

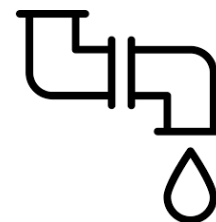


Beyond Pipeline and Pathways: Ecosystem Metrics

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Richard Layton and Michelle Camacho

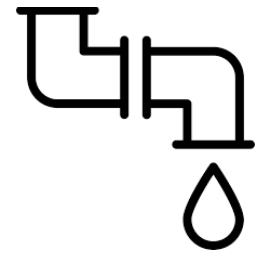


National Science Foundation
WHERE DISCOVERIES BEGIN

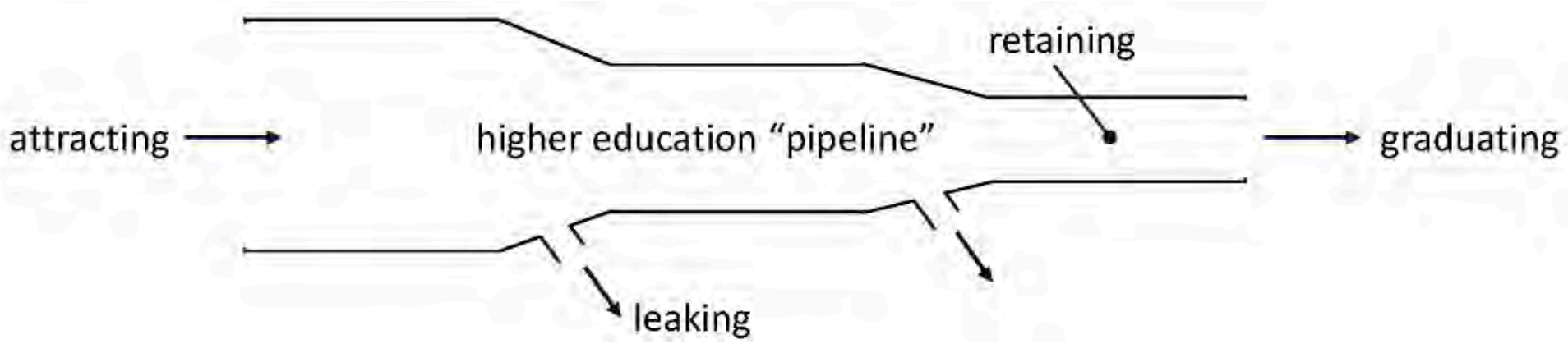


Variation by Engineering discipline

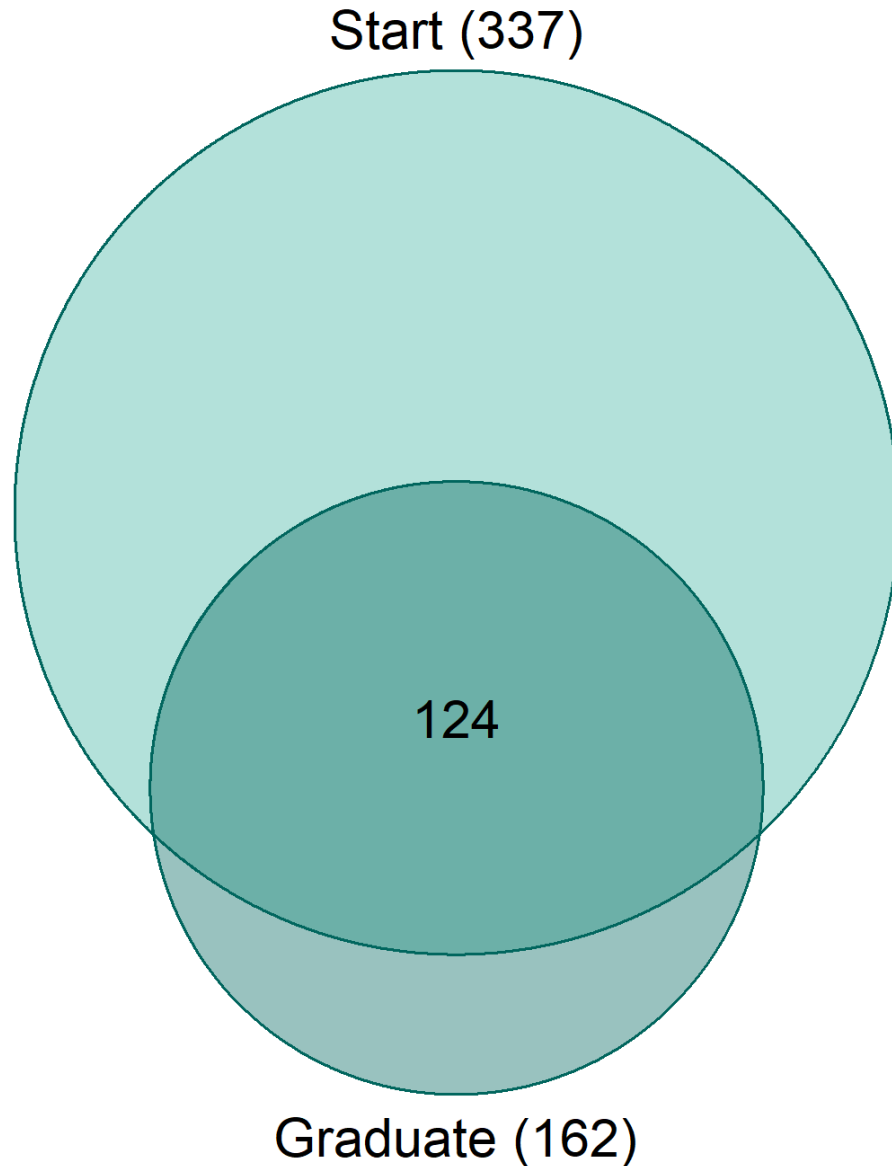
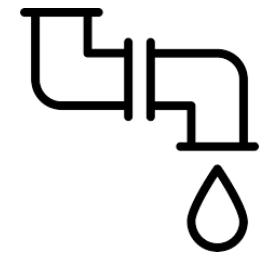
- Electrical (EE) & Mechanical Engineering (ME): highest # students but lowest % women
- Other engineering disciplines: higher % women but smaller # students
- Aggregating all engineering disciplines produces skewed view.
- Engineering Disciplines have their own cultures



