Engineering For All

Enhancing future students' sense of belonging and engineering identity

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URGENT

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KU LEUVEN

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ETHER
Supporting education for (future) engineers

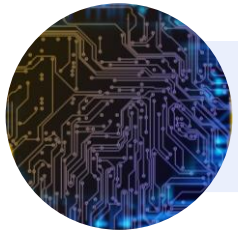
Agenda

- The Team
- Research problem & questions
- Methodology
- Results
- Next steps

AN INTERDISCIPLINARY PHD

IN ENGINEERING TECHNOLOGY AND SOCIAL SCIENCES

An Interdisciplinary Team



Engineering Technology

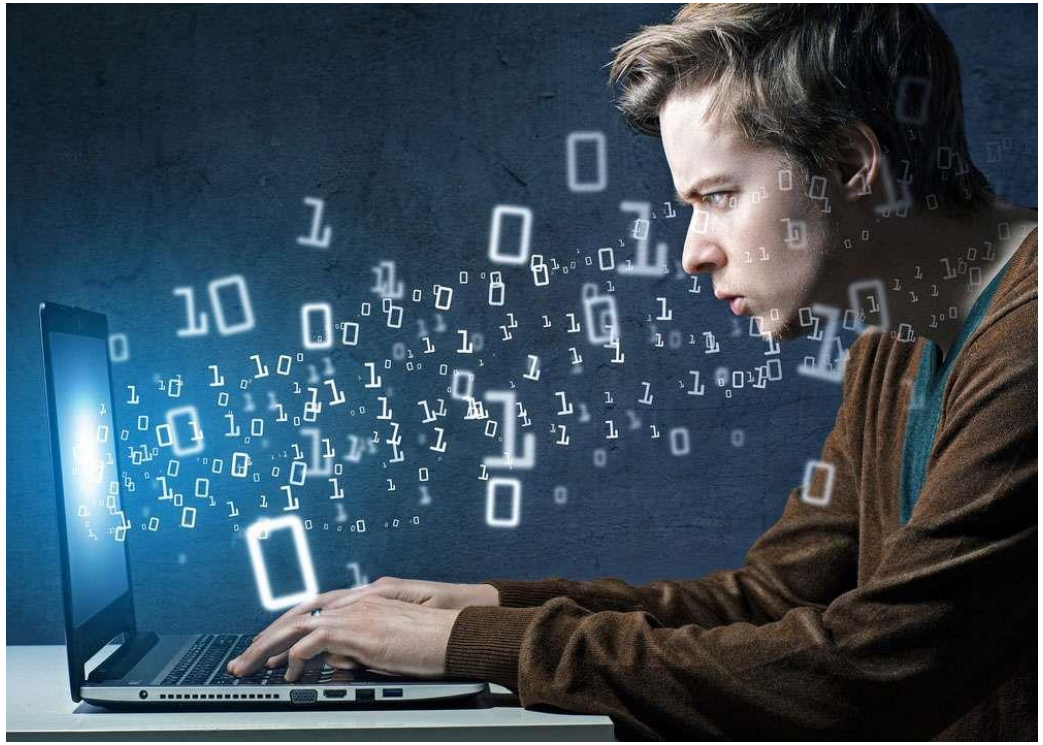
Sociology

Social Psychology

RESEARCH

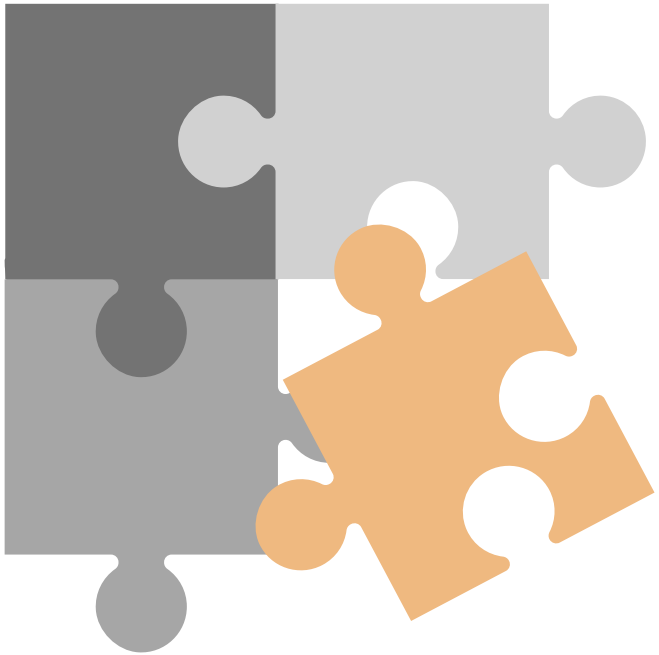
PROBLEM, QUESTIONS, METHODOLOGY

Who is an engineer?



What if you do not fit in this image?

- Lack of belonging
- Lack of engineering identity

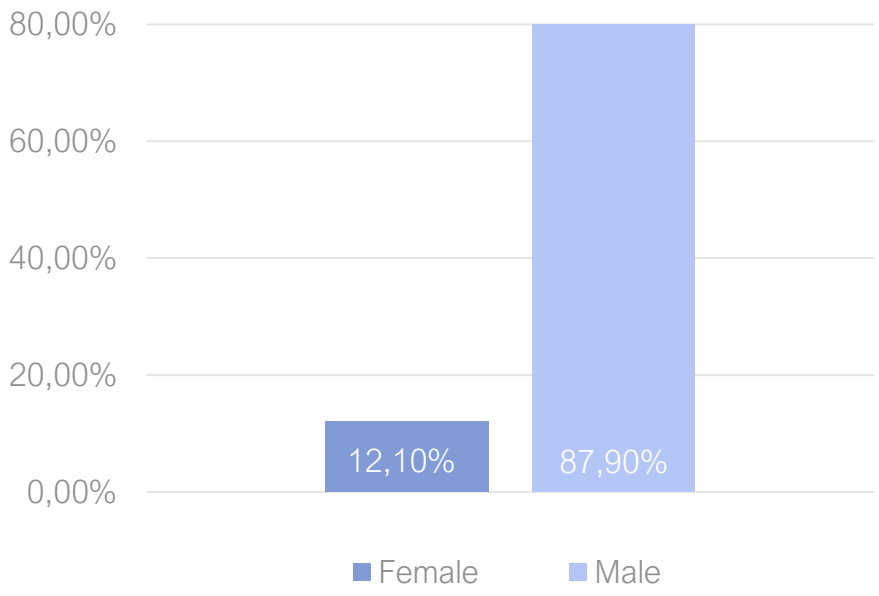


- Influences interest and persistence

Blosser, 2020; Godwin & Kirn, 2020; Good, Rattan & Dweck, 2012; Wilson & VanAntwerp, 2021

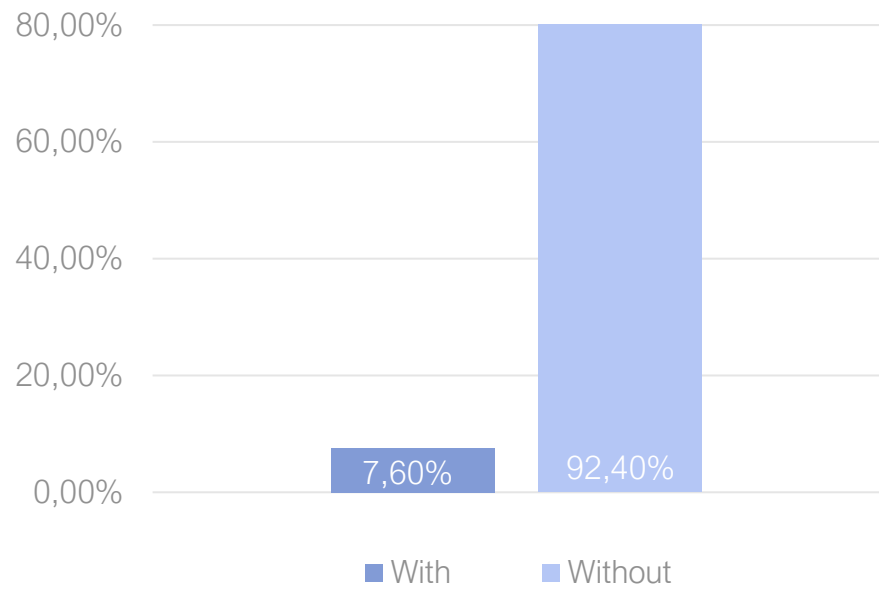
Different groups, different hurdles

› Intake by sex



Intake KU Leuven Faculty of Engineering Technology 2022-2023 [1]

› Intake by migration background

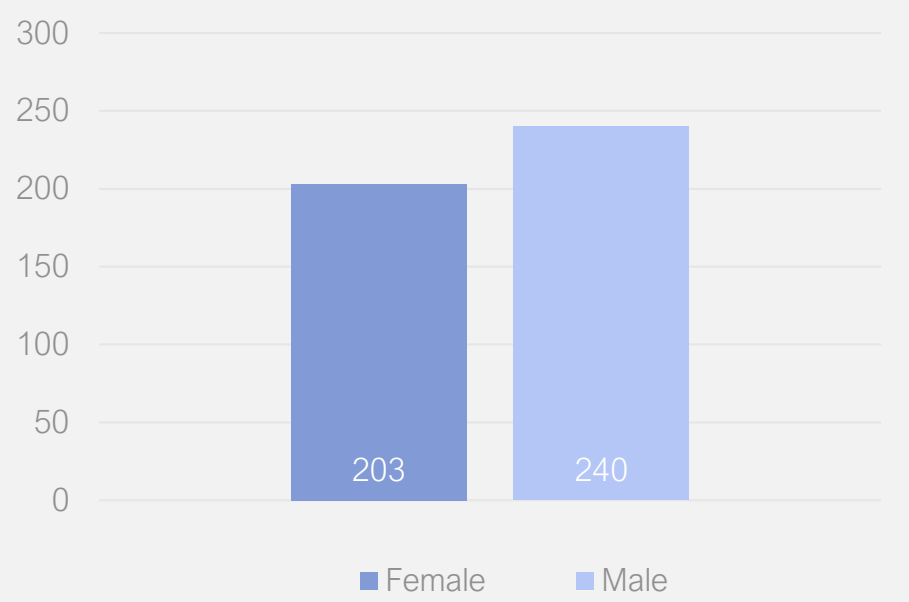


Intake KU Leuven Faculty of Engineering Technology 2022-2023 [1]

Different groups, different hurdles

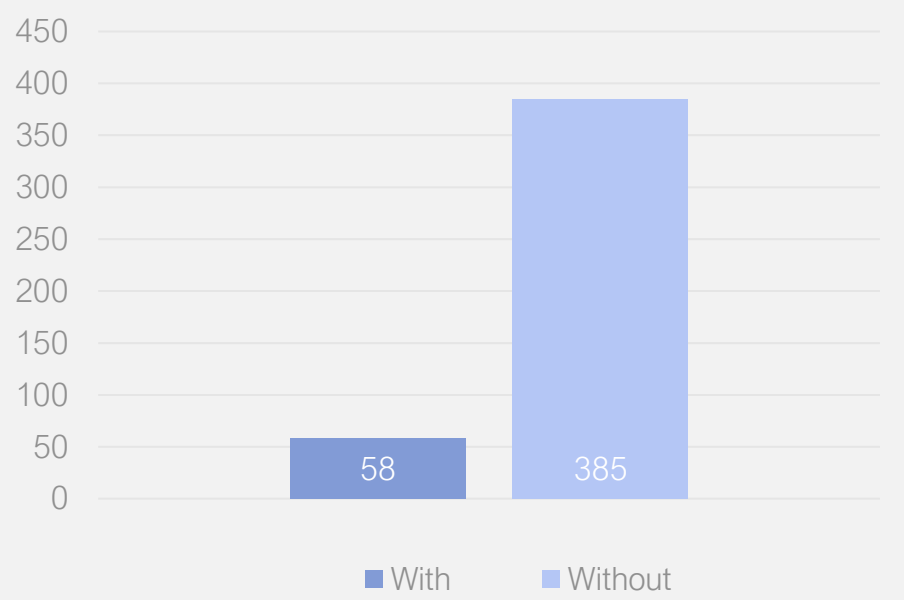
Number of respondents in secondary education

