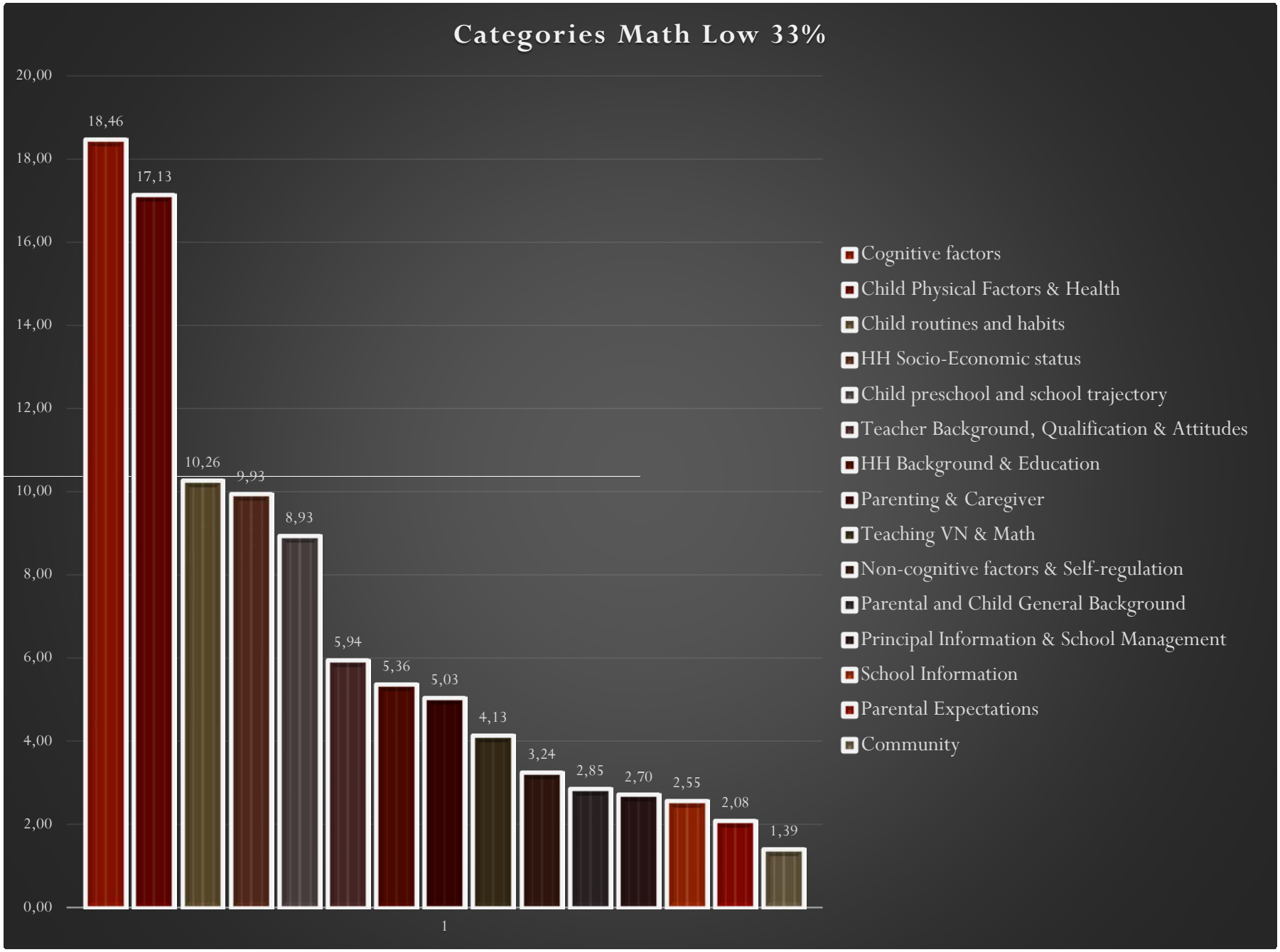
15,90
10,49
9,74
8,76
6,52
5,79
5,17
3,58
3,51
3,14
2,83
2,61
2,27
1,47
1
Cognitive factors
Child Physical Factors & Health
Child routines and habits
HH Socio-Economic status
Child preschool and school trajectory
Teacher Background, Qualification & Attitudes
HH Background & Education
Parenting & Caregiver
Teaching VN & Math
Non-cognitive factors & Self-regulation
Parental and Child General Background
Principal Information & School Management
School Information
Parental Expectations
Community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Cognitive factors