Pipeline



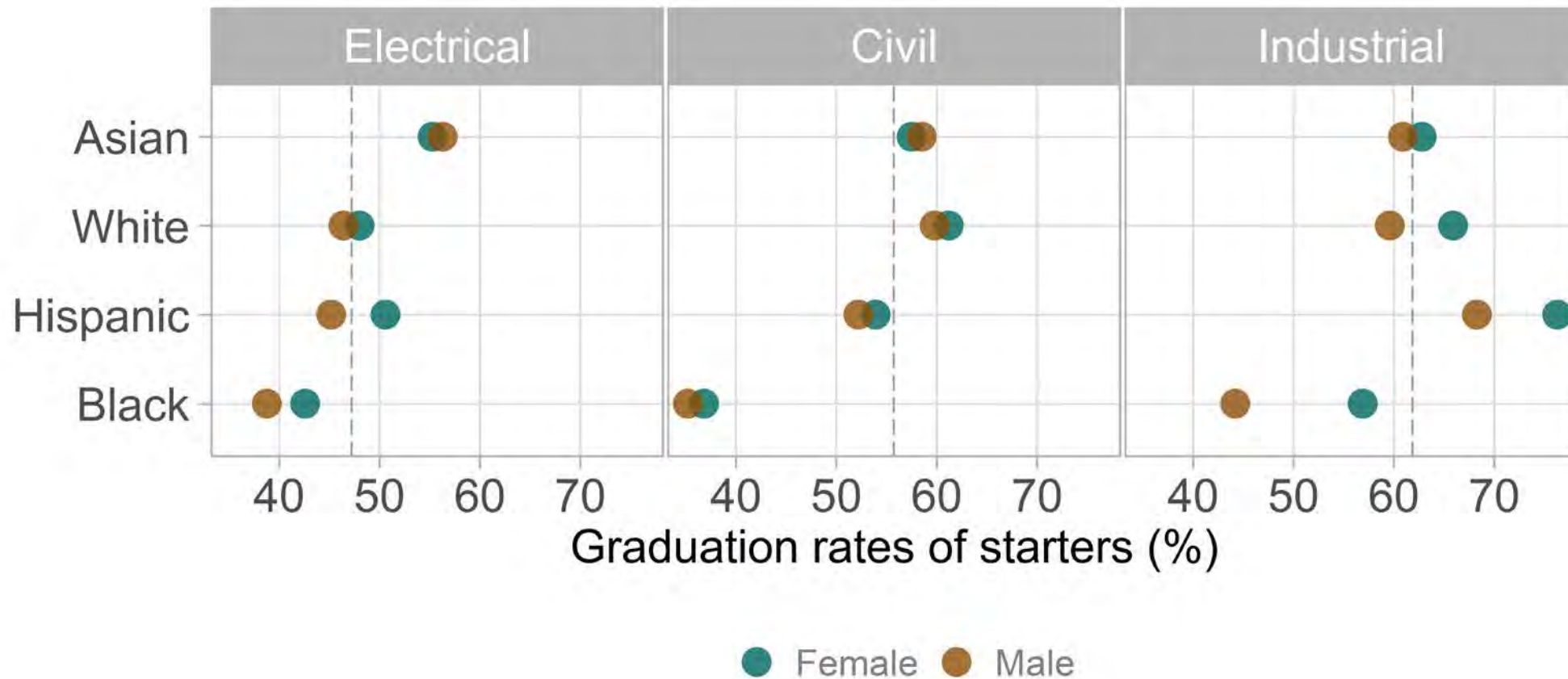
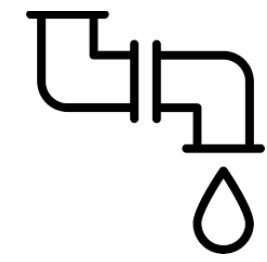
Pipeline Metric: Graduation Rate



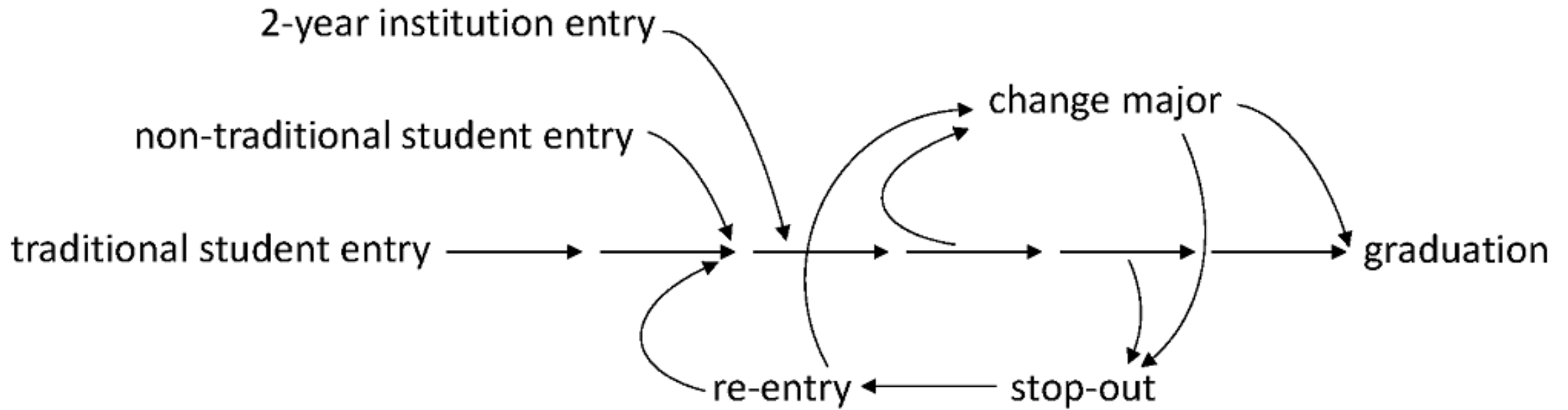
Black Female students in CE
424 start in CE