› Intake by sex



Intake KU Leuven Faculty of Engineering Technology 2021-2022 [1]

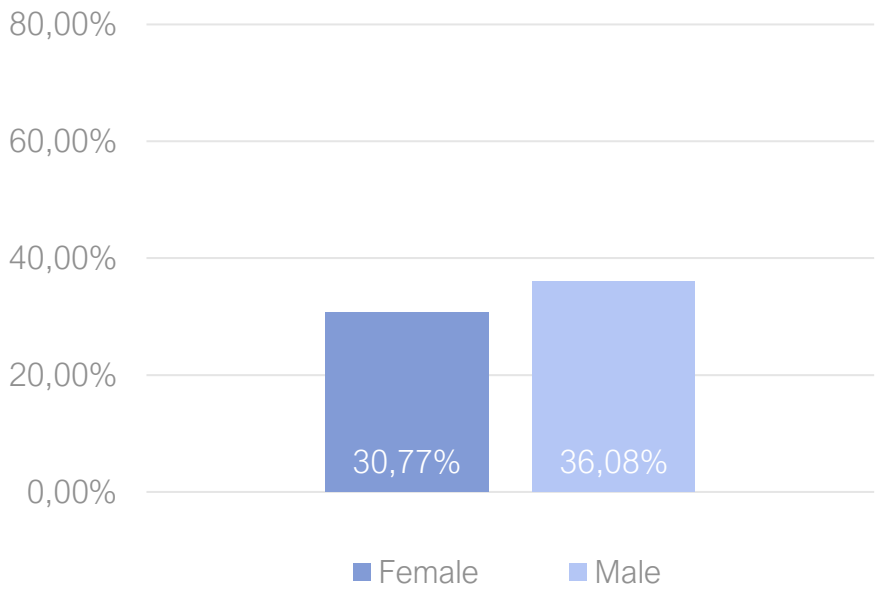
› Intake by migration background



Intake KU Leuven Faculty of Engineering Technology 2022-2023 [1]

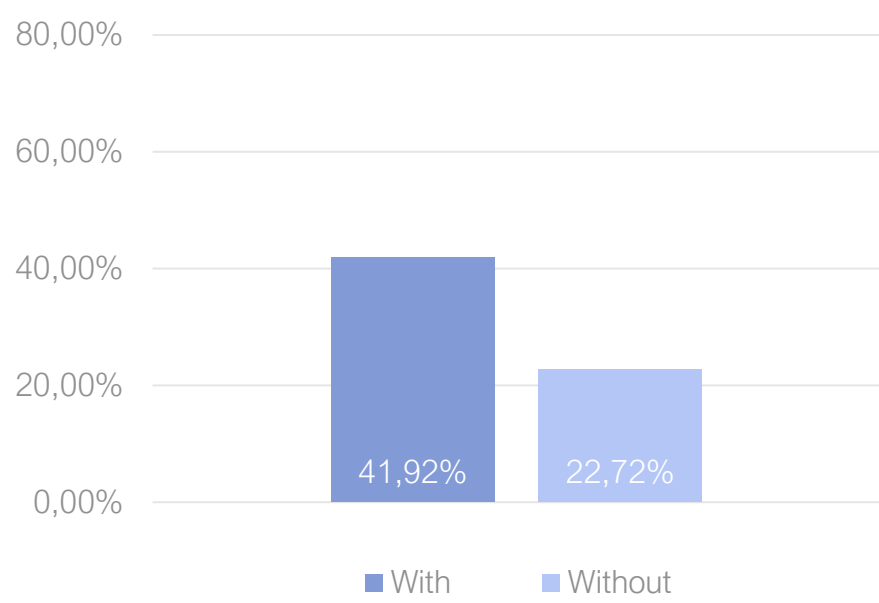
Different groups, different hurdles

› Drop out by sex



Drop out KU Leuven Faculty of Engineering Technology 2021-2023 [2]

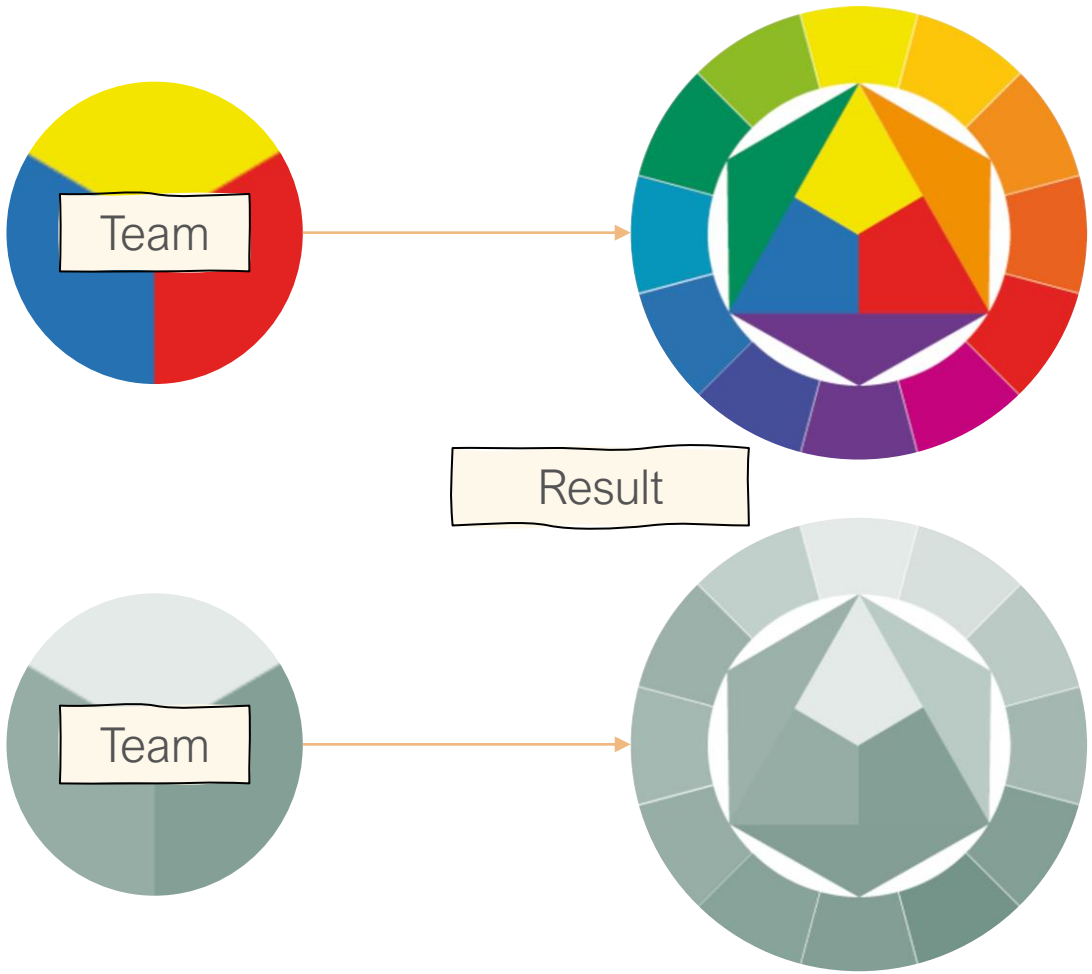
› Drop out by migration background



Drop out KU Leuven Faculty of Engineering Technology 2021-2023 [2]

Why diversity?

- Differences lead to more innovation and more succesful bussinesses
(Herring, 2009)



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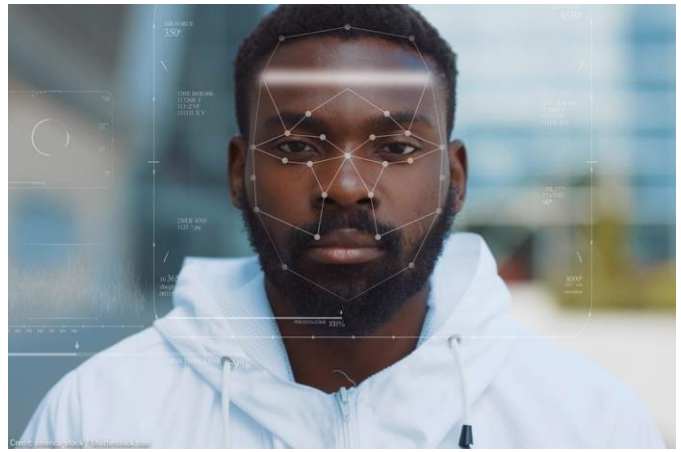


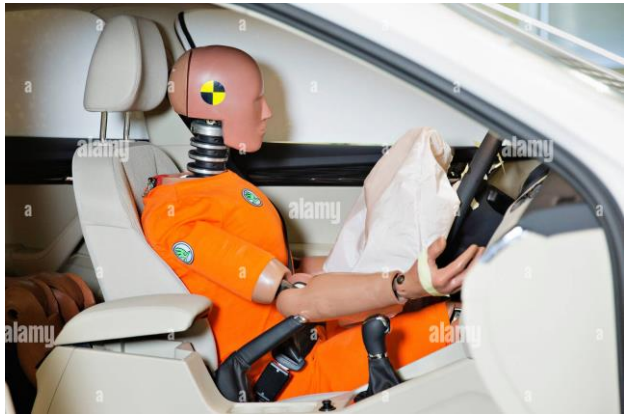
The First Female Crash Dummy Has Arrived

Women are more likely to get injured in car crashes, but the currently available test dummies don't reflect the average female body

Margaret Osborne

Daily Correspondent

November 4, 2022



Research focus

- Increasing the recruitment of female students
- Improving the retention of students with a migration background (MB)

By

- Strengthening a feeling of belonging (C. Gillen-O'Neel, 2021; C. Good, et. al., 2012; M. L. Pedler, et.al, 2022)
- Improving the engineering identity (A. Godwin and A. Kirn, 2020; S.-J. Leslie, et. al., 2015)

The Sense of Belonging

‘One’s personal belief that one is an accepted member of an academic community whose presence and contributions are valued’

Membership	Acceptance	Trust
Whether a student feels part of the engineering community	The extent to which a student feels accepted in one’s program	The trust that a student has in one’s teachers

Good, Rattan & Dweck, 2012

[5]

Engineering Identity

‘the ways in which students describe themselves and are positioned by others in the role of being an engineer’

Interest	Recognition	Performance
The enjoyment and fulfilment of studying engineering	The extent that people in their environment see the student as an engineer	Students’ belief to perform well in engineering programmes

Godwin & Kirn, 2020 [2]

Engineering Identity

‘the ways in which students describe themselves and are positioned by others in the role of being an engineer’

Interest	Recognition	Performance	Perceptions of future

A student's views of a future career in engineering

Godwin & Kirn, 2020 [2]

Research questions

1. Does the sense of belonging influence the recruitment and retention of engineering students?
   a. Does this change according to different subgroups*?
   b. Does the sense of belonging change over the course of the first year?

2. Does the engineering identity influence the recruitment and retention of engineering students?
   a. Does this change according to different subgroups*?
   b. Does the engineering identity change over the course of the first year?

3. Is the sense of belonging related to the engineering identity of engineering students?
   a. Does this change according to different subgroups*?

