AI Personality Extraction from Faces: Labor Market Implications

by

Marius Guenzel (Wharton)
Shimon Kogan (Reichman/Wharton)
Marina Niessner (Indiana)
Kelly Shue (Yale)

Background:
Personality and AI in Labor Market Screening

Personality and Labor Market Screening + AI

Top AI recruiting tools and software of 2025

AI continues to spread to every corner of recruiting and talent acquisition. Here's the latest on AI tools from GenAI to smart chatbots and agents, plus details on 13 products.

Find My Fit helps candidates identify roles that best match their potential by quickly assessing their skills, interests and personality.

THE WALL STREET JOURNAL.

BUSINESS | MANAGEMENT & CAREERS

Today's Personality Tests Raise the Bar for Job Seekers

More companies use assessments to hire, with fewer willing to take a chance on anyone who doesn't measure up

By Lauren Weber Follow

Updated April 14, 2015 11:13 pm ET

Your Next Job Interview May Be With 'Alex,' The AI Interviewer

Jack Kelly Senior Contributor

Jack Kelly covers career growth, job market and workplace trends.

Follow

0

May 10, 2024, 11:30am EDT

Apriora's key product is a two-way AI interviewer called "Alex" that conducts live video interviews with job candidates. [-] APRIORA

Recruiting is costly

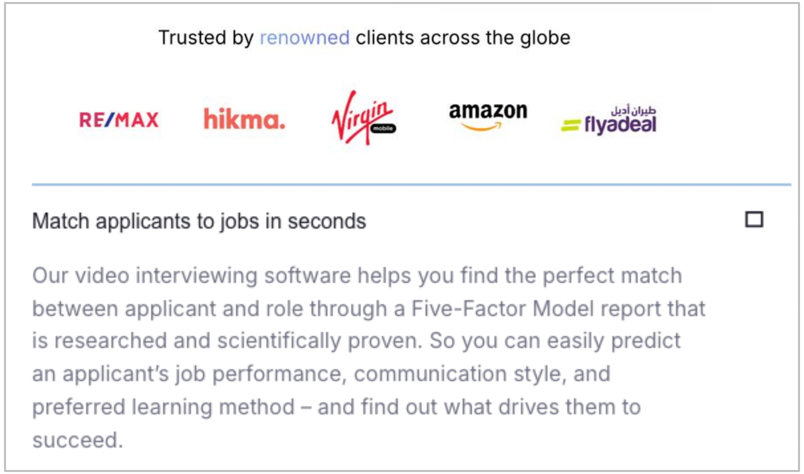
AI is getting involved in <u>screening</u>, <u>shortlisting</u>, and <u>selection</u>:

- Resume Screening
- Behavioral and Skills Assessments
- AI Video Interviews
- Predictive Analytics
- Cultural Fit and Personality Matching

Personality and Faces

- Early usage of personality extraction from videos: HireVue said its video-based algorithmic assessments provide “*excellent insight into attributes like social intelligence (interpersonal skills), communication skills, personality traits, and overall job aptitude.*” (2019)
- Black box: HireVue experienced a lot of pushback.

<u>Other firms engaging in similar behavior:</u>



Regulation on AI use in Hiring

- American Privacy Rights Act failed:

> WSJ PRO
>
> **Patchwork of State Privacy Laws Remains After Latest Failed Bid for Federal Law**
>
> Conflicting state privacy laws create unnecessary costs and confusion, companies say

- Current regulations in US:
    - Illinois: Artificial Intelligence Video Interview Act (2019)
    - Maryland: Facial Recognition Law (2020)
    - New York: Automated Employment Decision Tools (AEDT) Law (2023)
    - Colorado: Colorado Artificial Intelligence Act (2024)

- EU: The EU Artificial Intelligence Act (AI Act) (2024)

Ethics Considerations

We assess the Photo Big 5 predictive power, but are *not* advocating for usage in labor market screening

- Personality extraction from faces is Fundamental Statistical Discrimination
  - Inferences made from immutable characteristics

<u>A fundamental question:</u>

Among people of same gender and race, is it ethical to screen out those whose faces predict greater agreeableness?