Child Physical Factors & Health
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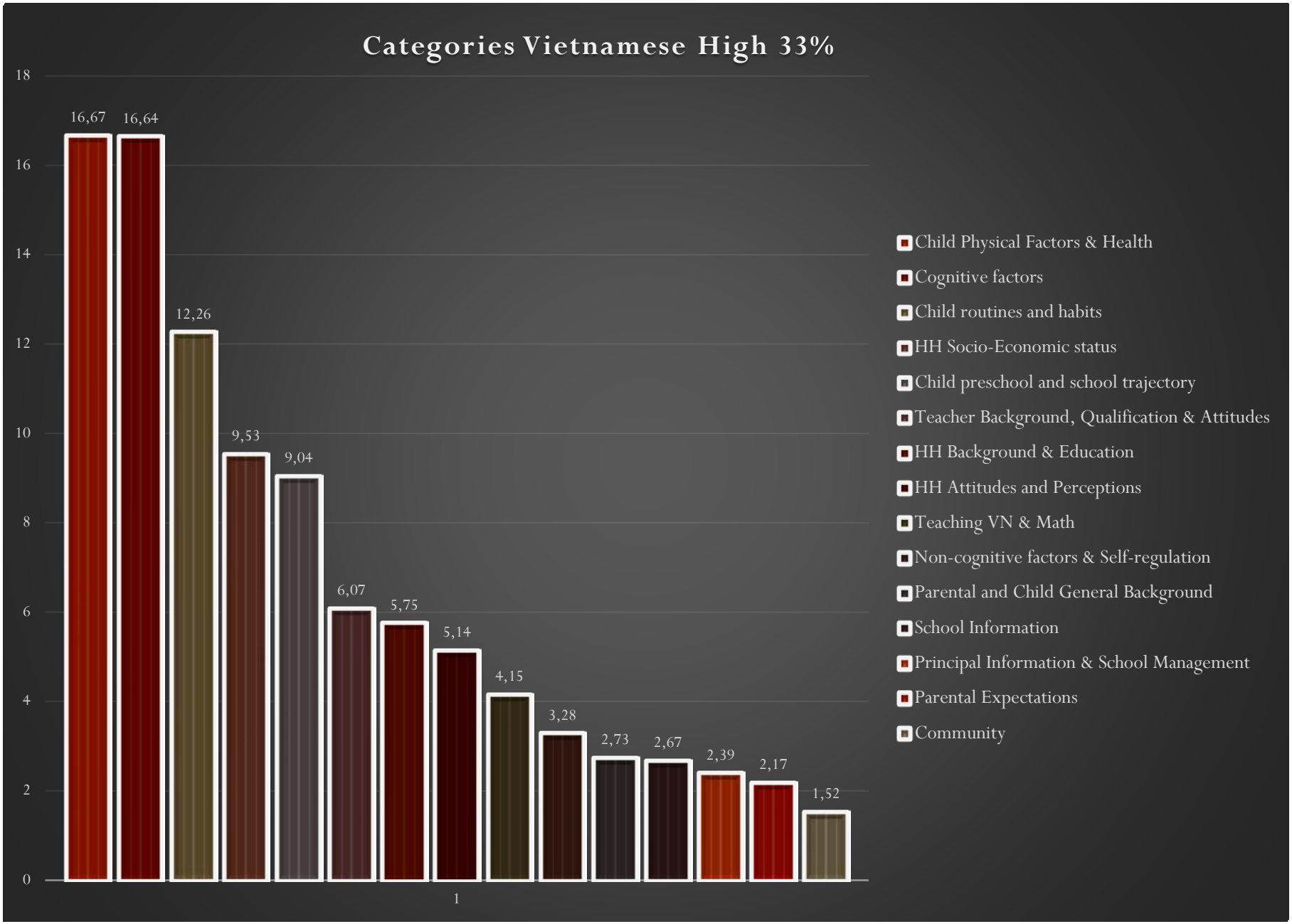
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1
Child Physical Factors & Health
Cognitive factors
Child routines and habits
HH Socio-Economic status
Child preschool and school trajectory
Teacher Background, Qualification & Attitudes
HH Background & Education
HH Attitudes and Perceptions
Teaching VN & Math
Non-cognitive factors & Self-regulation
Parental and Child General Background
School Information