*Subgroups: female students; students with a migration background

METHODOLOGY

Methodology

Target groups

Last-year pupils SE

First-year engineering students HE

Methodology

Target groups

Last-year pupils SE

First-year engineering students HE

Focus on students with a migration background

Mixed method approach:

- Surveys (Sept, Okt, March)
- Interviews/focus groups
- Narrative study

Interventions

Methodology – Participants

› Number of participants in October 2022

		Male	Female	Totaal
First-year engineering students HE	No migration background	551	186	737
	Migration background	53	25	78
	Totaal	604	211	815

› Across three engineering faculties

Methodology – Participants

› Number of participants in October 2022 and March 2023

		Male	Female	Totaal
First-year engineering students HE	No migration background	240	114	354
	Migration background	20	10	30
	Totaal	260 384	124	384

› Across three engineering faculties

Methodology – Dependent variables + groups

- Retention → Possible dropout
  - No or Maybe to the question 'Will you continue next year?'

- Gender/Sex
  - Registered sex by the university (through identity card)

- Migration background
  - Living in Belgium + secondary education degree from Belgium
  - Born with a non-Western European nationality
  - OR Have one parent or at least two grandparents born with a non-Western European nationality

RESULTS

HIGHER EDUCATION

Logistic regression (odds-ratio for Possible dropout)

- Odds-ratio for possible dropout

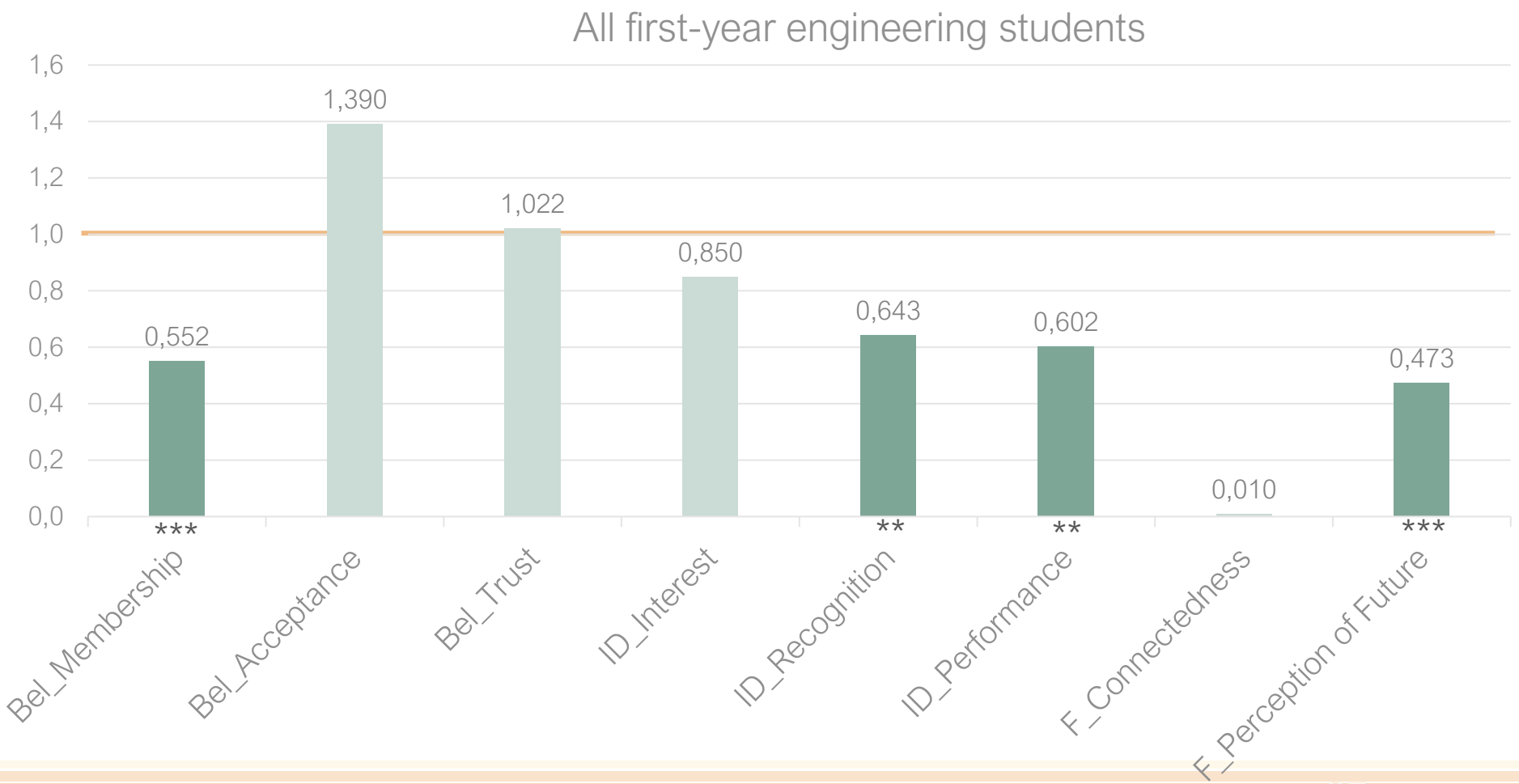
- Below 1 → Negative effect
  - Eg. Odds ratio of 1,5

  → The odds of possible dropout increases with 50% for every point increase of the dependable variable
- Above 1 → Positive effect
  - Eg. Odds ratio of 0,5

  → The odds of possible dropout decreases with 50% for every point increase in the dependable variable

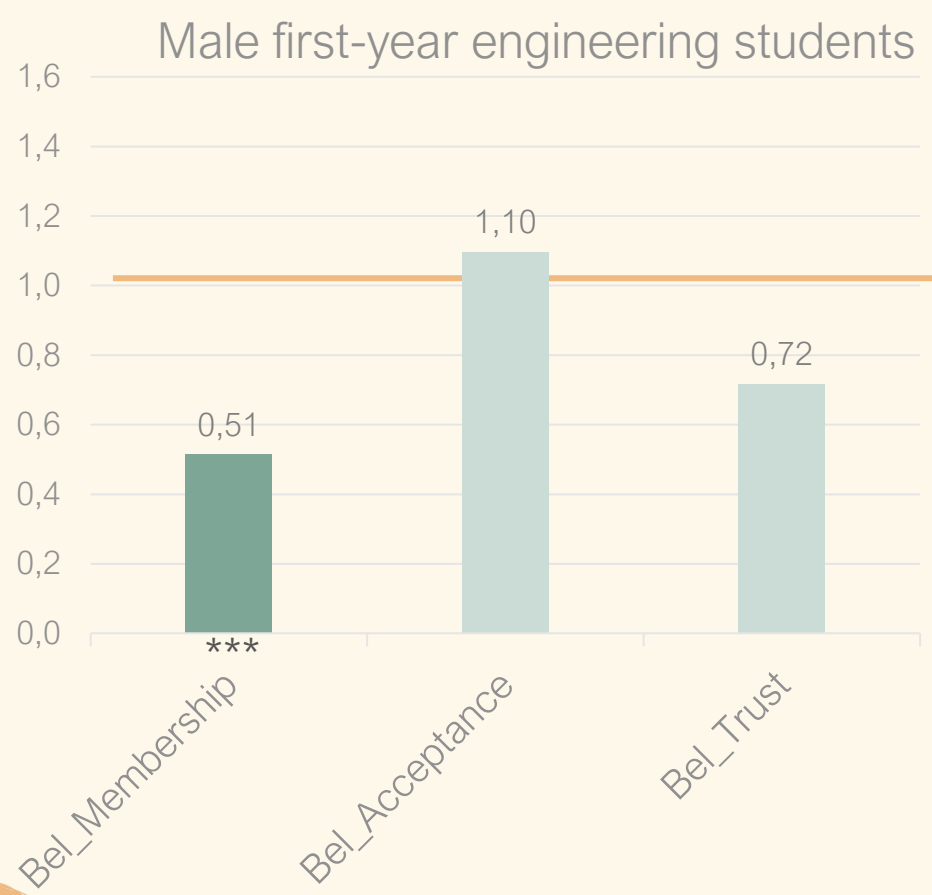
Possible Dropout	
Yes	No
226	589

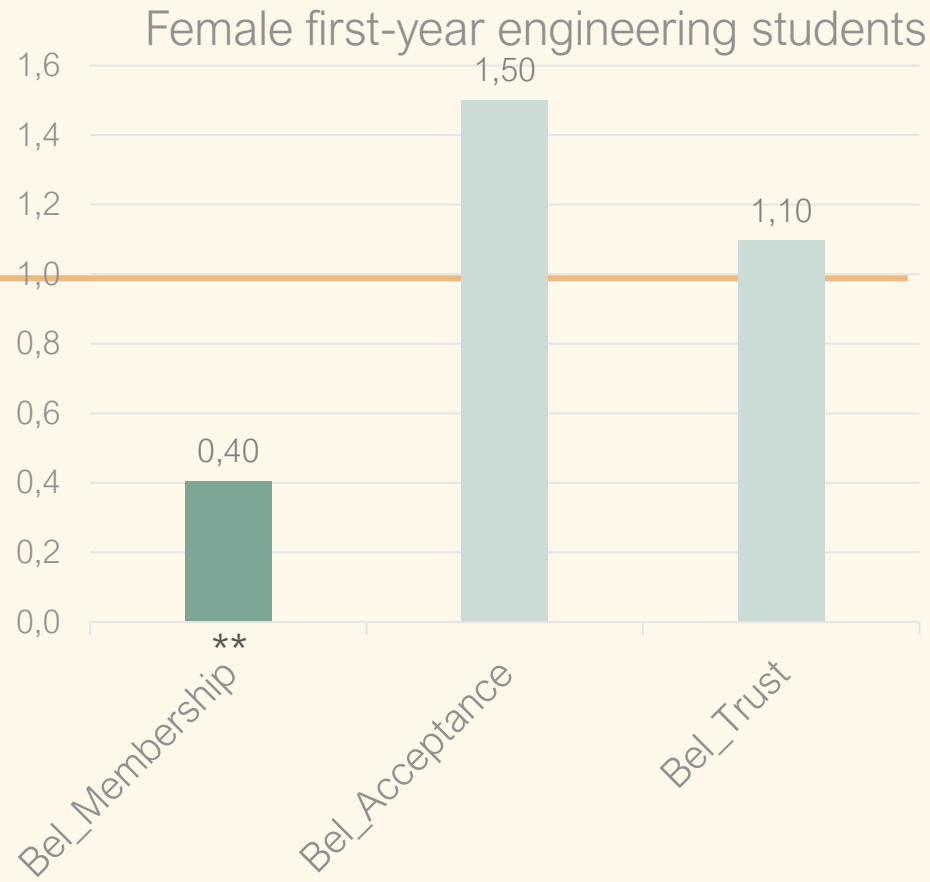
Logistic regression (odds-ratio for Possible dropout)



Logistic regression (odds-ratio for Possible dropout)