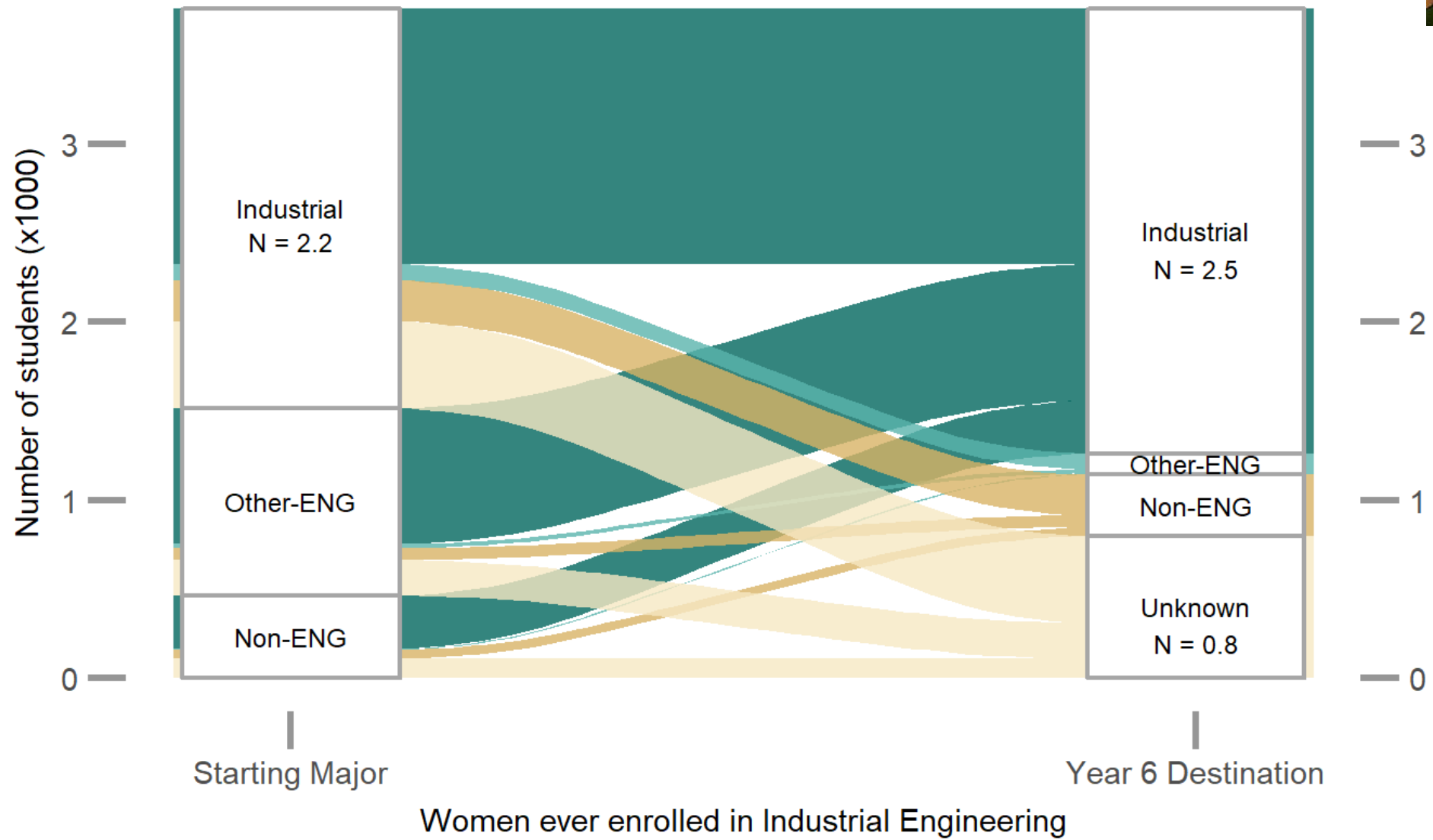
Of those, 124 graduate in CE
Graduation rate = $124 / 337 = 37\%$

