



Preliminary Study: Predicting Success in Academia Using Behavioral Stage and Holland Interest Scores

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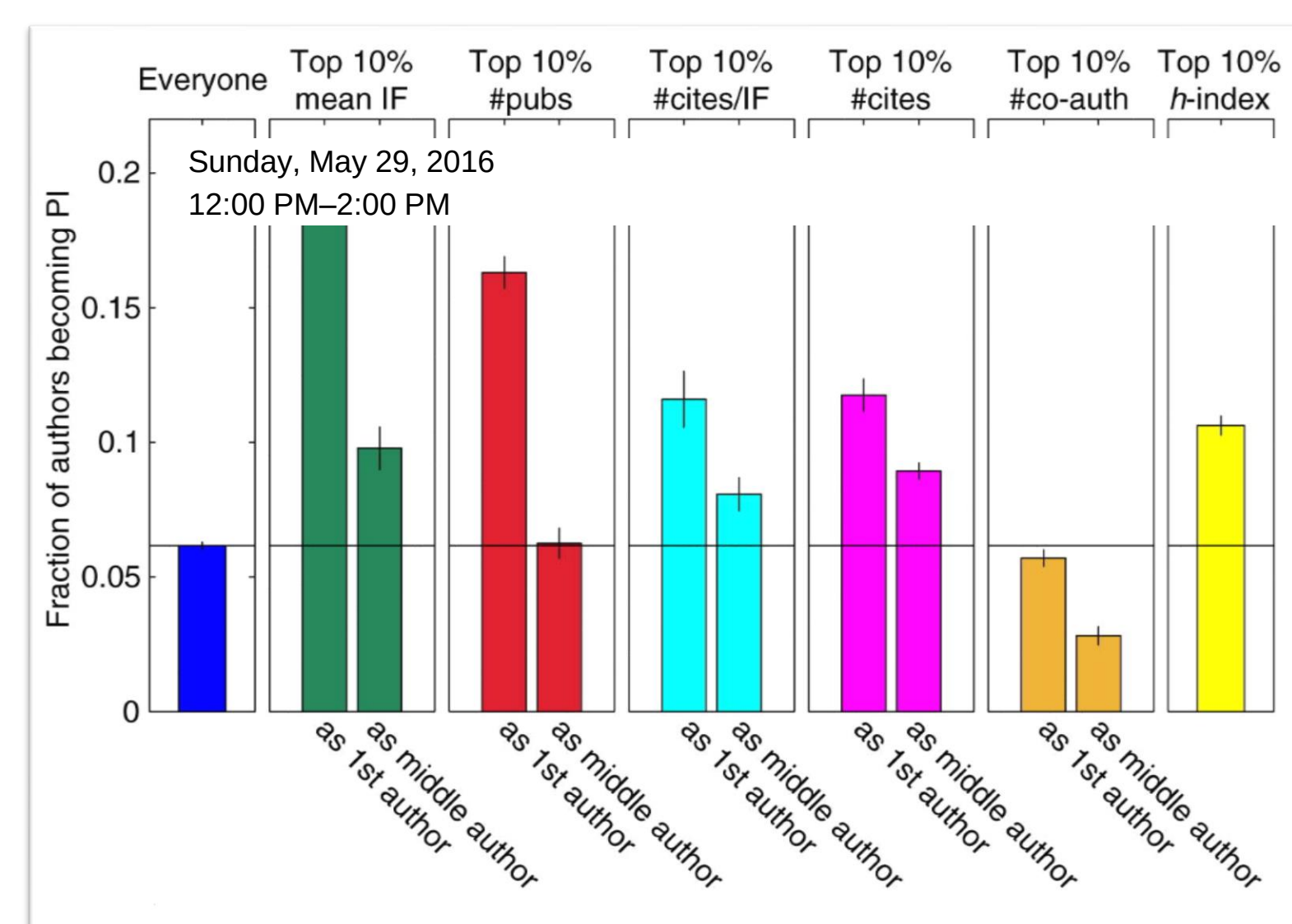
Background