	Possible Dropout	
	Yes	No
Male	157	447
Female	69	142
Total	226	589





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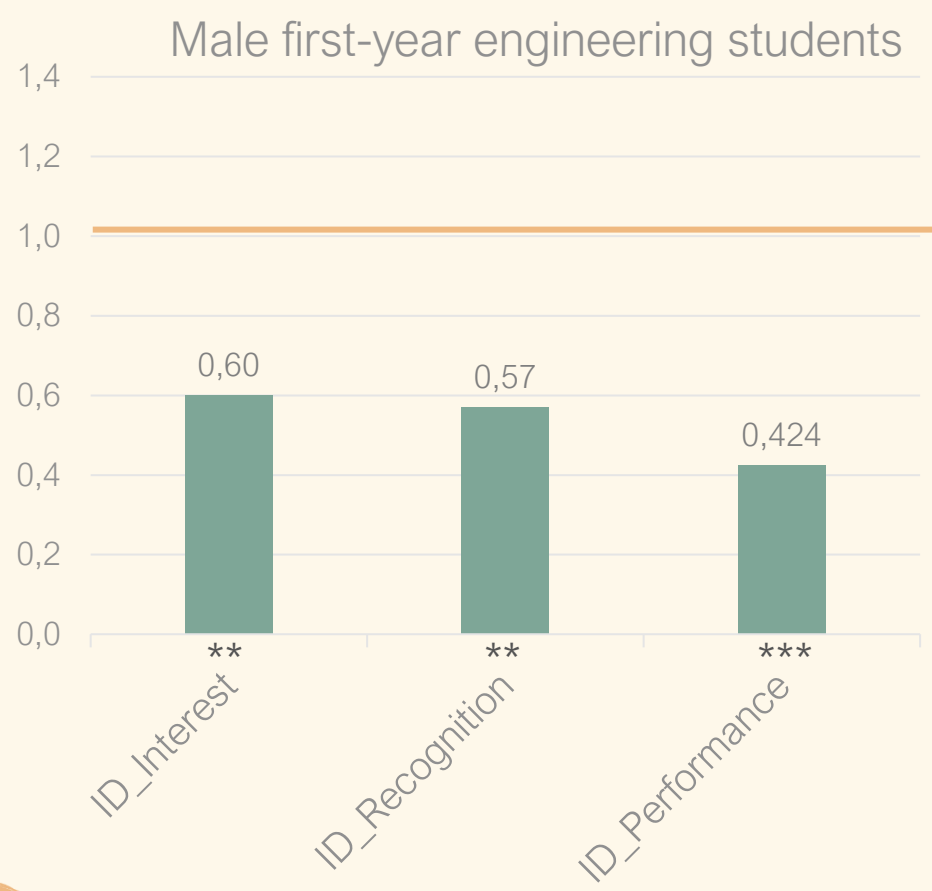

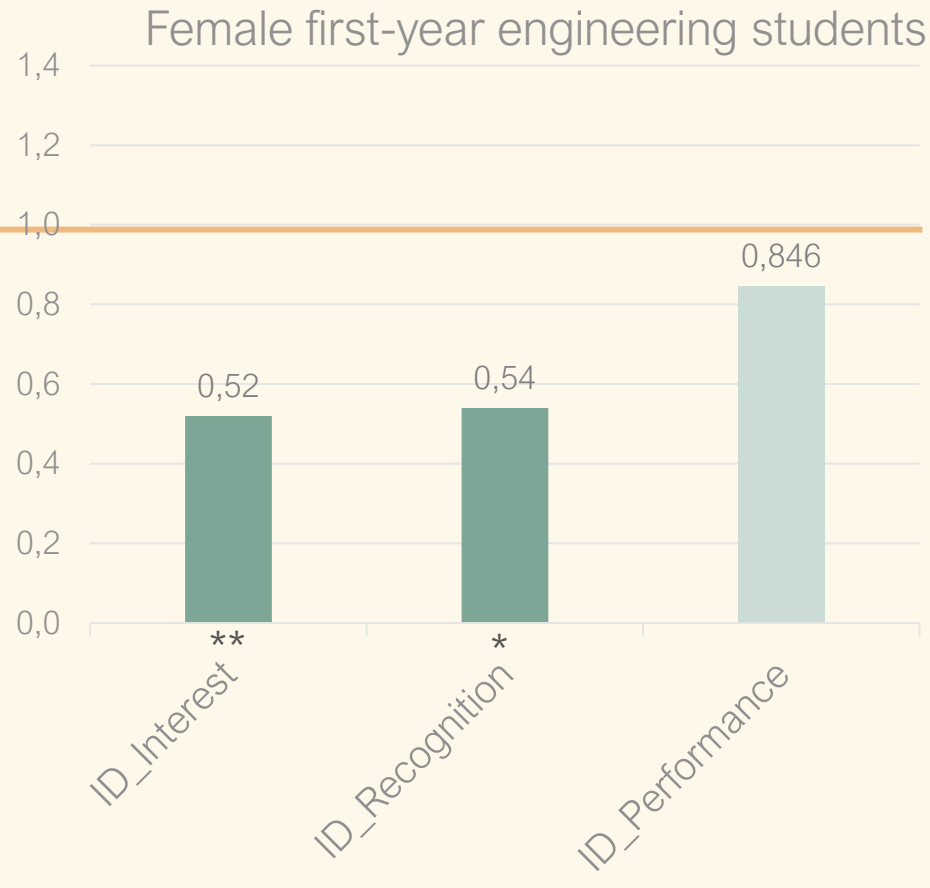

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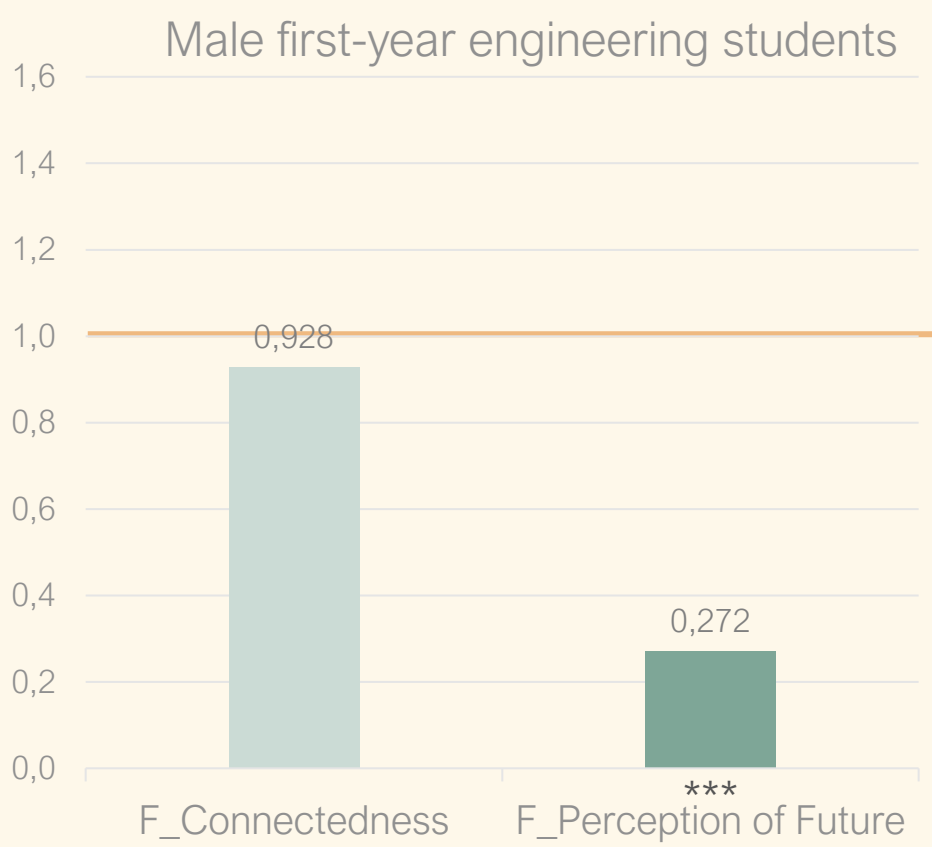
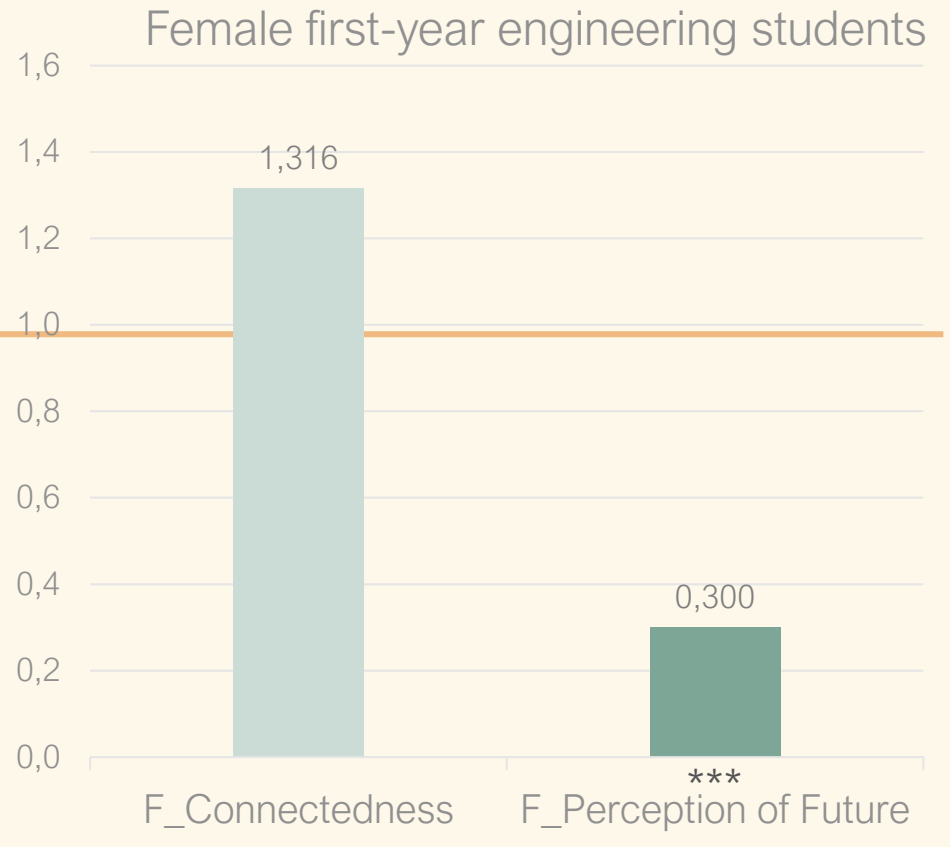
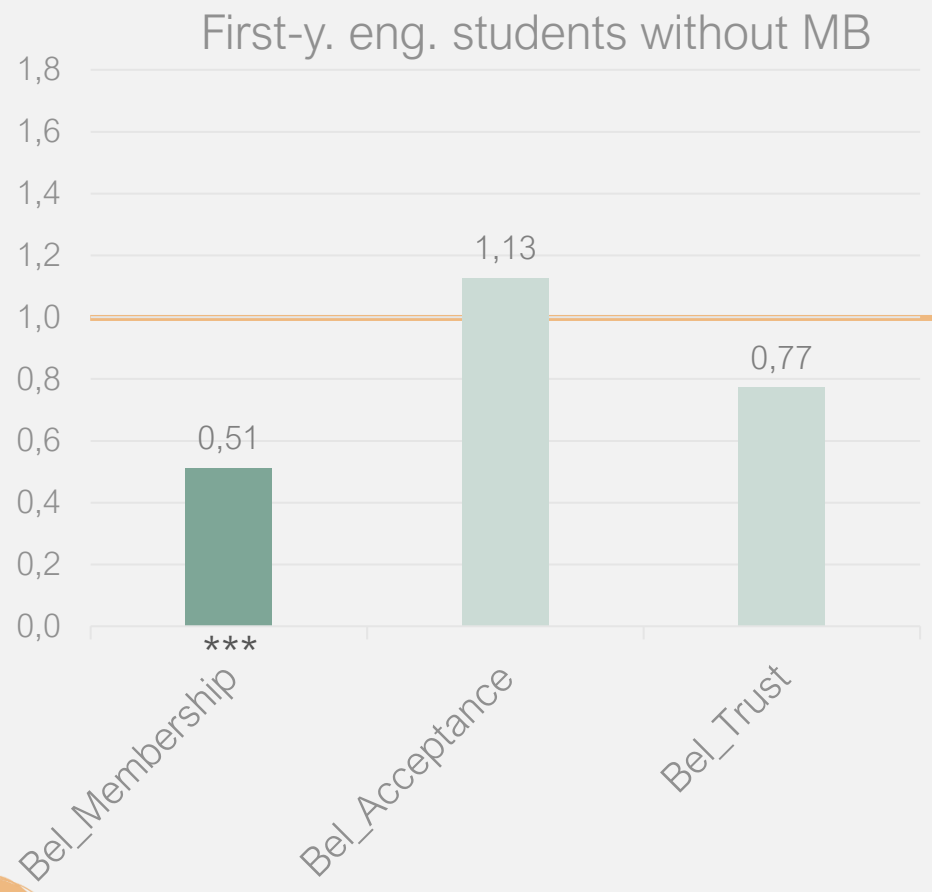
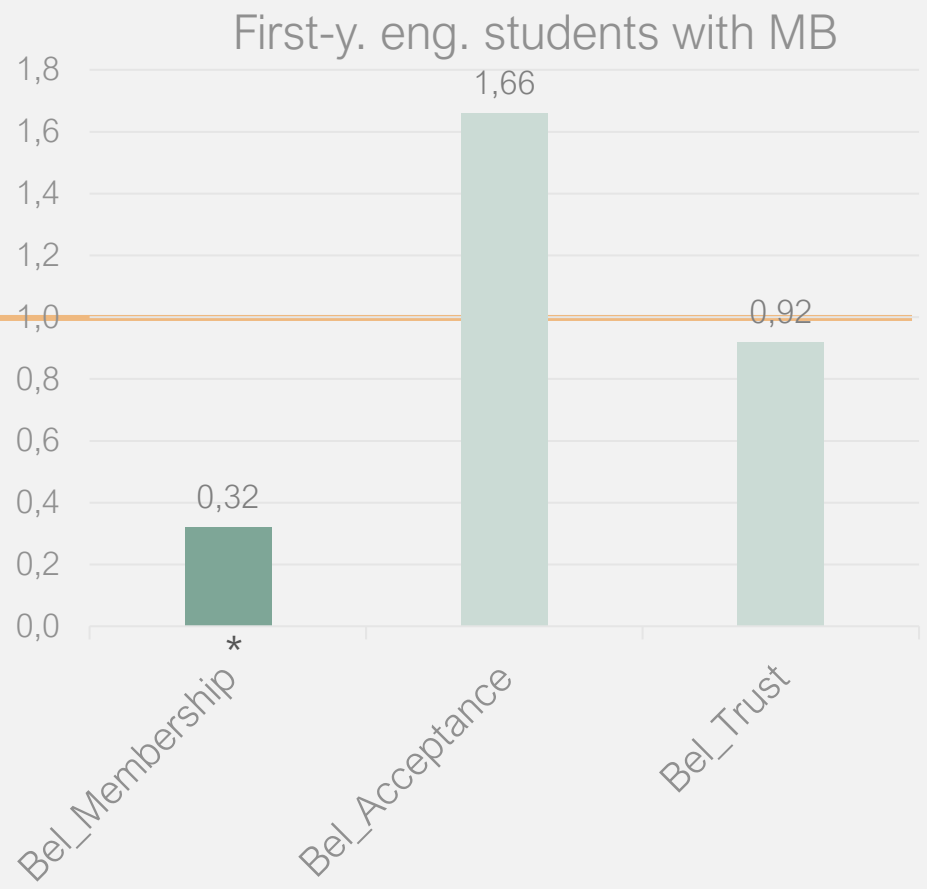