- Violation of autonomy and respect for individuals
- Removes incentives to improve personality
- Inequality of opportunity

Our Paper

Academic Motivation

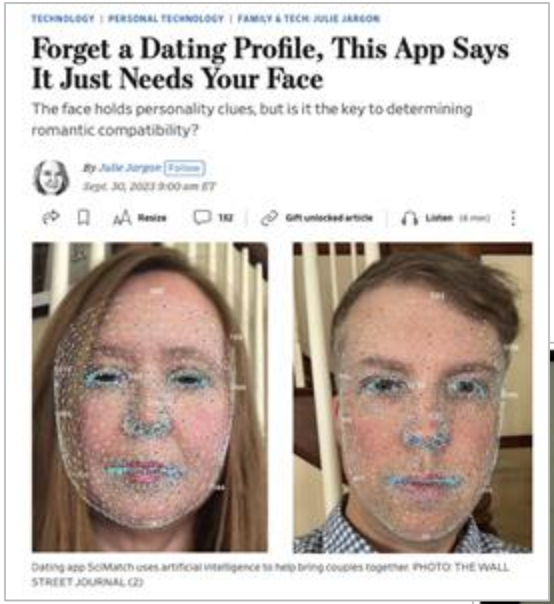
- Human capital—skills, knowledge, and personality—is a critical determinant of labor market success
- Personality often has larger explanatory power than other individual characteristics

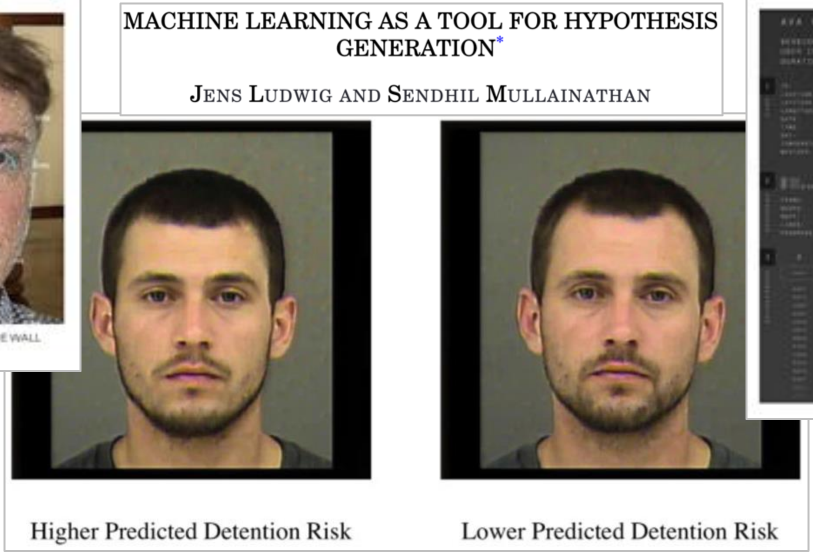
  Labor market (e.g., Barrick and Mount, 1991; Nyhus and Pons, 2005; Heckman et al., 2006; Mueller and Plug, 2006; Almlund et al., 2011); education (e.g., Heckman and Rubinstein, 2001; Heckman et al., 2011); health (e.g., Roberts et al., 2007; Kern and Friedman, 2014); crime (e.g., Cunha et al., 2006); financial investments (e.g., Jiang et al., 2024)

- **Key obstacle:** Personality remains difficult to ***measure at scale***
  - Lack of large-scale personality surveys coupled with individual (employment) outcomes
  - Survey-based measures susceptible to manipulation

➢ **Photo Big 5 is accessible for large datasets with other observable characteristics.**

AI facial recognition has entered `mainstream’





This paper

- Apply **AI-photo-personality analysis** to LinkedIn data on MBAs
- Evaluate the **predictive power** of the **'Photo Big 5' for labor market** outcomes
- Why MBAs?
    - Industry participants argue personality traits and soft skills important for MBAs
    - Survey and task-based personality measures already heavily used in hiring and job screening