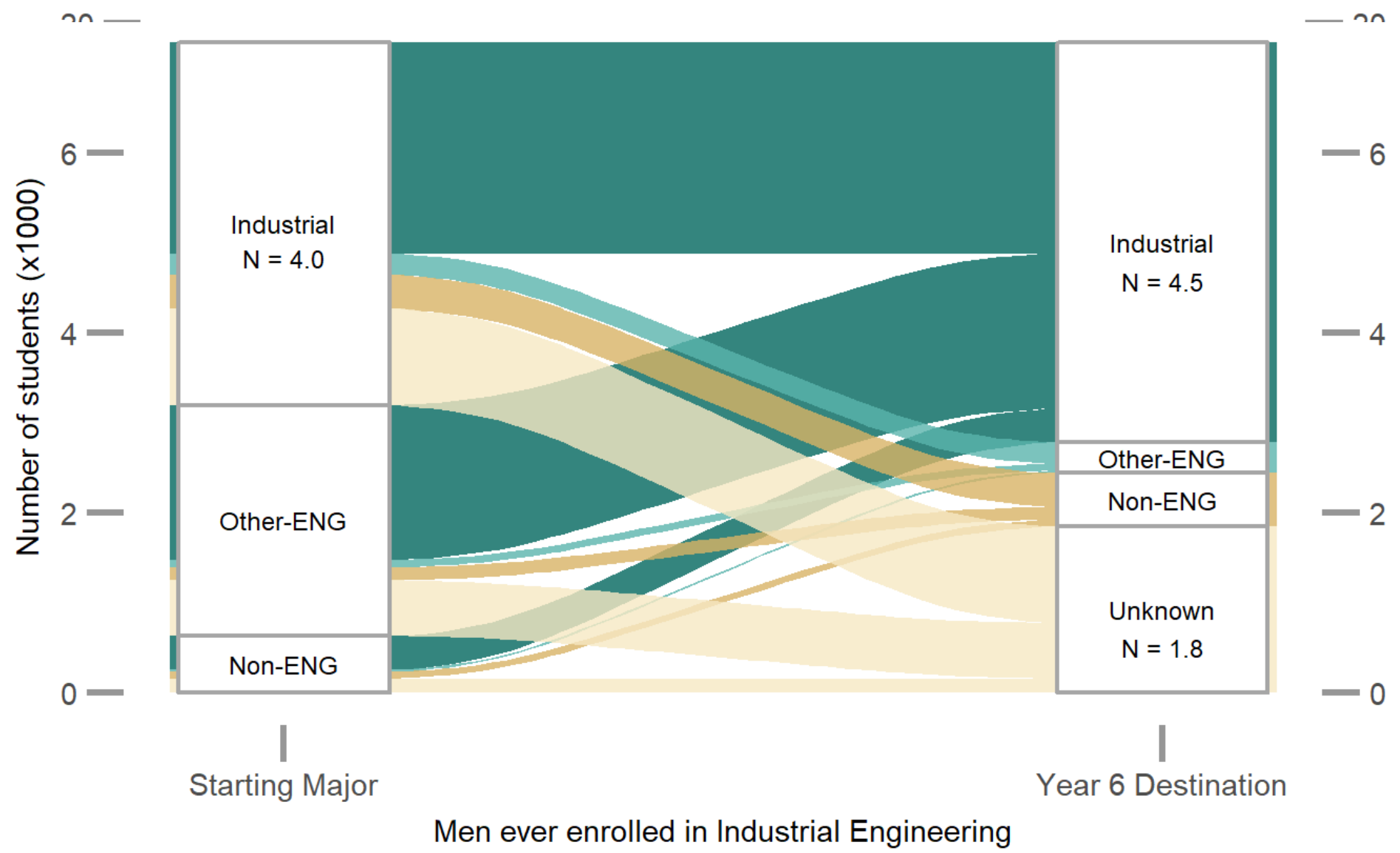
Engineering Discipline Matters



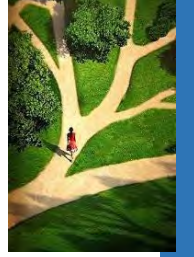
Pathways







Research Question



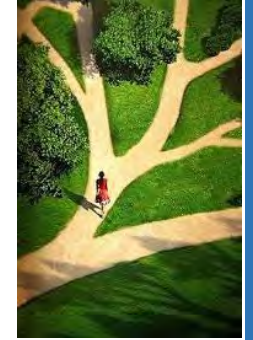
“How do the trajectories of engineering students in different engineering disciplines vary by race/ethnicity and gender?”