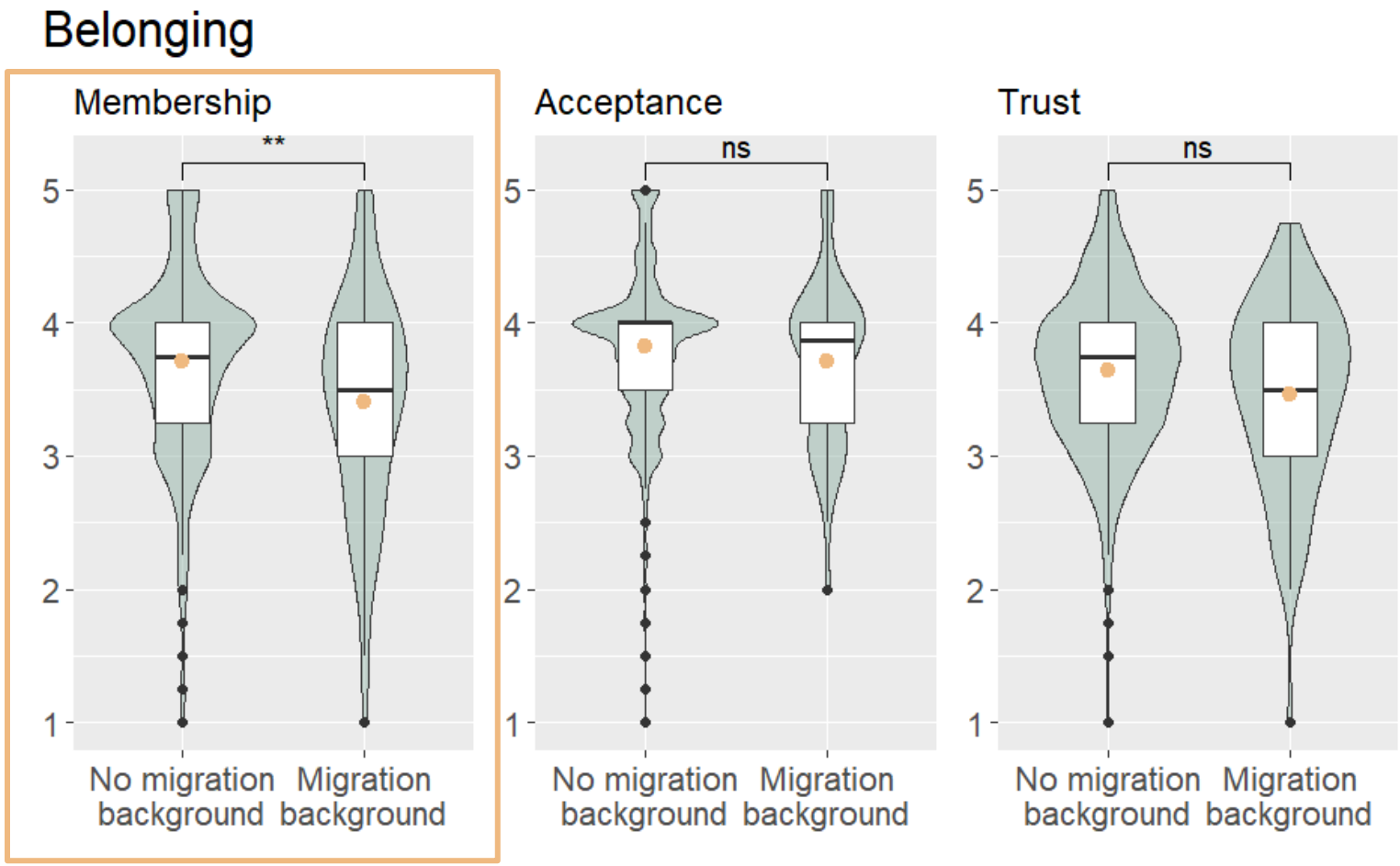
Logistic regression (odds-ratio)

	Possible Dropout	
	Yes	No
No MB	198	539
MB	28	50
Total	226	589





Migration background



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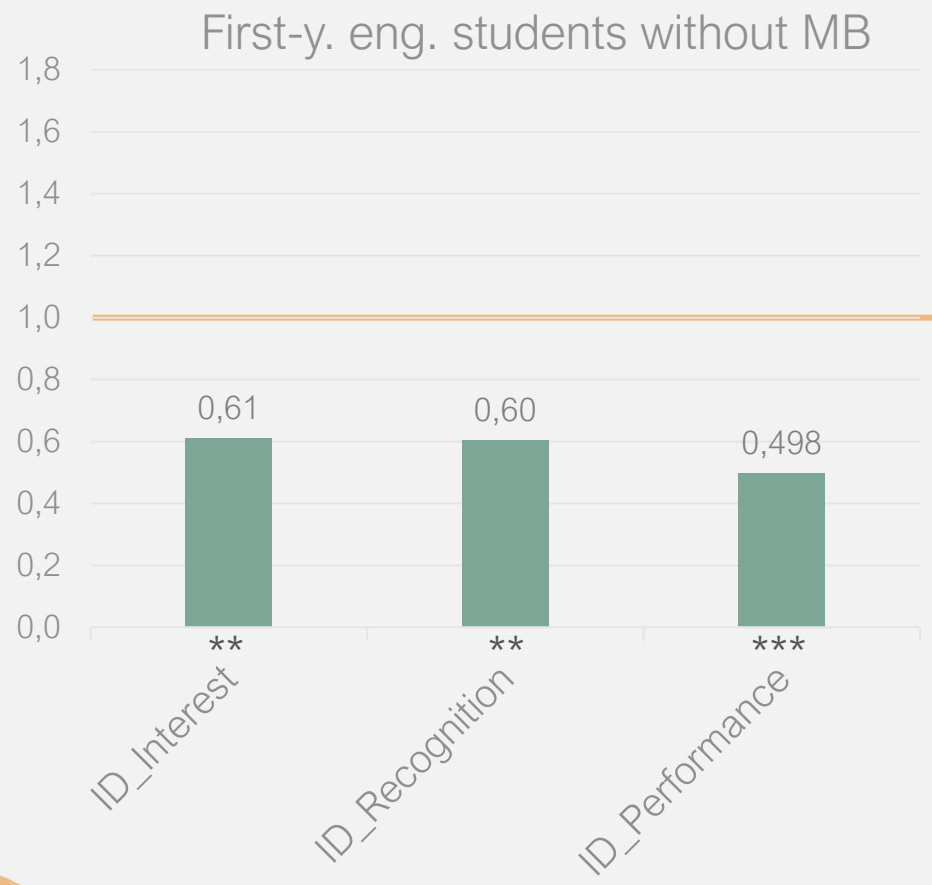