- The purpose of this study is to determine if there are differences in stage and Holland interest between researchers who are currently Principal Investigators (PIs) and those who aspire to be Principal Investigators, such as Postdoctoral fellows and Graduate Students.
- We hope to investigate these differences by examining the reasoning and perspective taking skills of these researchers and their Holland interests.
- Understanding the unique combination of the variables of what it takes to be a successful Principal investigator would help graduate students make better life choices, hone their tangential skills and significantly improve their planning as well as long and short term goal setting.
- Furthermore such knowledge would enable companies to build products that would help researchers achieve fulfilling careers, both in and outside academia.

Previous Research

Important factors in determining who becomes a PI:

- Number of first and second author publications
- Impact factor (IF) of journals in which those papers are published
- Number of papers that receive more citations than the average for the journal in which they are published
- Gender
 - Males are more likely to become PIs
- University ranking



Scientists with more first-author publications are more likely to become PIs, but the number of citations is not as important as IF, which suggests that the perception of a paper is more important than its actual quality

Predicting the future *h*-index of scientists:

- Predicting next year ($R^2 = 0.92$)

$$h_{+1} = 0.76 + 0.37n + 0.97h - 0.07y + 0.02j + 0.03q$$

- Predicting 5 years into future ($R^2 = 0.67$)

$$h_{+5} = 4 + 1.58n + 0.86h - 0.35y + 0.06j + 0.2q$$

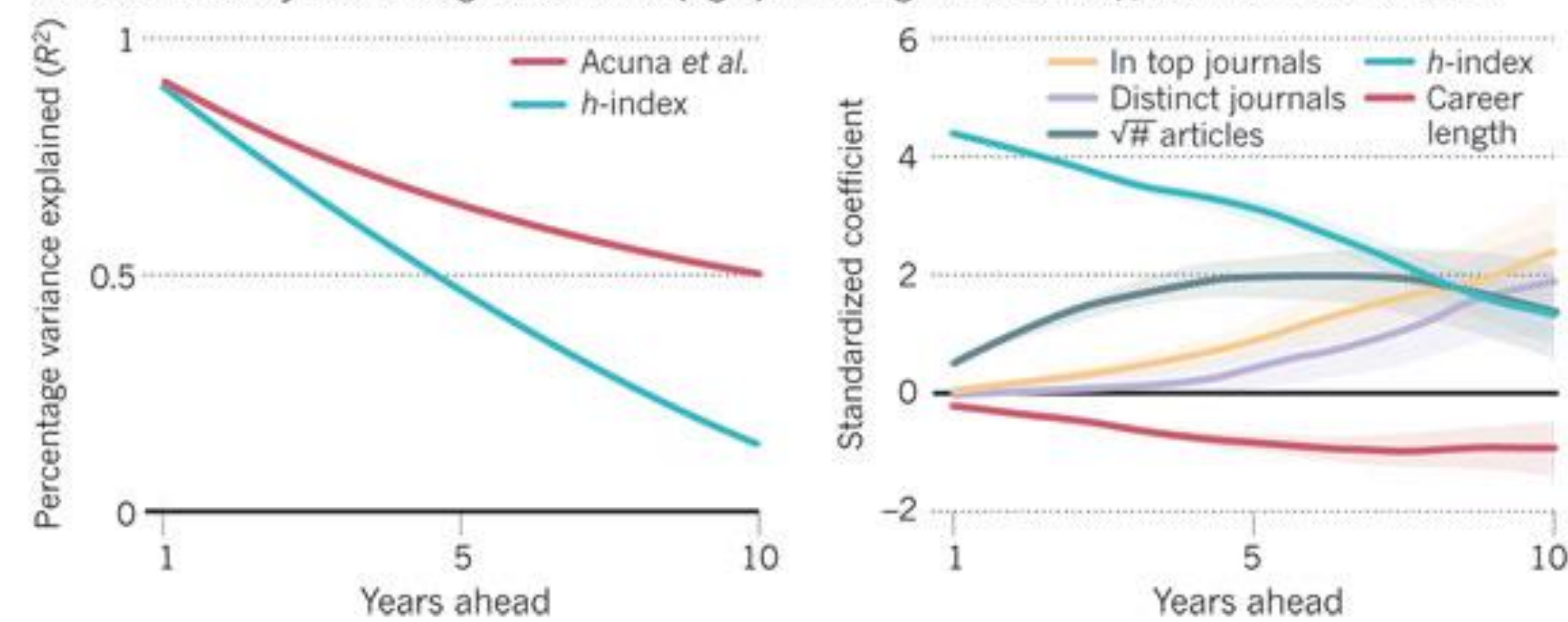
- Predicting 10 years into future ($R^2 = 0.48$)