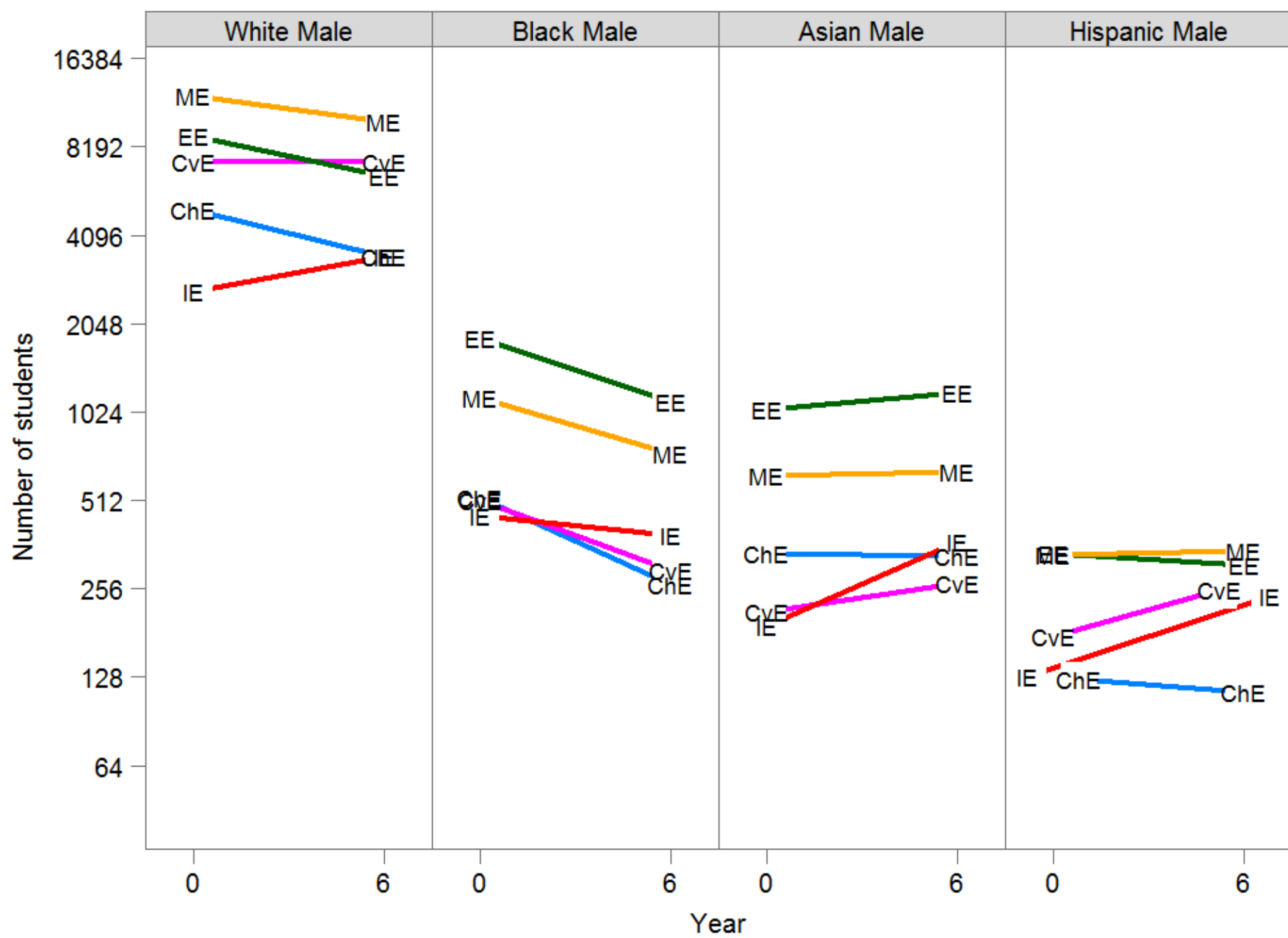
Research Method

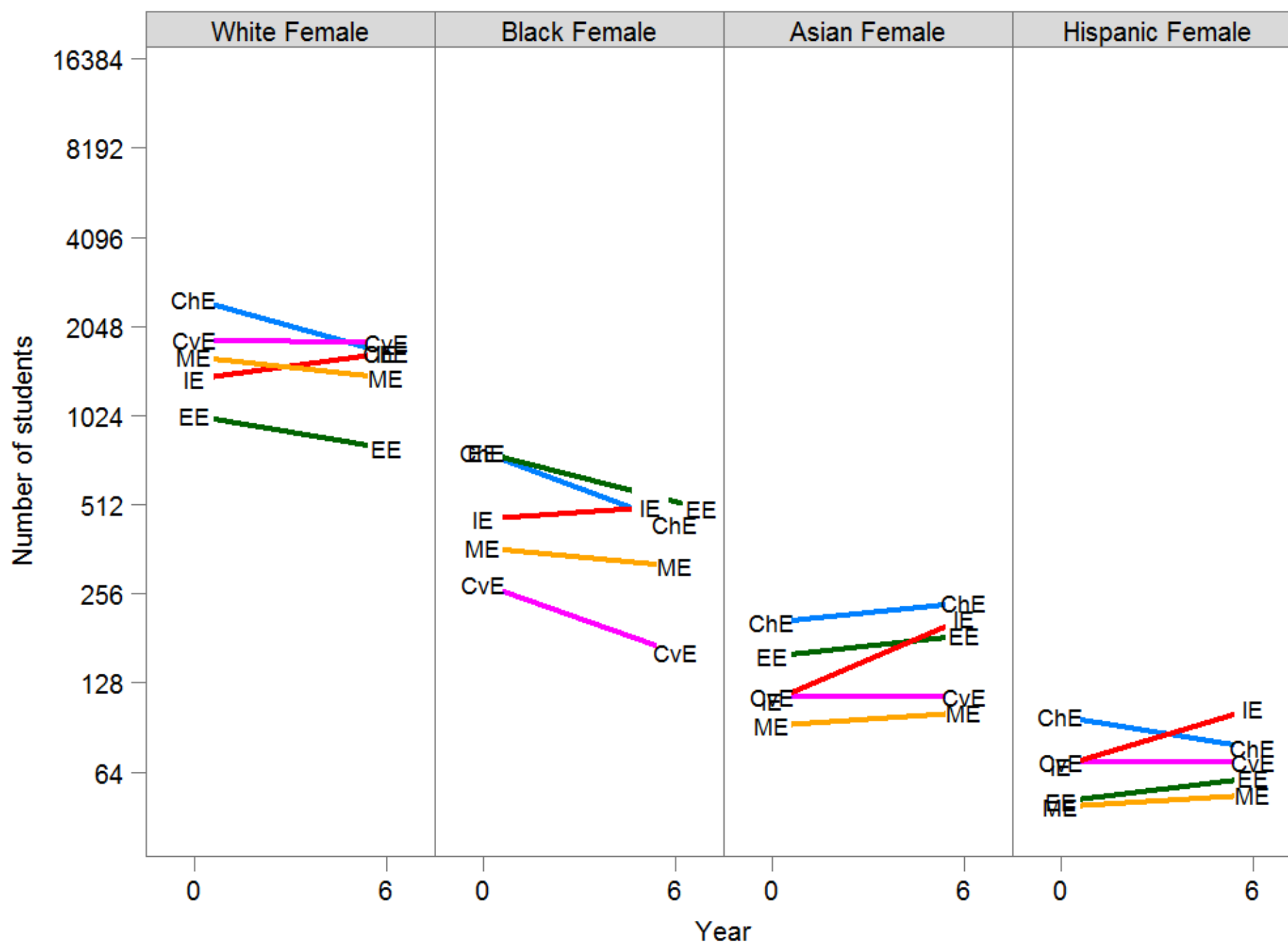
- Focuses on largest engineering disciplines: Chemical (ChE), Civil (CVE), Electrical (EE), Industrial (IE), & Mechanical (ME)
- Trajectories measured at matriculation & 6-year graduation for students who
 - Matriculate directly into engineering discipline (FTIC)
 - Matriculate into a first-year engineering (FYE) program (FTIC)
 - Migrate into engineering (FTIC)
 - Choose engineering as Transfer students
- Race/ethnicity self-reported by students including Asian, Black, Hispanic, and White

Trajectories



- All engineering disciplines lose about half of their starters.
- When transfer students and others who switch into the majors included, there is variation by race/ethnicity, gender, and engineering discipline.