Preview of results

Photo Big 5:

- Significantly predicts school rank, compensation, job seniority, job transitions
- Has predictive power comparable to race, attractiveness, and educational background
  - Bottom to top quintile of 'desirable' personality
    = **64%-122% of Black-White compensation gap**

- **Correlated** with survey-based measures of personality
- **High incremental predictive power** to GPAs and test scores

Methodology and Data

Big Five personality traits

- The five factors are:
  - **O**penness to experience (curiosity, aesthetic sensitivity, imagination)
  - **C**onscientiousness (organization, productiveness, responsibility)
  - **E**xtraversion (sociability, assertiveness, energy level)
  - **A**greeableness (compassion, respectfulness, trust)
  - **N**euroticism (anxiety, depression, emotional volatility)

- The five factors are:
  - **Labels** reflecting distinct personality dimensions each encompassing a broad range of specific characteristics

AI personality extraction from faces

Use **ML algorithm** developed by Kachur, Osin, Davydov, Shutilov, Novokshonov (2020):
Assessing the big five personality traits using real-life static facial images.
Nature Scientific Reports 10 (1), 8487

- 12,447 volunteers submitted photos + took a Big 5 personality survey
- Extract facial features from self-submitted images
- Train a cascade of artificial neural networks (ANNs) on survey-based measures of Big 5 traits
- Algorithms were trained separately for male and female faces

Why might face be associated with personality?

1. Genetics contribute to both face and personality
   - Craniofacial characteristics can be predicted with DNA (e.g., Claes et al. 2014)
   - Recent studies have attributed 40-60% of personality traits to genetic factors. Consistent across different cultures and age groups (e.g., Bouchard and McGue 2003, Vukasovic and Bratko 2015, Gupta et al. 2024)

Yale SCHOOL OF MEDICINE | How Genes Shape Personality Traits: New Links Are Discovered | The Big Five and novel loci

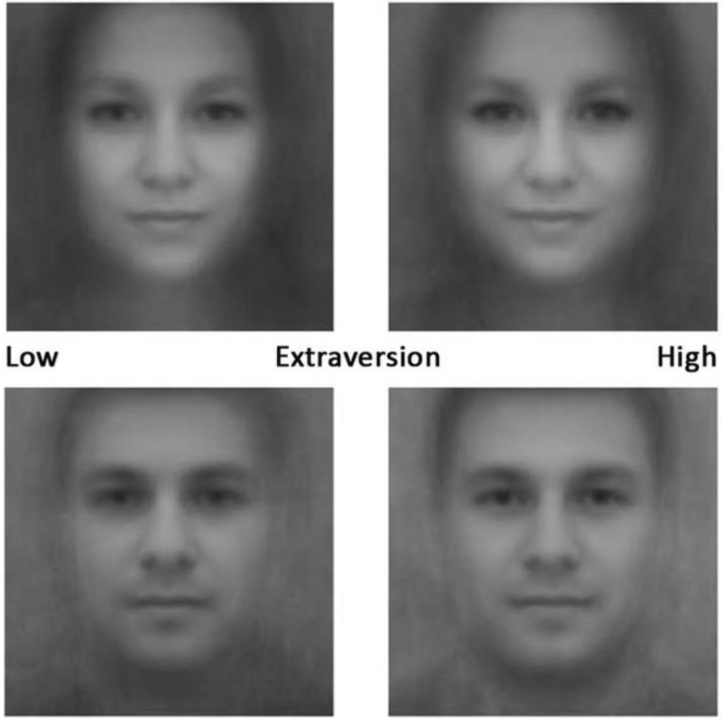
2. Pre- and postnatal hormones affect both facial shape and personality (e.g., Lefevre 2013 and Penton Voak 2004)