$$h_{+10} = 8.73 + 1.33n + 0.48h - 0.41y + 0.52j + 0.82q$$

where n , number of articles written; h , current *h*-index; y , years since first publishing first article; j , number of distinct journals published in; q , number of articles in *Nature*, *Science*, *Nature Neuroscience*, *Proceedings of the National Academy of Sciences*, and *Neuron*

PATHS TO SUCCESS

The accuracy of future *h*-index prediction decreases over time, but the Acuna *et al.* formula predicts future *h*-index better than does current *h*-index alone (left). The contribution of each factor to the formula accuracy also changes over time (right). Shading indicates 95% confidence error bars.

Figure 2: Paths to success using *h*-indices and other factors

The power of the *h*-index to predict success for scientists decreases over time, but other factors such as number of articles written, articles in distinct journals, and articles in prestigious journals (listed above) become more important.

Study Design

Collect Holland and Stage data from:

- Graduate students
- Postdoctoral fellows
- Professors

Assessment I: The Holland Interest Profile (HIP)

- Interest in performing certain tasks were gauged using a modified version of the Holland test
- Participants rank a series of 24 occupations on a six-point Likert scale
- Each aspect of the scale can take a value between 8 and 48, inclusive
- Scores are scaled to fit on 0-18, inclusive

Assessment II: Logic/mathematics/physical sciences domain - Laundry Problem

Laundry problem assessments measures the employee's cognitive development on the Model of Hierarchical Complexity (MHC) scale.

- We measure a test-taker's aptitude through a series of progressively harder cause-and-effect scenarios. The first levels ask the candidate to connect a cause and its effect in a linear relationship. Higher levels ask candidates to synthesize lists of scenarios and extract rules from them, and finally to make qualitative judgements comparing different sets of rules.
- Total of six sets of questions, each testing a MHC stage from 8 to 13
- Evaluated using Rasch analysis
 - Right and wrong answers are important, but the patterns in the participants' responses are just as important, as the MHC assumes that each stage will build upon the last (Joaquim 2014).

Assessment III: Social subdomain - Perspective Taking

- The Perspective Taking Instrument (PTI) asks the participant to make subjective judgements about the logic of several arguments.
- Participants are presented with a series of vignettes describing arguments made by "helper" characters as to why their method of assistance is best suited to the needs of their client.

- Participants evaluate the persuasiveness and logical consistency of each character's line of argumentation.
- In line with MHC, these first two aspects of the test measure the participants' ability to organize their less sophisticated thoughts and actions at lower levels to produce the more systematic thought processes characteristic of higher levels (Commons 2007).