Most popular engineering disciplines vary by gender and race/ethnicity



For **male** engineering students

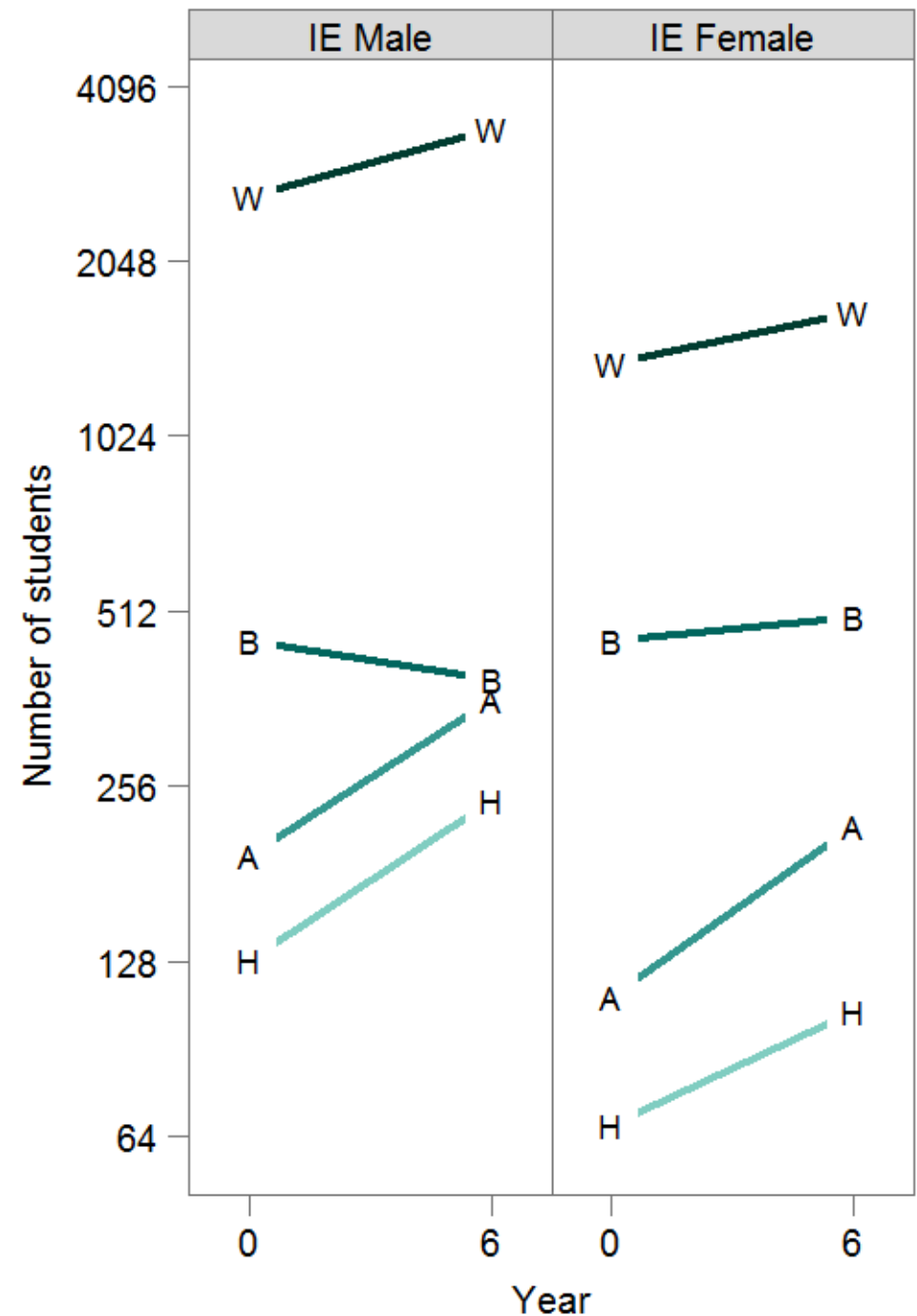
- Top 2 choices at *start* and graduation: ME and EE
- Whites prefer ME; Blacks & Asians prefer EE; Latinos choose ME and EE at about same #

For **female** engineering students

- ChE more popular than ME
- Latinas prefer ChE & IE at *start*; flip to IE & ChE by graduation
- Whites top 2: ChE and Civil at *start* and graduation
- Black and Asian top choices at *start* ChE and EE
- Graduation top choices: EE & IE for Black
and ChE & IE for Asian

Industrial Engineering is different!

- Growth for all populations (except Black men) between matriculation and graduation
- IE attracts men and women from all races/ethnicities.
- Lessons to be learned?



Ecosystem



<https://www.etsy.com/ca/listing/258759160/pond-and-river-ecosystem-print-childrens>

Stickiness



Ever in Civil (424)

Black Female students in CE
424 ever enrolled in CE

Grad from Inst (252)

Of those, 252 graduated from the Institution
Institutional stickiness = $252 / 424 = 59\%$

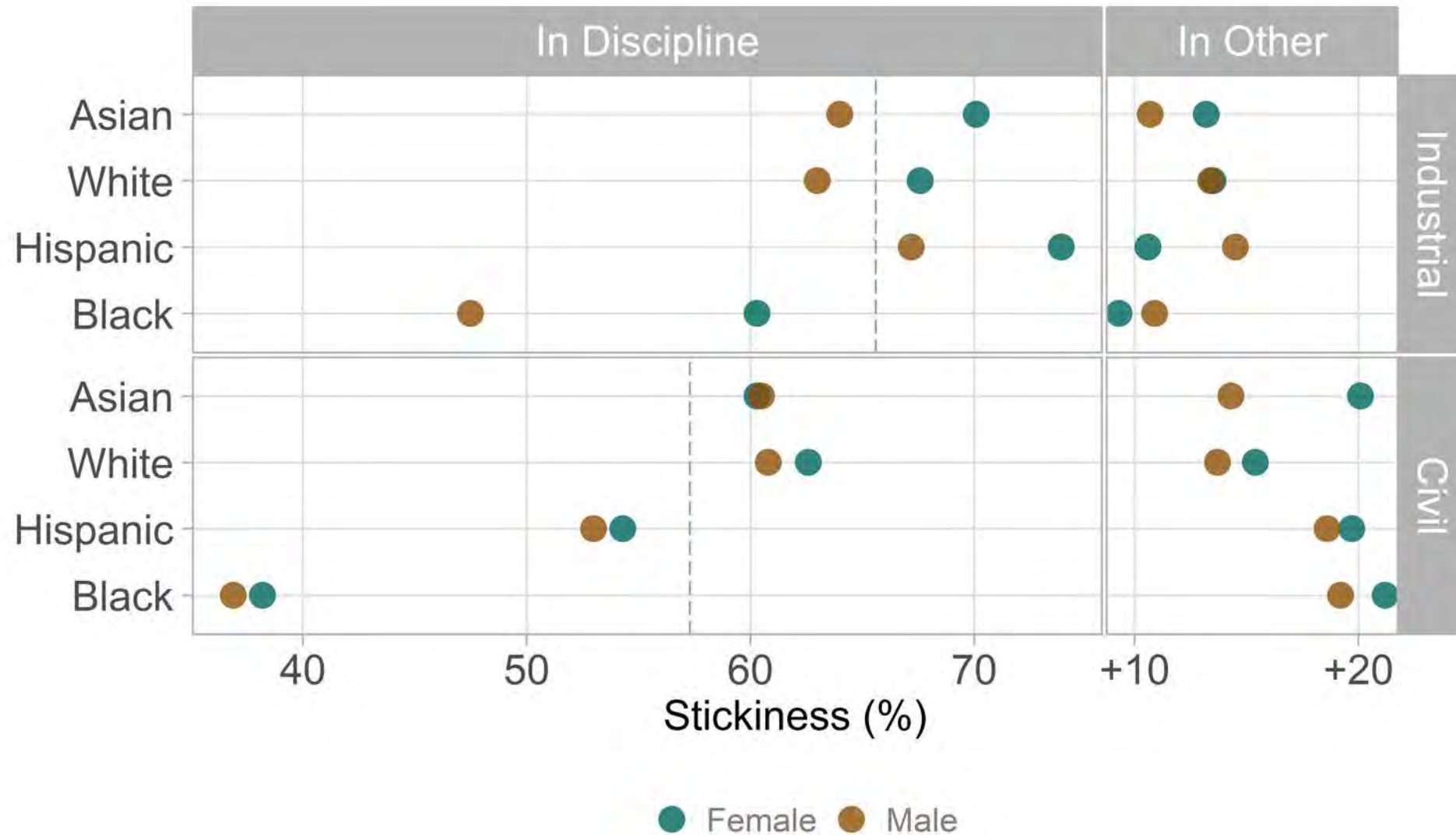
Grad in Engr (203)