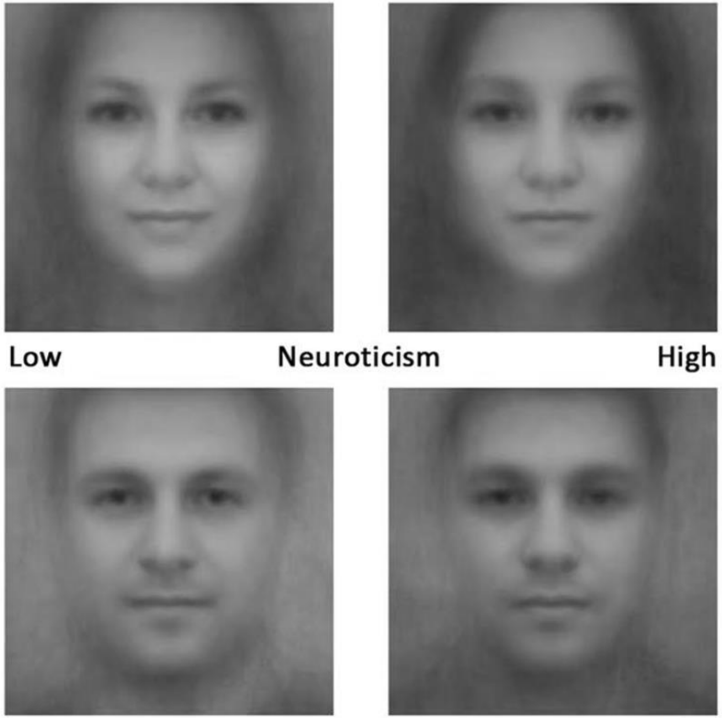
3. Perceived facial shape by self and others could affect personality and vice versa (e.g., "Quasimodo complex" in Masters and Greaves 1967)

KODSN (2020) examples

Humans can perceive personality traits from each other's faces with some accuracy

Combined images created based on differences in **survey** responses





Method stability

The results are **not** (or **very slightly**) affected by:

- Clothes
- Makeup/haircut
- Resolution of the photo (as long >30 pixels between eyes)
- Facial expression

Personality extraction from faces: Accuracy

Accuracy:

- Correlations between self-reported and predicted scores:
  - **0.14** (openness; women) to **0.36** (conscientiousness; men).
  - **7** out of **10** correlations are **> 0.2**.

Benchmarks:

- Compared to 0.30 to 0.41 for peers and -0.01 to 0.29 for strangers (Connolly et al., 2007)
- "correlations between *behavioral task measures* of personality and *questionnaire measures* seldom, if ever, exceeded 0.3" (Almlund, Duckworth, Heckman, Kautz, 2011)

➢ **Note**: true personality is latent

Data

1. **Large-scale dataset** of education and employment history from LinkedIn & Photos (*Revelio Labs*)
2. **Smaller dataset** of several top 10 US MBA programs' entrance screening and academic performance measures

- Photo age and race (*Guenzel, Borgschulte, Liu, Malmendier (2024), Deepface/Revelio)*
- Attractiveness score (*Liang, Lin, Jin, Xie, Li, 2018)*
- Face blurriness, glasses recognition, emotional expression (*Microsoft Face API*)
- Probability of Photoshop (*Wang, Wang, Owens, Zhang, Efros, 2019*)

LinkedIn Sample

LinkedIn Data (Revelio Labs)

- Focus on graduates of full-time MBA programs from top 110 business schools (US News 2023)
- Require non-missing undergrad graduation year & MBA graduation year (between 2000-2023) and at least one post-MBA (within 1 year of graduation) position listed on LinkedIn in the US:
    - **Final Sample: 70,593 men and 26,316 women**

School ranking and Photo Big 5

- Regress school ranking (1 is a `good' ranking) on Photo Big 5 and controls.
- **Consistent** prior literature on performance in **post-secondary education** & on **standardized tests** (Poropat, 2009 & Duckworth 2011)
- **Photo Big 5 effect (Top20-Bottom20):** going from 'undesirable' to 'desirable' personality