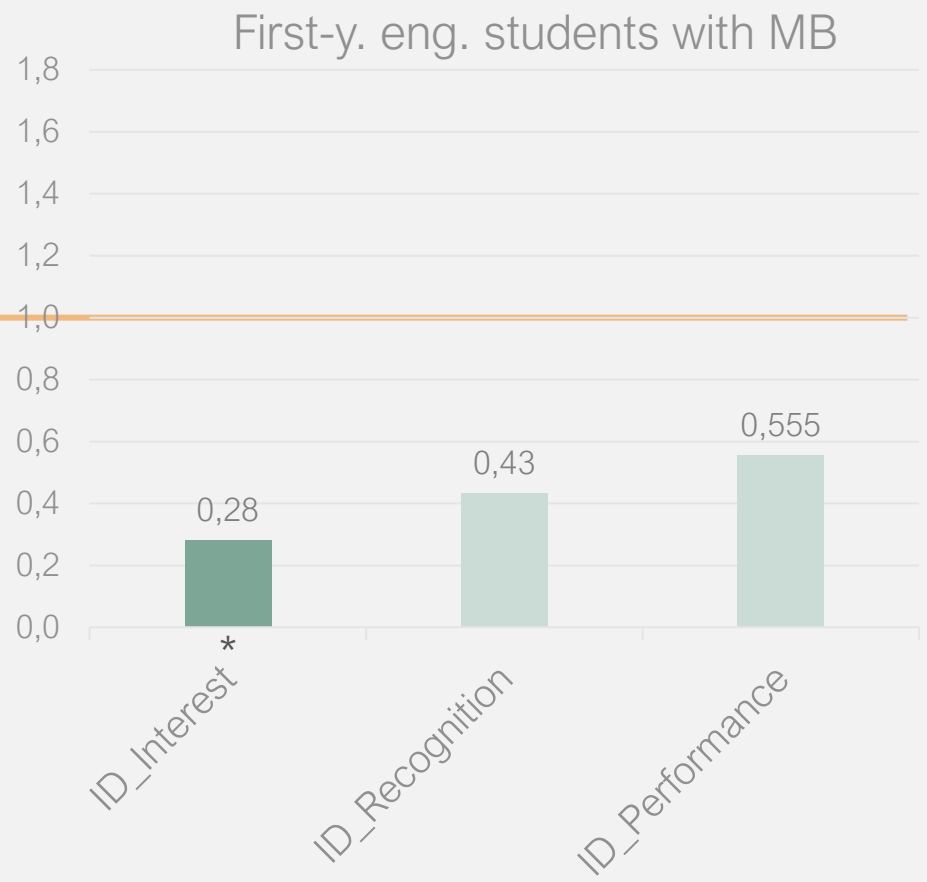

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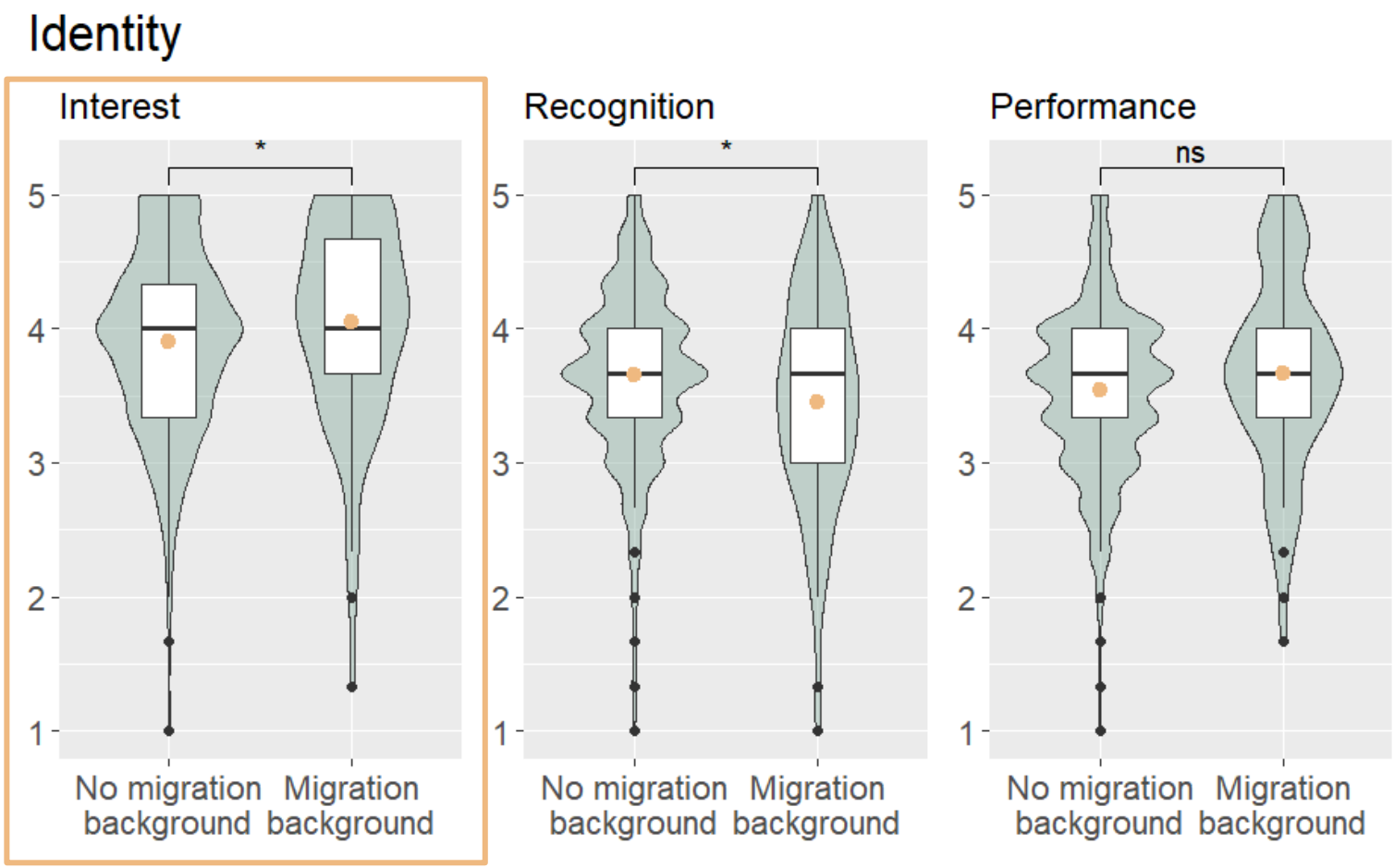

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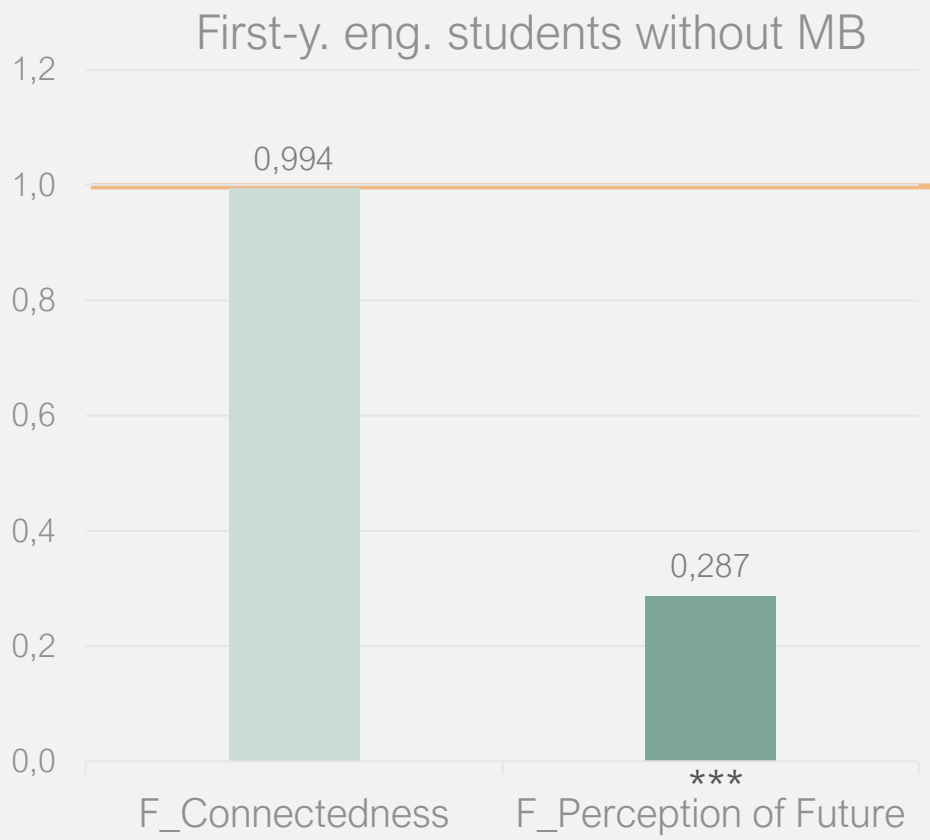
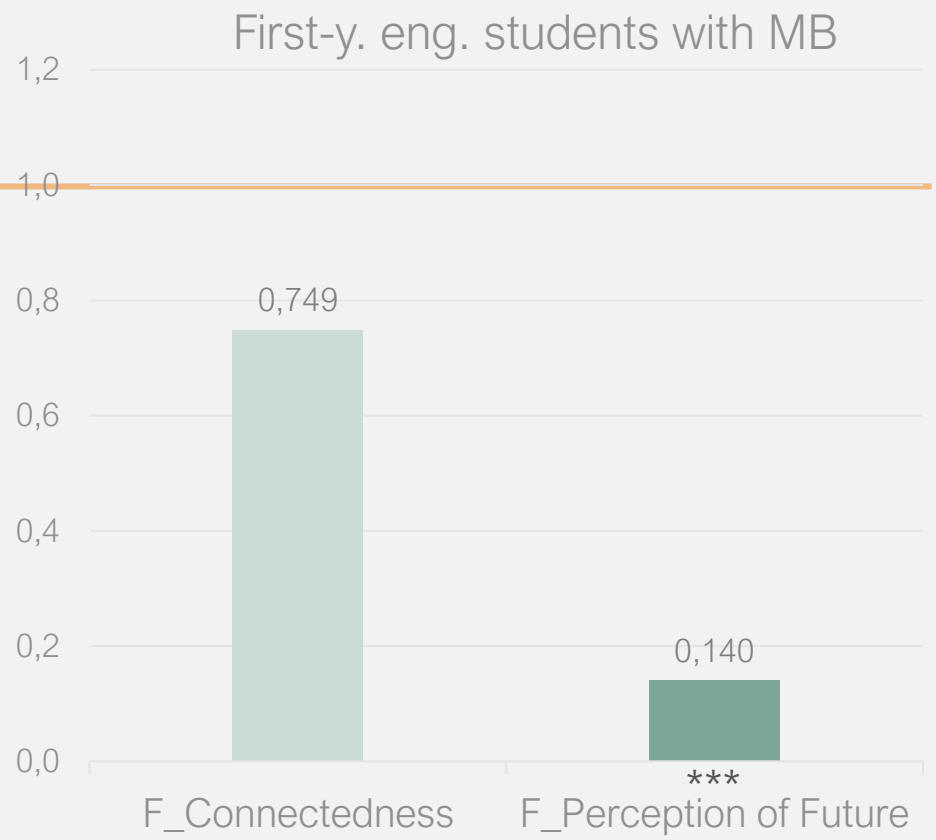
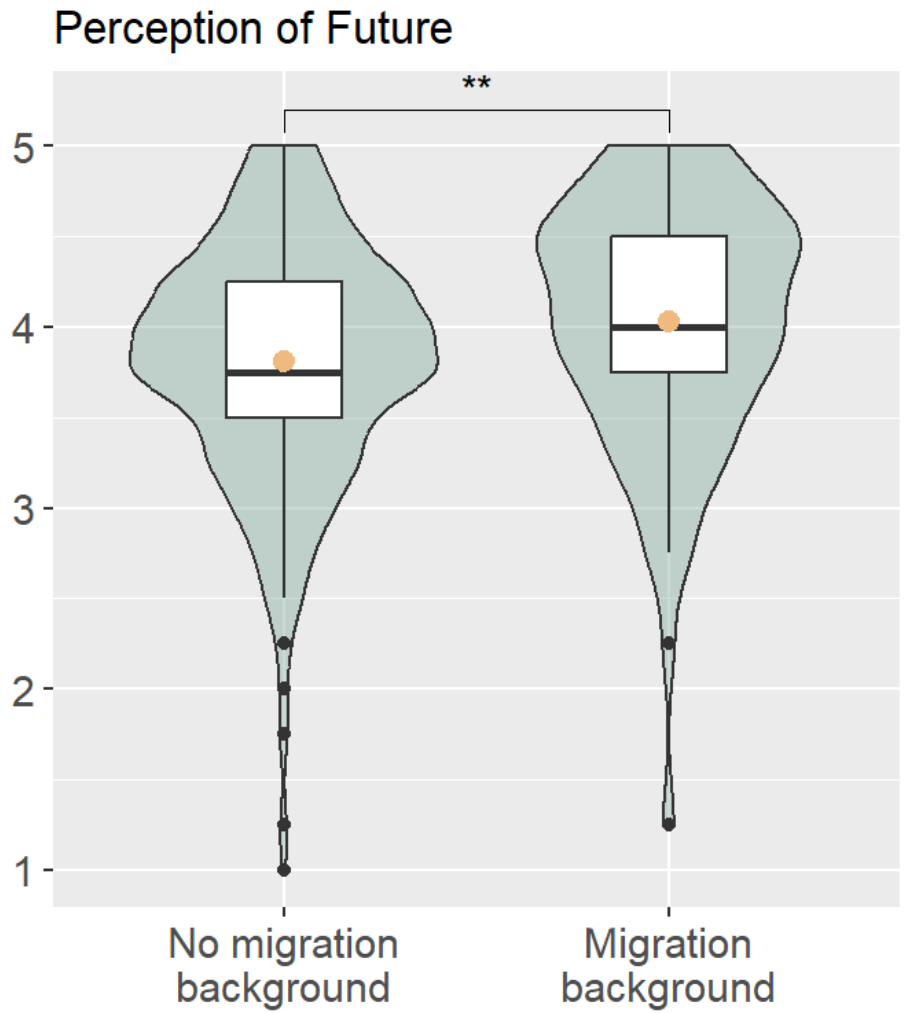
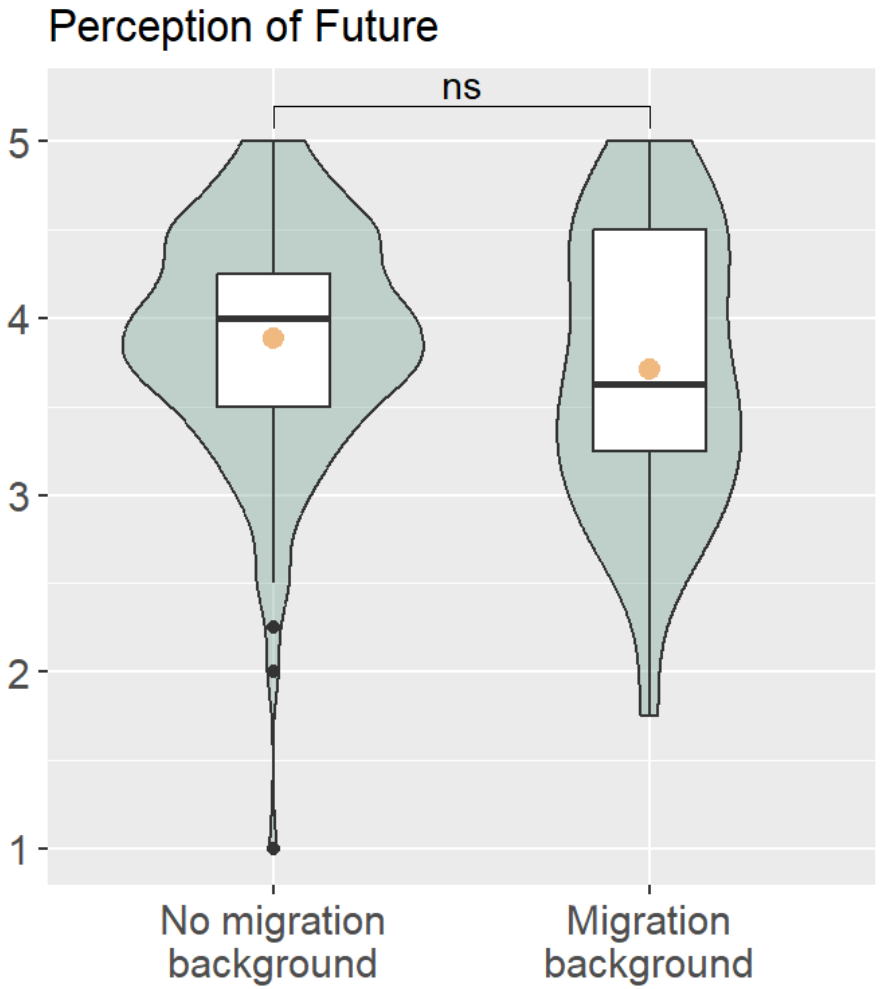