Data Demographics

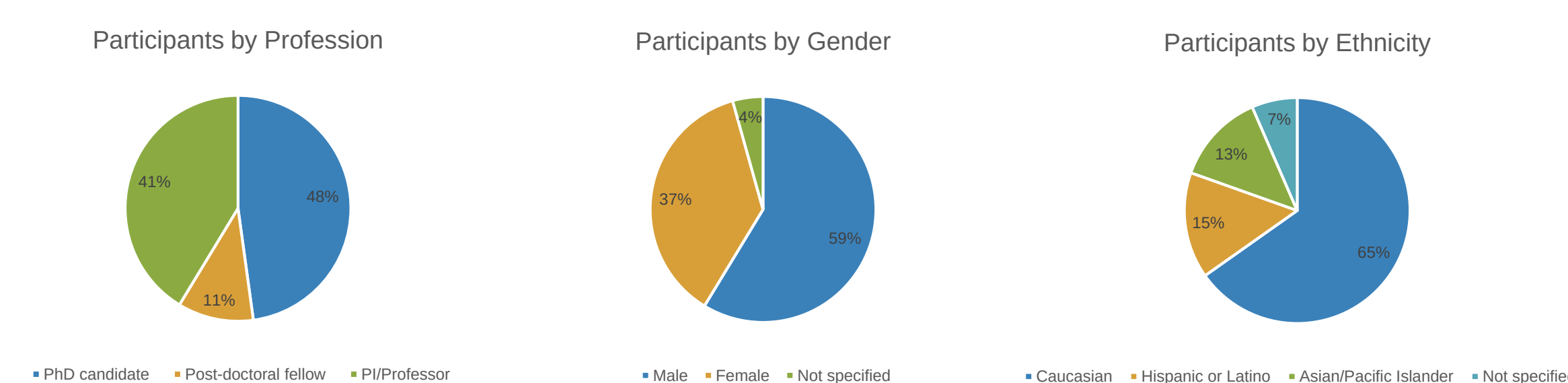


Figure 4: Participants by Profession, Gender, and Ethnicity

The two independent groups that formed the study sample ($N = 46$) included 22 PhD candidates, 5 Postdoctoral fellows, and 19 principal investigators/professors. Of the 22 PhD candidates, 17 were male, and only 5 were female. However, only 1 of the 5 Postdocs were male. Similarly, 17 of the PhD candidates were Caucasian and the remaining 5 were Hispanic or Latino, but 3 of the 5 Postdocs were Asian/Pacific Islanders and the remaining 2 were Asian. 9 PI/professors were male and 8 were female. The ethnic mix was not as evenly split: there were 11 Caucasians and only 3 Asians/Pacific Islanders and 2 who identified as Hispanic or Latino. 2 PI/professors did not disclose gender, and 3 did not disclose ethnicity.