	School Ranking (1=highest)	
	Men (1)	**Women** (2)
Agreeableness (z)	0.382***	-1.897***
	(0.148)	(0.235)
Conscientiousness (z)	0.733***	0.853***
	(0.160)	(0.237)
Extraversion (z)	-0.480***	-1.446***
	(0.184)	(0.213)
Neuroticism (z)	-0.626***	0.107
	(0.111)	(0.208)
Openness (z)	0.308*	-0.024
	(0.182)	(0.234)
Grad. Year FE	Yes	Yes
Race FE	Yes	Yes
Image Controls	Yes	Yes
Age Controls	Yes	Yes
|LHS mean|	35.582	37.982
R2	0.101	0.132
Observations	70,593	26,316
Big 5 Top20-Bottom20	**2.616**	**6.588**

1st Post-MBA Compensation

- Include controls: race, age at MBA (and squared), attractiveness, image blurriness, glasses dummy, emotional expression, lighting adjustment dummy, implied age in the photo, the probability of Photoshop
- Add School FE effects

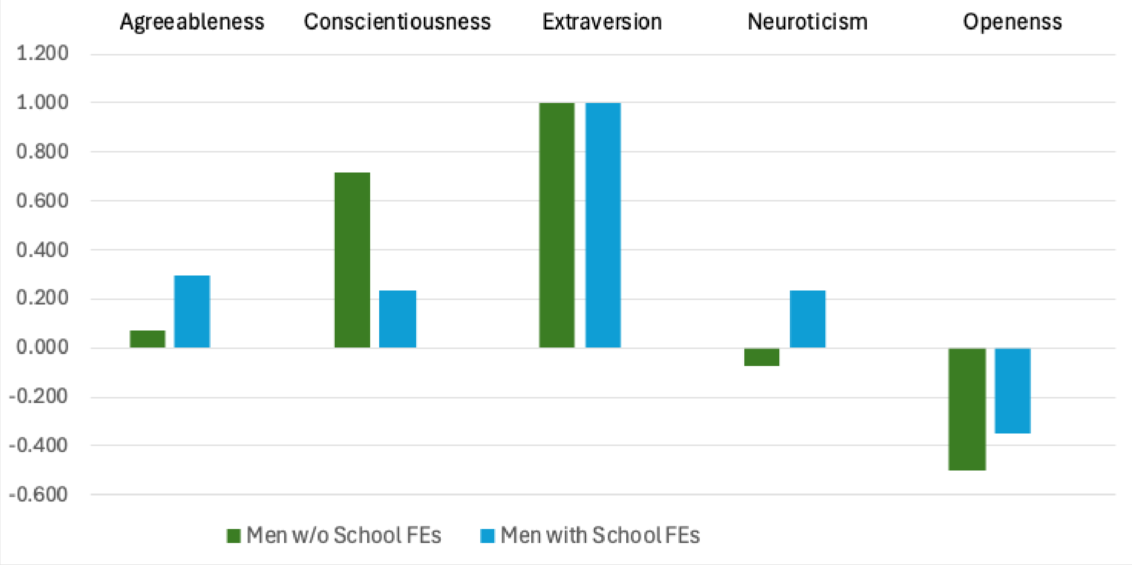
- **Photo Big 5 effect:**
  4.3% (men), 4.7% (women)
  - **122%** and **64%** of the **Black-White gap**

- Effects are **stable** if we control for O*NET job classifications from BLS

	1st Post-MBA Compensation (log)			
	Men		**Women**	
	(1)	(2)	(3)	(4)
Agreeableness (z)	0.001			
	(0.003)			
Conscientiousness (z)	0.010***			
	(0.003)			
Extraversion (z)	0.014***			
	(0.003)			
Neuroticism (z)	-0.001			
	(0.002)			
Openness (z)	-0.007**			
	(0.003)			
Asian	0.079***			
	(0.007)			
Black	-0.016*			
	(0.010)			
Hispanic	0.012			
	(0.013)			
Other Non-White	0.024***			
	(0.006)			
Age at MBA	0.121***			
	(0.004)			
Attractiveness Score (z)	0.028***			
	(0.002)			
Grad. Year FE	Yes			
Image Controls	Yes			
Age at MBA^2	Yes			
School FE				
R2	0.100			
Observations	70,593			
Big 5 Top20-Bottom20	**0.048**			