October



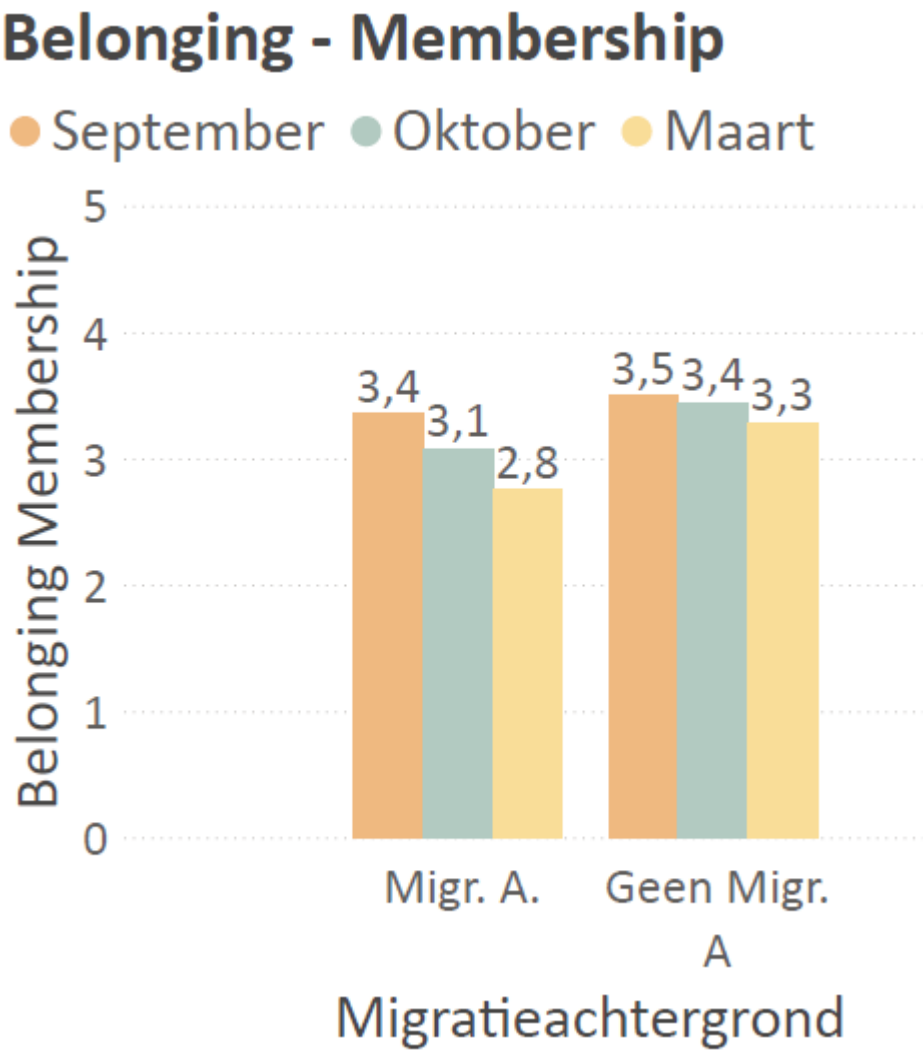
March



Noteworthy trends

- Not significant, but clear decline in membership, for students with a migration background who are considering to drop out.

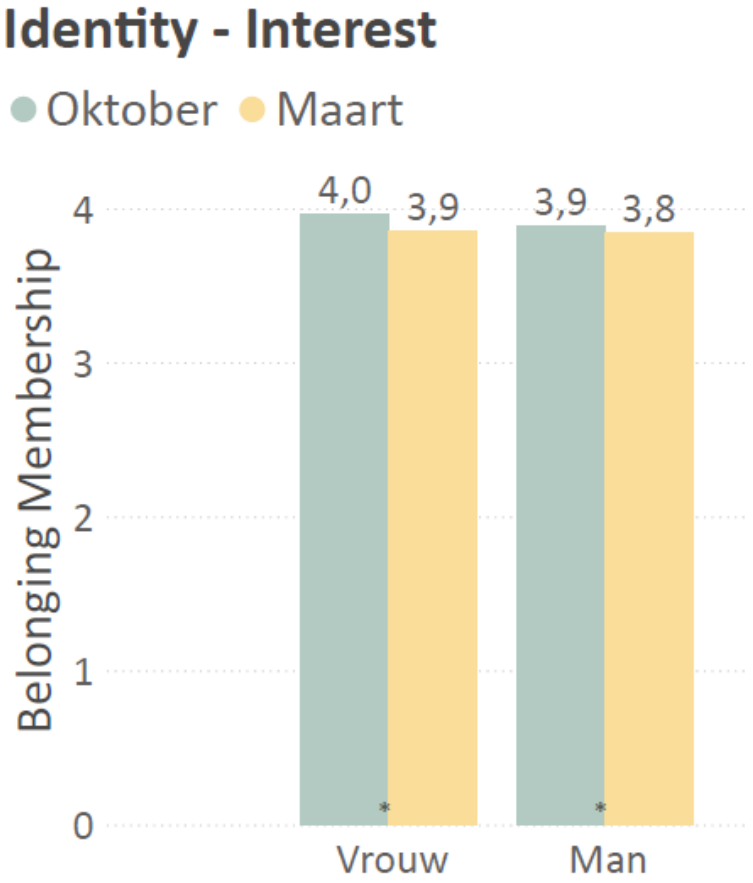
	Possible Dropout – Sept, Oct, Mar		
	Yes	No	
No MB	80	246	326
MB	13	16	29
Total	93	262	355

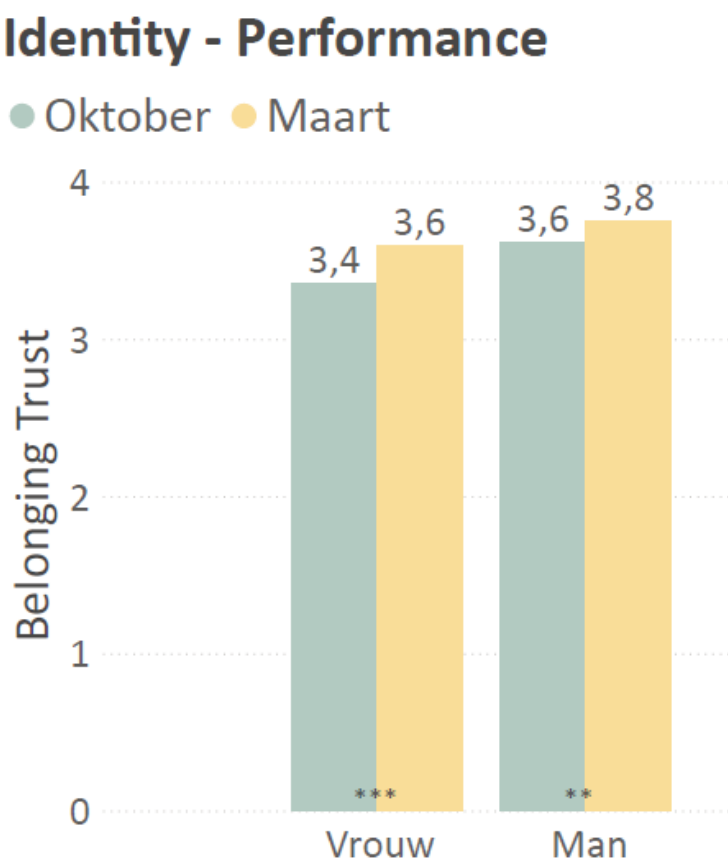


Noteworthy trends

- Interest declines
- Performance (self-confidence/ self-efficacy) rises

	Possible Dropout – Oct, Mar		
	Yes	No	Total
Male	63	86	149
Female	38	197	235
Total	101	283	384