Results

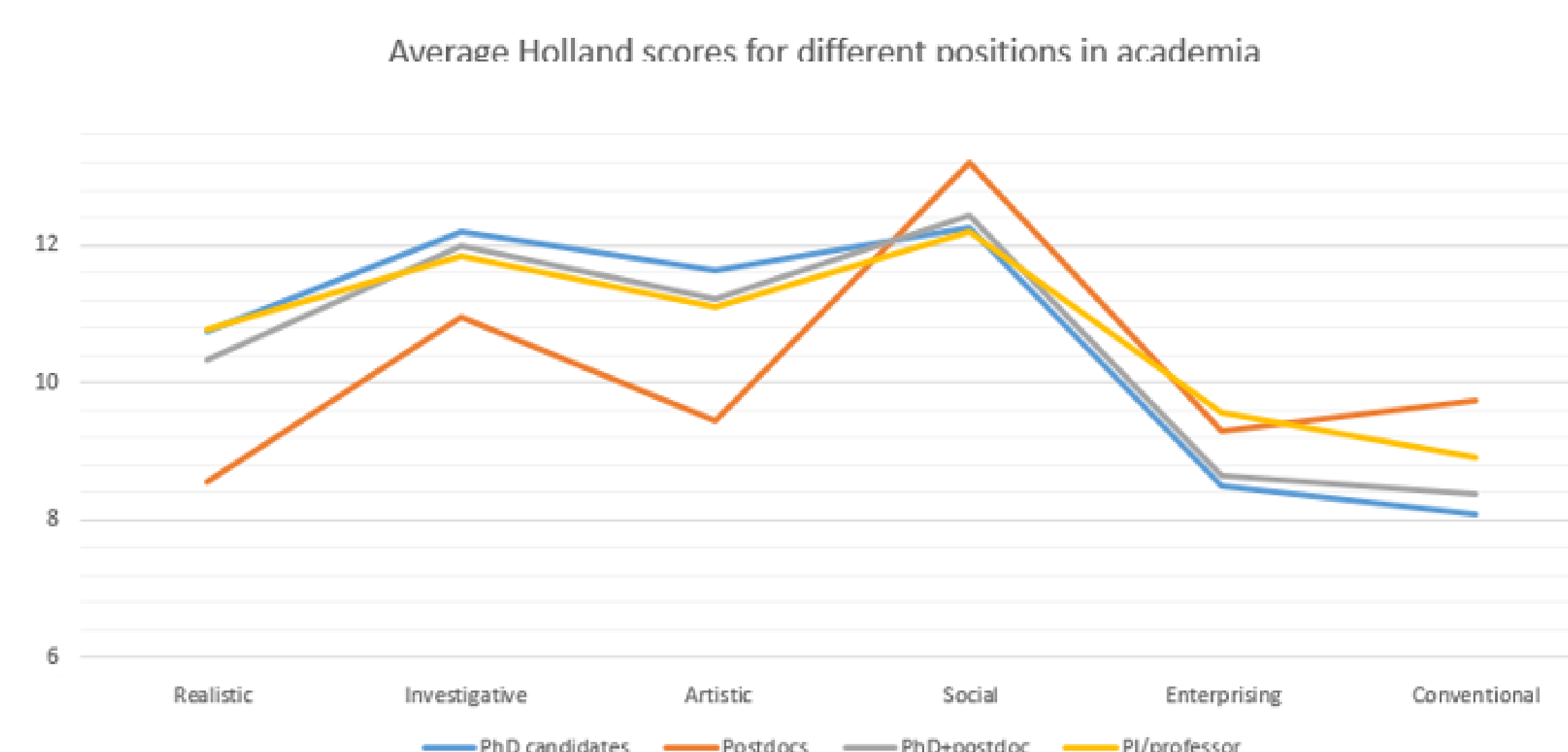


Figure 5: Average Holland scores for different professions in academia

Principal investigators and professors seem to score higher on the Conventional/Enterprising side than PhD candidates and postdocs (as one collective group). PhD candidates and postdocs score higher for investigative and social Holland characteristics. The postdocs as an individual group are the most Social and least Realistic. PhD candidates as an individual group are the least Conventional and highest in Investigative and Artistic. Overall, the trend for PhDs and postdocs mirrors that of PIs and professors. This suggests that PhDs and postdocs have similar interests as PIs and professors, which is probably a good sign because most PhDs and postdocs want to become professors or work in academia. Both groups have high scores in Realistic, Investigative, Artistic, and Social and noticeably lower scores in Enterprising and Conventional.

The combination of these interests is expected because it is evident that academics have a clear preference for one side of the Holland's hexagon. Holland's Hexagon organizes the six personality types by degree of similarity, with personality types adjacent to each other the most similar and personality types and personality types opposite the least alike.