Big 5 and Job Productivity: Prior Literature

- Display '**scaled**' coefficients (|largest coefficient| = 1)
- Compare to prior literature on **job productivity**, also `**scaled**' (Barrick and Mount, 1991)



Post-MBA Compensation: Long-term effect

- The effect of personality on compensation is **present 5 years** after MBA

Photo Big 5 effect:

- **2.2% (men), 2.4% (women)**
  - Magnitude is **smaller** than for 1st job.

- Find **similar** similar results for **seniority**

	Δ 5yr-1st Post-MBA Comp. (log)			
	Men		Women	
	(1)	(2)	(3)	(4)
Agreeableness (z)	-0.003	0.004	-0.000	0.004
	(0.003)	(0.004)	(0.005)	(0.005)
Conscientiousness (z)	0.016***	0.010**	-0.012**	-0.009*
	(0.004)	(0.004)	(0.005)	(0.005)
Extraversion (z)	0.002	-0.004	0.004	-0.001
	(0.004)	(0.004)	(0.005)	(0.005)
Neuroticism (z)	-0.000	0.000	0.006	0.002
	(0.003)	(0.003)	(0.005)	(0.005)
Openness (z)	-0.004	-0.003	-0.007	-0.005
	(0.004)	(0.004)	(0.005)	(0.005)
Asian		-0.039***		-0.021
		(0.010)		(0.016)
Black		-0.021		-0.009
		(0.014)		(0.030)
Hispanic		-0.033*		-0.046
		(0.019)		(0.030)
Other Non-White		-0.023***		-0.030**
		(0.007)		(0.013)
Attractiveness Score (z)		0.003		-0.000
		(0.003)		(0.005)
Grad. Year FE	Yes	Yes	Yes	Yes
Image Controls	No	Yes	No	Yes
Age Controls	No	Yes	No	Yes
School FE	No	Yes	No	Yes
R2	0.003	0.018	0.006	0.025
Observations	47,049	47,049	15,913	15,913
Big 5 Top20-Bottom20	**0.044**	**0.022**	**0.040**	**0.024**

Job Mobility

Men:

- Agreeableness is positive for tenure and negative for # of firms/industries/job categories
- Conscientiousness is positive for tenure and positive for # of industries
- Extraversion is negative for tenure and positive for # of firms/industries/job categories
- Neuroticism is negative for tenure and negative for # of industries
- Openness is positive for tenure and negative for # of firms/industries/job categories

Women:

- CEAN are the same as for men
- Openness is negative for tenure and positive for # of firms/industries/job categories

Top MBA Programs Sample

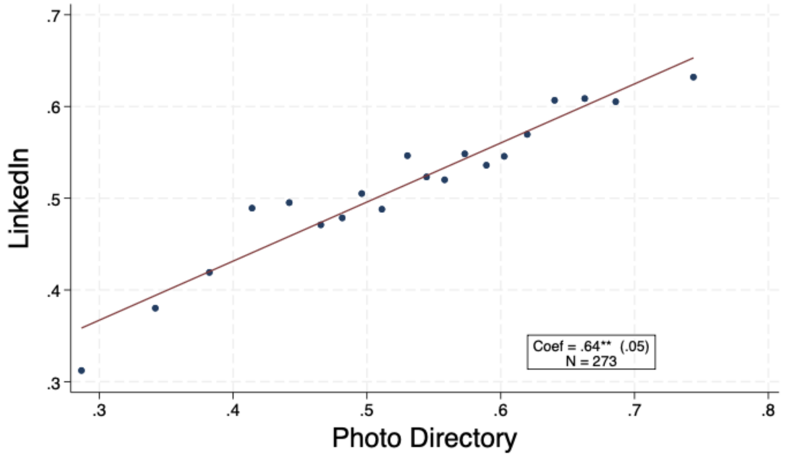
Validating our measures

- Admission data & photo directories from several top MBA programs.
- Match to LinkedIn profiles