Noteworthy trends

- Perception of Future
  - Increases for women
  - Decreases for students with a MB

	Possible Dropout – Oct, Mar		
	Yes	No	Total
No MB	88	266	354
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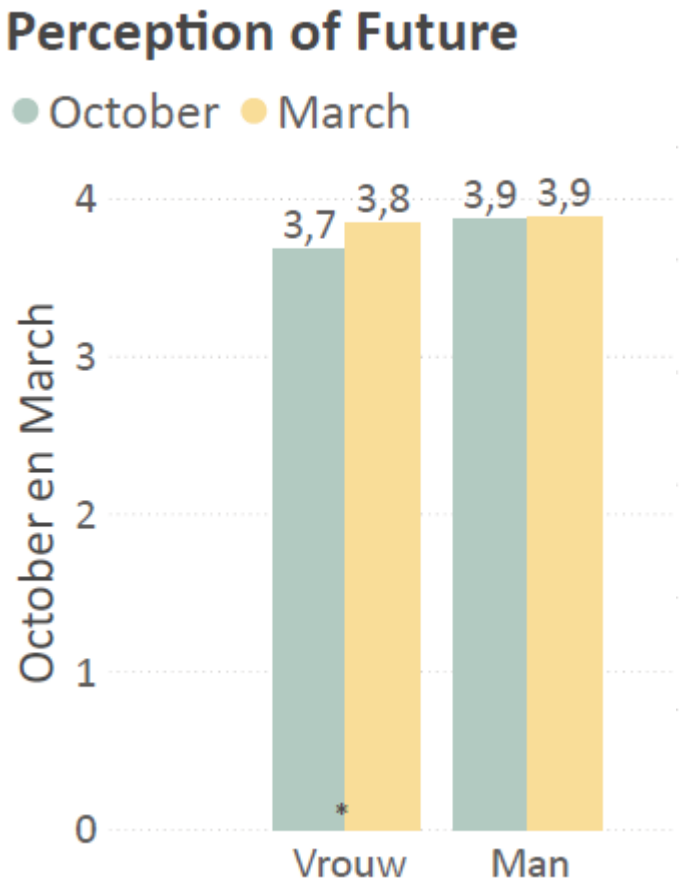

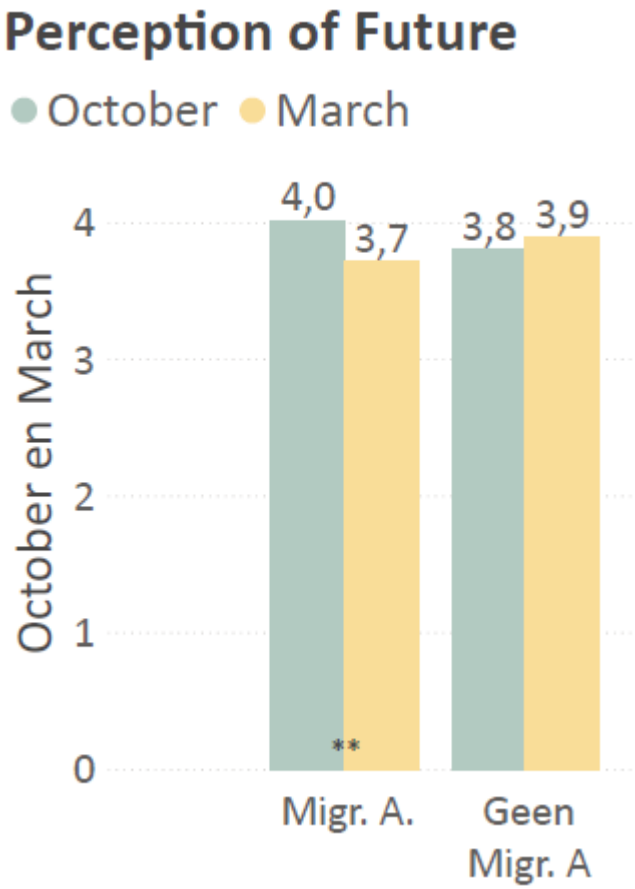

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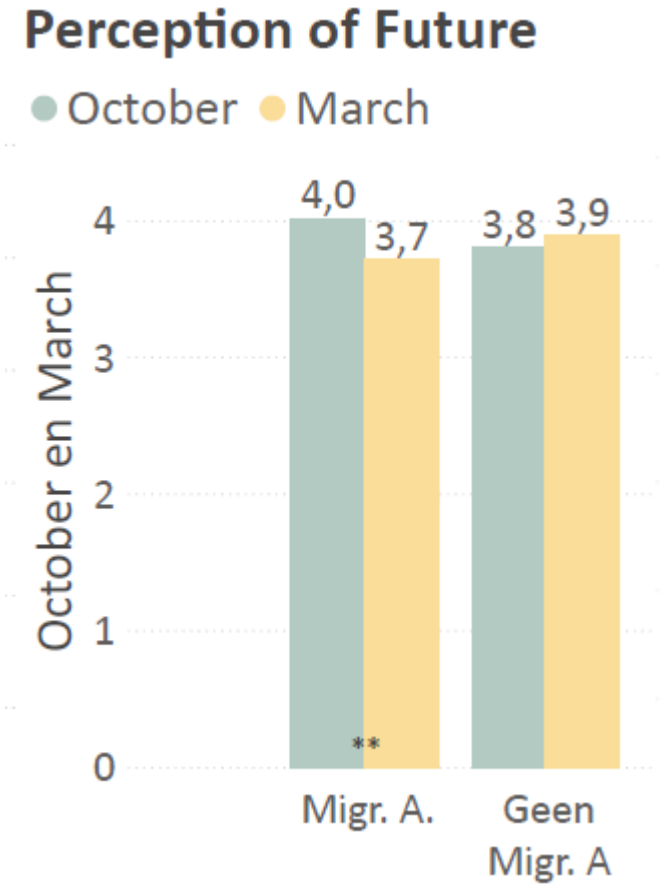
Mogelijke Dropout

Nee



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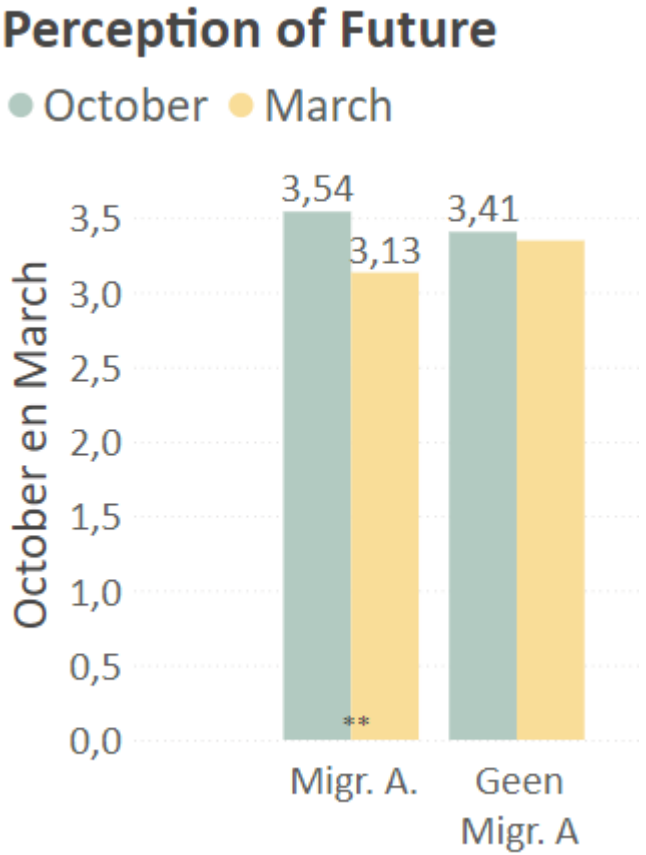

Research question

1. Does the sense of belonging influence the recruitment and retention of engineering students?
   a. Does this change according to different subgroups*?
   b. Does the sense of belonging change over the course of the first year?

2. Does the engineering identity influence the recruitment and retention of engineering students?
   a. Does this change according to different subgroups*?
   b. Does the engineering identity change over the course of the first year?

3. Is the sense of belonging related to the engineering identity of engineering students?
   a. Does this change according to different subgroups*?

*Subgroups: female students; students with a migration background

Research question

1. Does the sense of belonging influence the retention of engineering students?
   → Yes, membership
   a. Does this change according to different subgroups*?
      → No
   b. Does the sense of belonging change over the course of the first year?
      → Yes, membership decreases, especially for students with a MB who will possibly drop out

*Subgroups: female students; students with a migration background

Research question

2. Does the engineering identity influence the retention of engineering students?
   → Yes, interest and perception of future
   a. Does this change according to different subgroups*?
      → The effect is stronger for students with a MB
   b. Does the engineering identity change over the course of the first year?
      → the effect becomes stronger + perception of future decreases over time

*Subgroups: female students; students with a migration background

Next steps

- Retention based on actual drop-out

- Narrative study

→ Getting a better understanding of the obstacles that students with a migration background face

Next steps

- Interventions

→ Semester 1: Increasing the pro-diversity mindset* + focus on relevance of diversity

  → Membership & Perception of future

  → Fix the system, not the student

→ Semester 2: Focus on Perception of future

  → Value affirmation?

  → Role models?

*(Eagly, 2016; Palid et al., 2023; van Knippenberg et al., 2007)

Thank you for listening!

Suggestions regarding data analyses with small groups?

Do you have experience in contacting students with a migration background?

How to stimulate belonging/identity within higher education?

Questions?

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References

- C. Gillen-O'Neel, "Sense of Belonging and Student Engagement: A Daily Study of First- and Continuing-Generation College Students," *Res. High. Educ.*, vol. 62, pp. 45–71, 2021, doi: 10.1007/s11162-019-09570-y.
- C. Good, A. Rattan, and C. S. Dweck, "Why do women opt out? Sense of belonging and women's representation in mathematics," *J. Pers. Soc. Psychol.*, vol. 102, no. 4, pp. 700–717, 2012, doi: 10.1037/a0026659.
- Godwin and A. Kirn, "Identity-based motivation: Connections between first-year students' engineering role identities and future-time perspectives," *J. Eng. Educ.*, vol. 109, no. 3, pp. 362–383, 2020, doi: 10.1002/jee.20324.
- KU Leuven, "Doorstroomsitueringen met cijfers over de studieprestaties tot en met de cohorte generatiestudenten van academiejaar 2021-2022," Leuven, 2022.
- KU Leuven, "Instroomsitueringen generatiestudenten 2022-2023," Levuen, 2023.
- M. L. Pedler, R. Willis, and J. E. Nieuwoudt, "A sense of belonging at university: student retention, motivation and enjoyment," *J. Furth. High. Educ.*, vol. 46, no. 3, pp. 397–408, 2022, doi: 10.1080/0309877X.2021.1955844.
- S.-J. Leslie, A. Cimpian, M. Meyer, and E. Freeland, "Expectations of brilliance underlie gender distributions across academic disciplines," *Science (80-.).*, vol. 347, no. 6219, pp. 23–34, 2015.
- Palid, O., Cashdollar, S., Deangelo, S., Chu, C., & Bates, M. (2023). Inclusion in practice: a systematic review of diversity-focused STEM programming in the United States. In *International Journal of STEM Education* (Vol. 10, Issue 1). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1186/s40594-022-00387-3
- van Knippenberg, D., Haslam, S. A., & Platow, M. J. (2007). Unity Through Diversity: Value-in-Diversity Beliefs, Work Group Diversity, and Group Identification. *Group Dynamics*, *11*(3), 207–222. https://doi.org/10.1037/1089-2699.11.3.207