Principal Information & School Management
Parental Expectations
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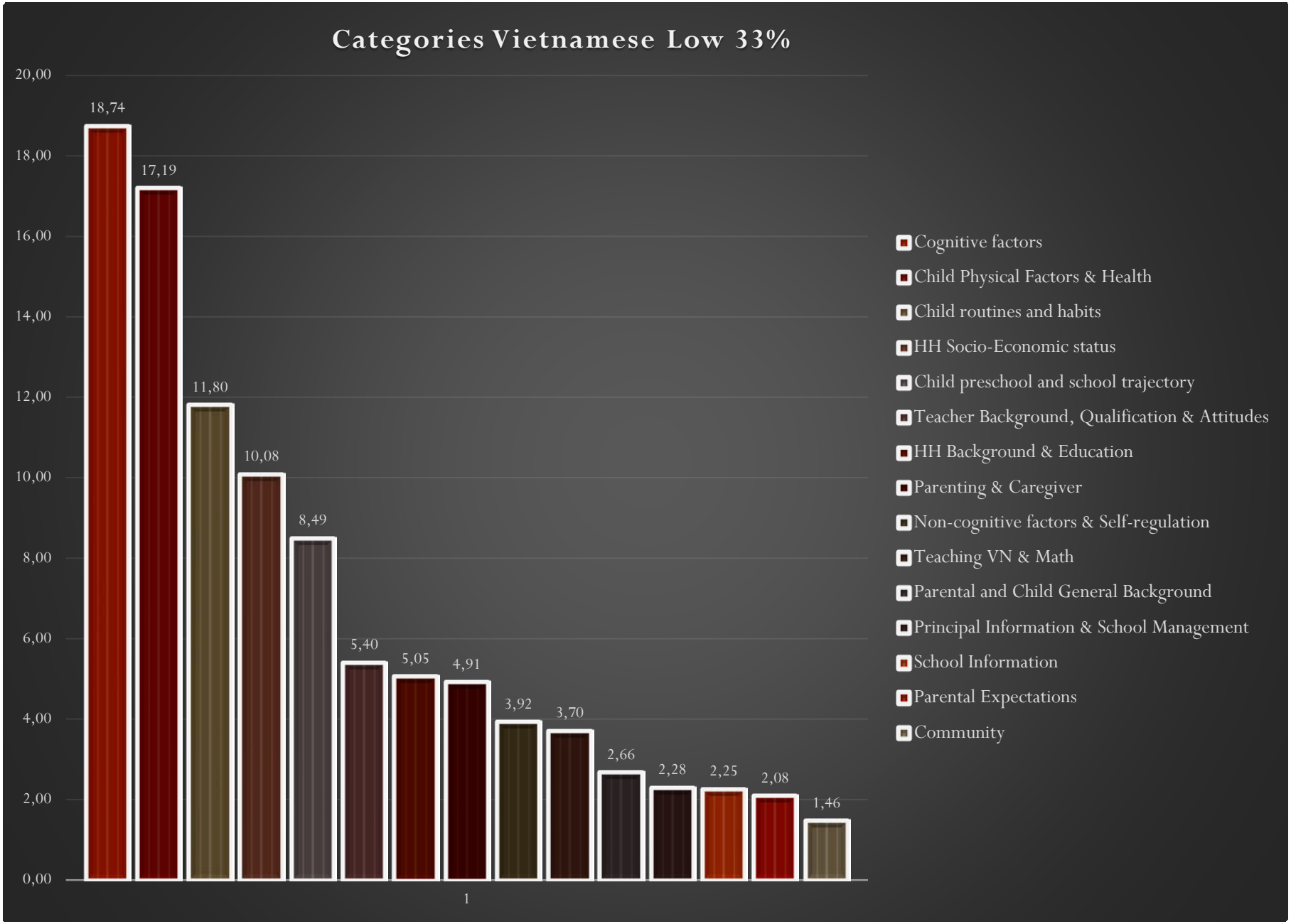
Categories Vietnamese Low 33%
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1
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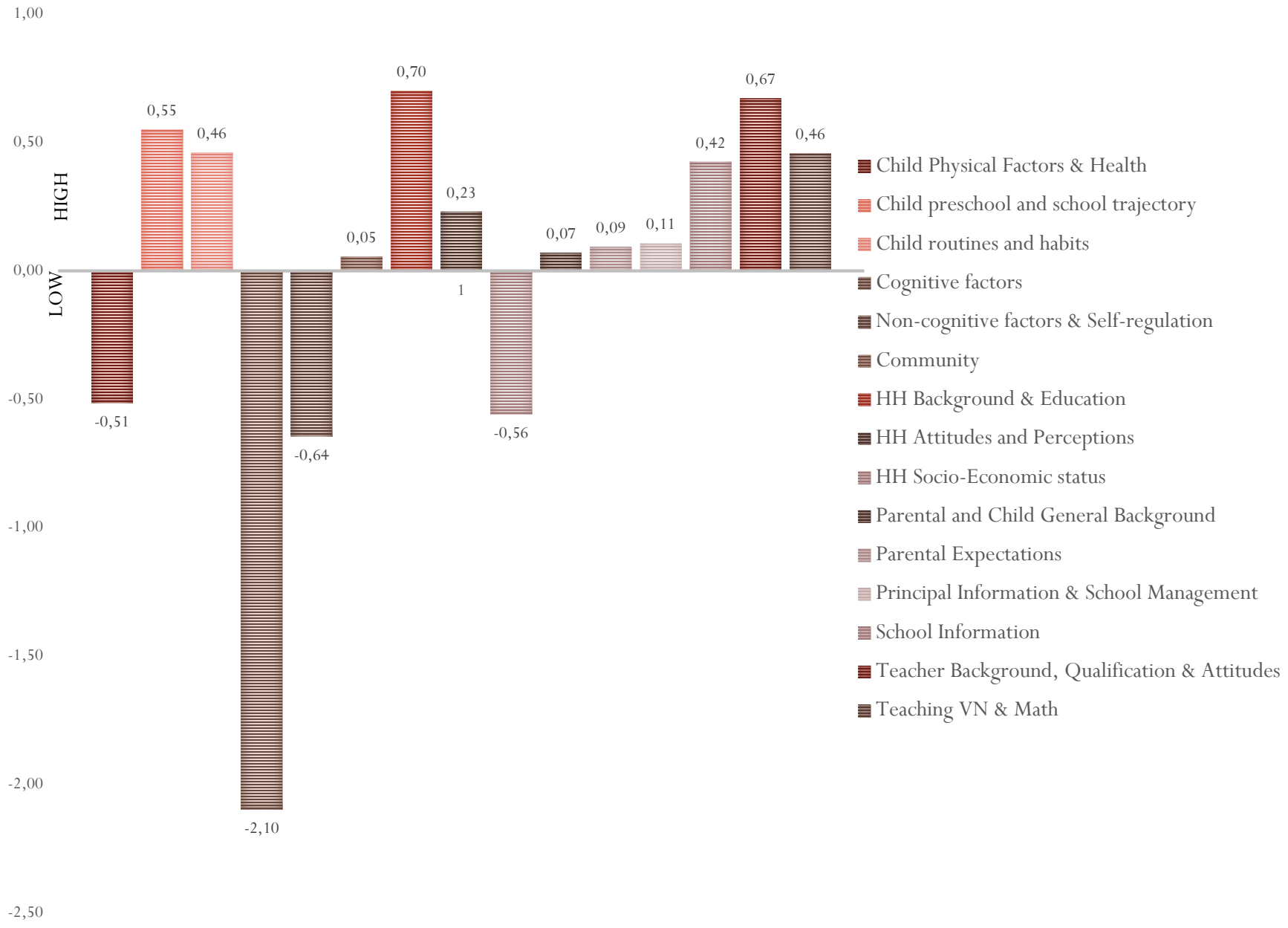
DIFFERENCES CATEGORIES MATH LOW- HIGH 33%

CATEGORIES DIFFERENCES VIETNAMESE LOW-HIGH 33%



In conclusion…

- We need new approaches to increase the effectiveness and the accuracy of our university admission programs (and many testing programs as well…)
- No mature science or applied field would tolerate decision-making schemes with 50% error rate in classification
- Or… making decisions based on knowledge of factors that predict only approximately 30% (at best) of the variance of the desired outcome.
- We cannot ignore these factors in our discussions of validity and psychometric approaches… it is the big elephant in the room that we should address to satisfy the true spirit of the equity and fairness practices that we promote.
- LET'S OPEN THE DISCUSSION ON THESE ISSUES…

Thank you for your attention!

Any Questions?