Of those, 203 graduated in an Engr discipline
Engineering stickiness = $203 / 424 = 48\%$

Grad in Civil (162)

Of those, 162 graduated in CE
Major stickiness = $162 / 424 = 38\%$

Stickiness

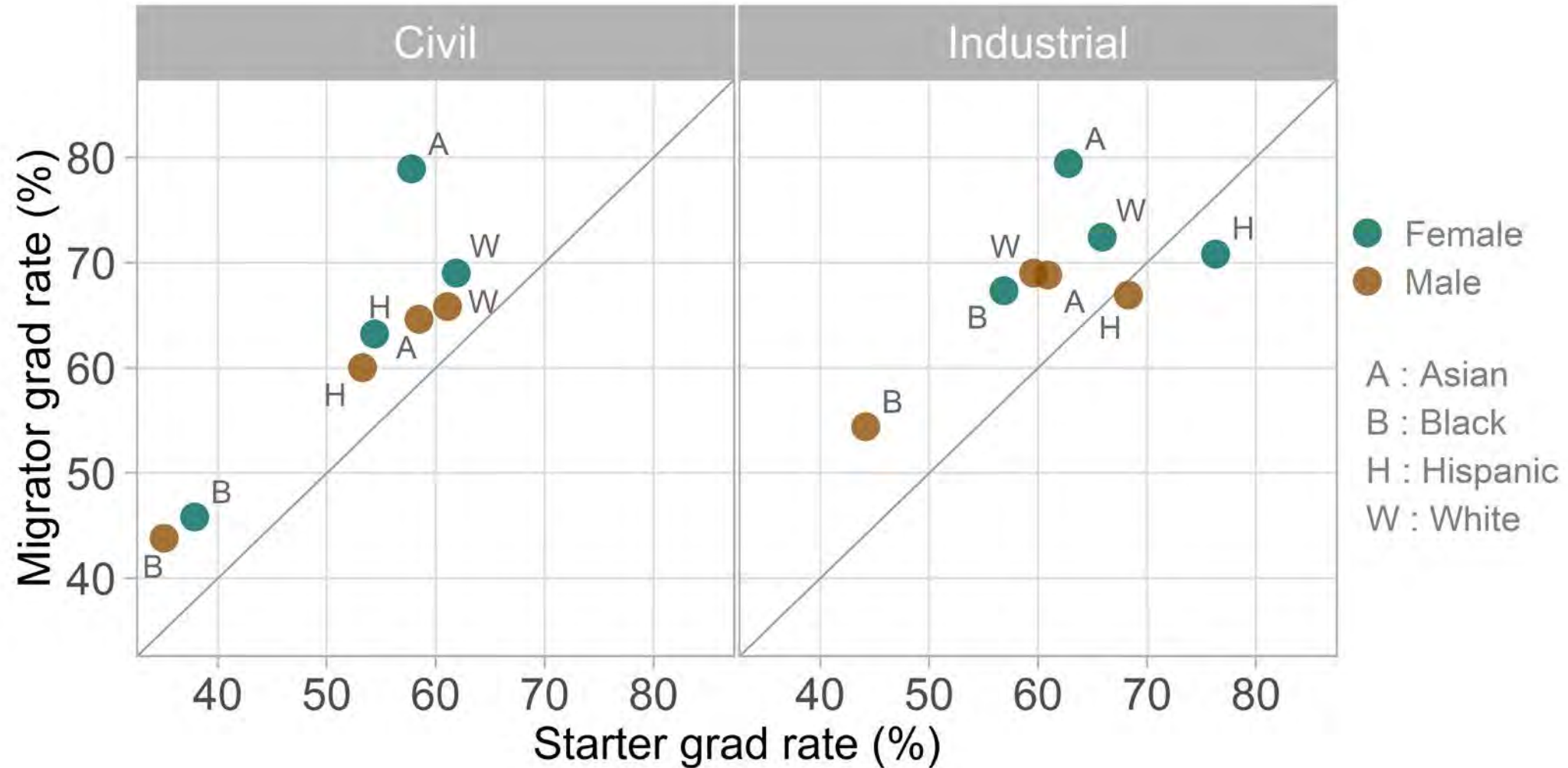


Migrators

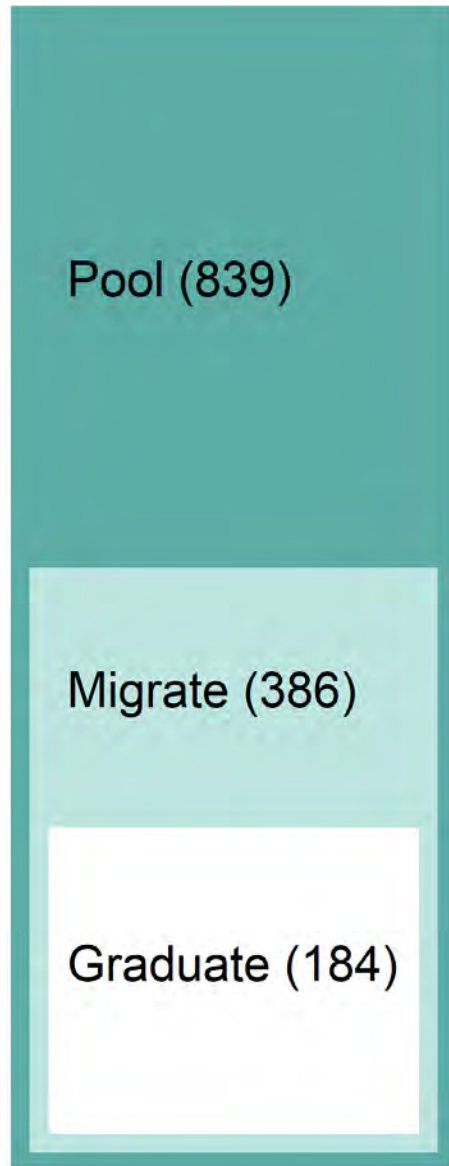
- “Not all those who wander are lost.”
- How successful are undergraduate students who migrate into engineering?
- Adopting an ecosystem mindset, we developed metrics to uncover successes of students who migrate among the top five engineering disciplines.



Migrators are successful!



Migration Yield



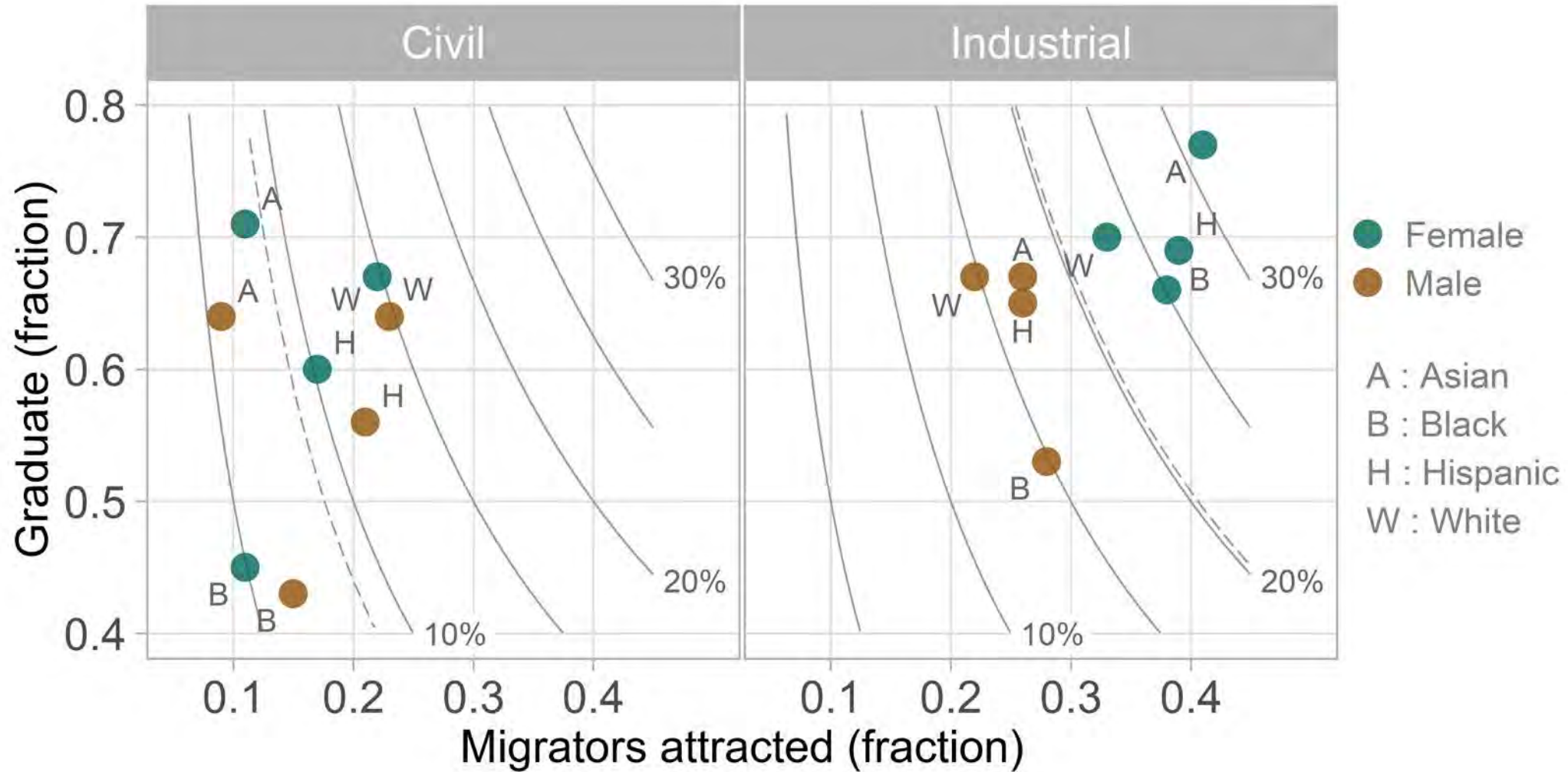
Black Male students in EE
839 potential migrators to EE

Of those, 386 migrated to EE
Fraction of migrators attracted = $386 / 839 = 0.460$

Of those, 184 graduated in EE
Fraction attracted that graduate = $184 / 386 = 0.477$

Migration yield is computed in one of two ways:
Product of the two fractions: $0.460 \times 0.477 = 22\%$
Ratio of graduates to pool: $184 / 839 = 22\%$

Migration Yield



Summary/Conclusion

- Metaphors influence metrics
- Nuances of engineering education ecosystem
- Migrators have stories of success
- Consider more effective metrics and data displays
- Use an ecosystem mindset to offer new insights