Figure 6: Holland's hexagon

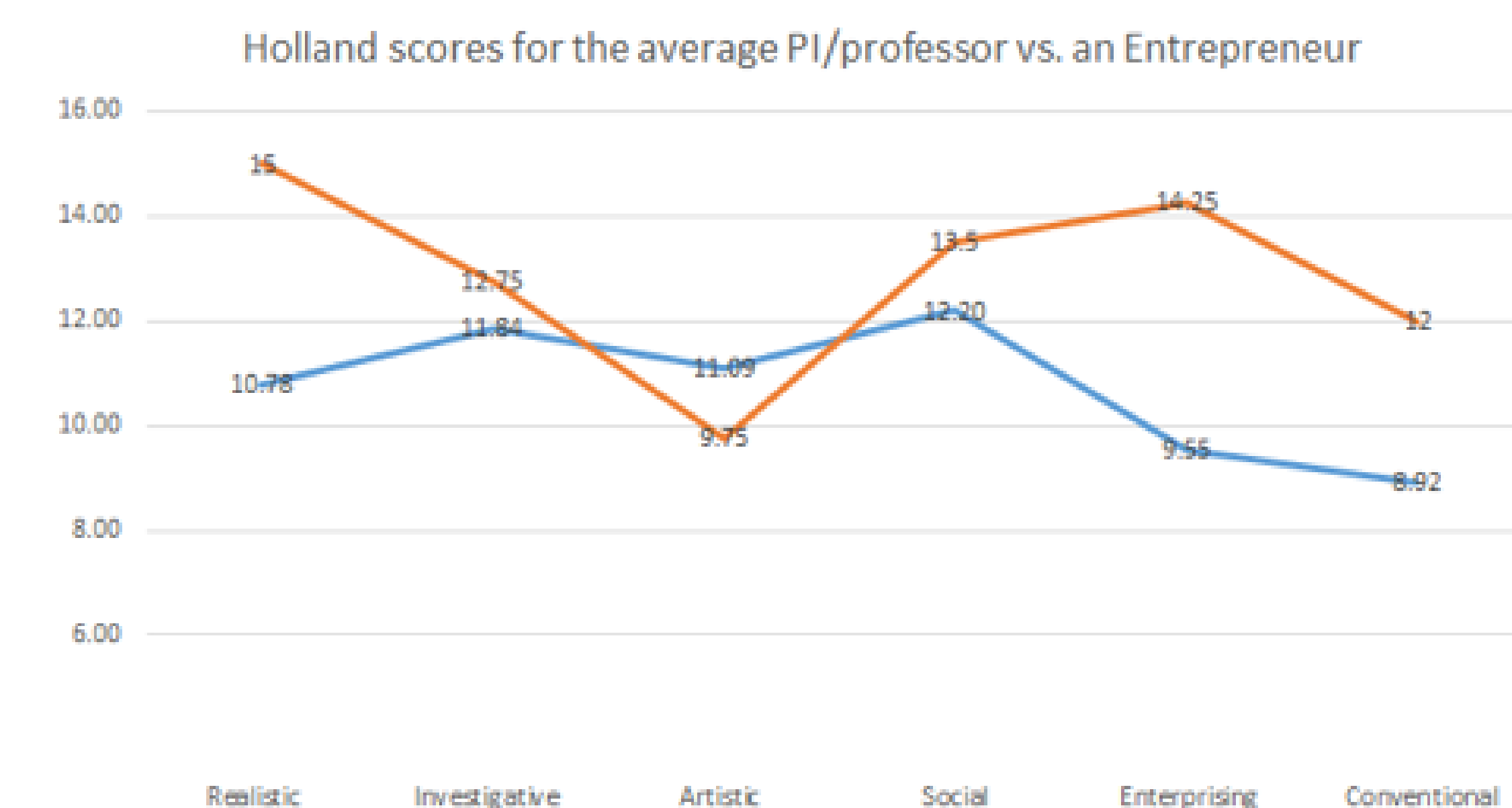


Figure 7: Academics vs. non-academics

The shape of an academic's Holland interest profile is very different than that of a non-academic.

Conclusions

- The Holland interests of PhD candidates and postdocs mirror the interests of PI/professors
- There is a clear distinction between the interest profiles of academics and non-academics
- Principal investigators and professors seem to score higher on the Conventional/Enterprising side than PhD candidates and postdocs

Limitations/steps going forward

- There are no distinguished PI/professors in our data set, e.g. Nobel Laureates. Maybe those people have different characteristics than the average PI/professor that are not reflected in our data.
- Need more data
- The number of years in each position is not taken into consideration. For example, we do not differentiate between a professor who has been teaching for 30 years and a professor who has been teaching for 2 years.