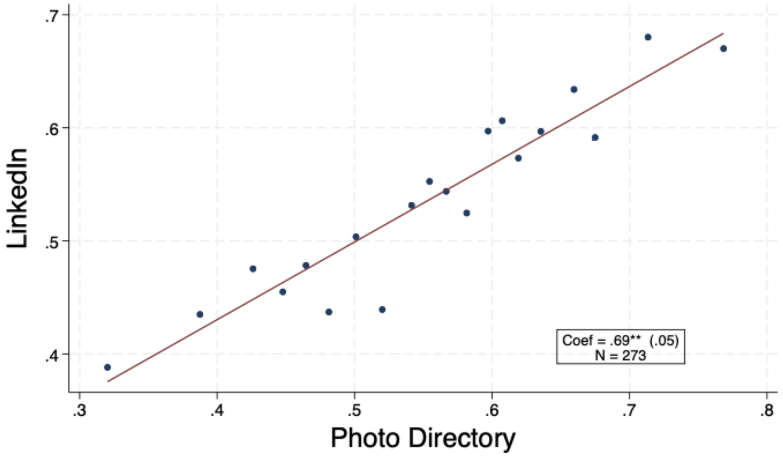
➢ 1,374 observations; 1,100 LinkedIn profiles; 273 MBA +LinkedIn photos.

Personality measures: LinkedIn vs. MBA photos

(a) Agreeableness



(b) Conscientiousness



Survey and Photo Big 5

- Men: N = 544; Women: N = 380
- Map facets into Big 5.
- **Men**: Average correlation is **0.166**; **Women**: Average correlation is **0.186**

1^{st} Post-MBA Salary

- Similar effects of Photo Big 5 to the full sample results.
- Undergraduate/MBA GPAs and GMAT only slightly affect the relationship between Photo Big 5 and the 1^{st} post-MBA salary

	1st Post-MBA Compensation (log)			
	Men		Women	
	(1)	(2)	(3)	(4)
Agreeableness (z)	0.019	0.024	0.029	0.029
	(0.029)	(0.029)	(0.033)	(0.034)
Conscientiousness (z)	0.070**	0.061*	-0.039	-0.043
	(0.034)	(0.034)	(0.047)	(0.046)
Extraversion (z)	0.049	0.058	0.038	0.042
	(0.038)	(0.038)	(0.029)	(0.030)
Neuroticism (z)	0.002	0.002	0.031	0.030
	(0.023)	(0.023)	(0.035)	(0.034)
Openness (z)	-0.085**	-0.083**	-0.029	-0.028
	(0.035)	(0.035)	(0.035)	(0.037)
Undergrad GPA		-0.133**		-0.078
		(0.063)		(0.121)
GMAT Quant		-0.002		-0.002
		(0.002)		(0.003)
GMAT Verbal		0.002		-0.001
		(0.003)		(0.004)
MBA GPA		0.109		0.259**
		(0.071)		(0.101)
Grad. Year FE	Yes	Yes	Yes	Yes
Image Controls	Yes	Yes	Yes	Yes
Age Controls	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes
R2	0.062	0.076	0.167	0.205
Observations	883	883	217	217
Big 5 Top20-Bottom20	**0.217**	**0.217**	**0.155**	**0.161**

Conclusion

- Explore a new methodology: leveraging machine learning techniques to infer Big 5 personality characteristics from individuals' images
  - This methodology circumvents the limitations of survey-based assessment: limited sample size and gaming of the survey.

- **Current project finds that:**
  - Photo Big 5 have strong predictive power for future compensation/seniority
  - Predictability remains strong after controlling for demographic characteristics, past labor and education history

Thank you!