The Role of Participating in Physics Communities in the Development of Physics Identity: A Study of Physicists in an Academic Environment

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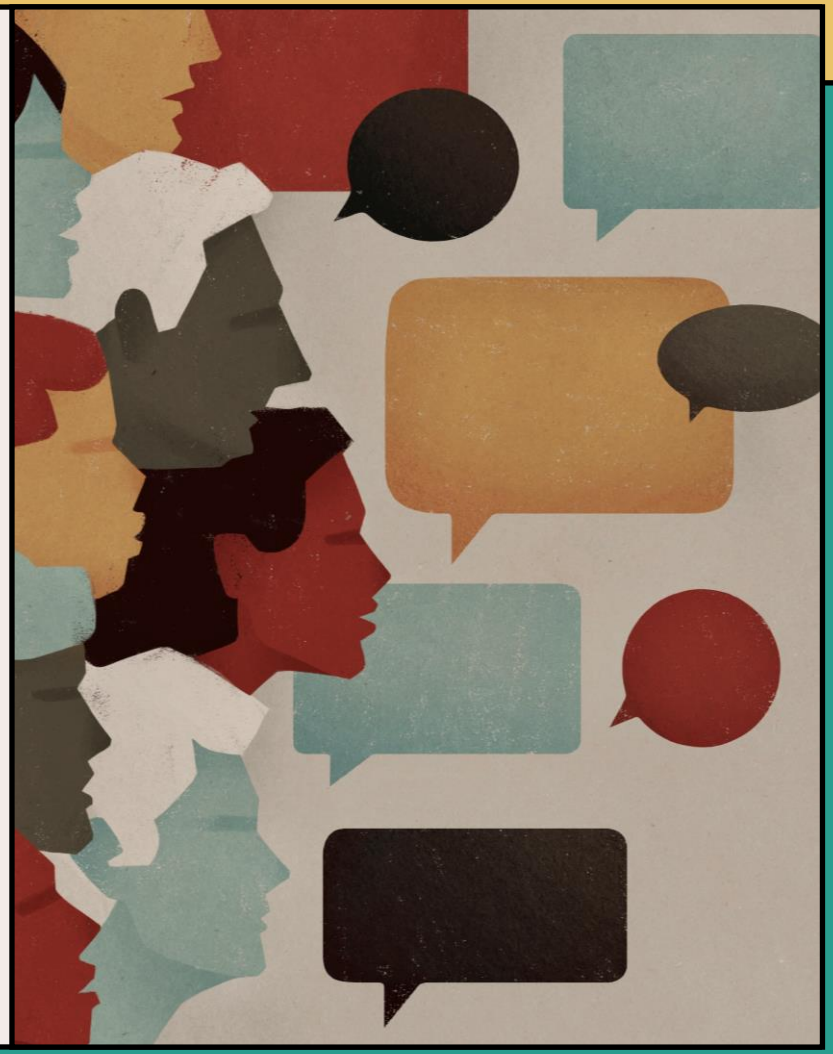
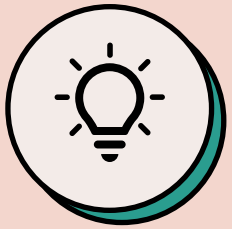
ASTRONOMY & PHYSICS EDUCATION



Outline

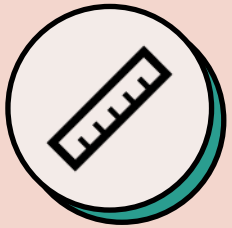
Introduction

Why should we be talking about identity in Higher Education?



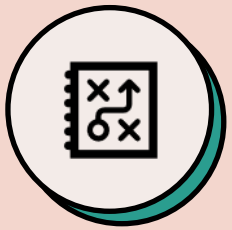
Theoretical Framework

Physics Identity and Communities of Practice



Methodology

Qualitative data analysis to explore individual's identity development



Results

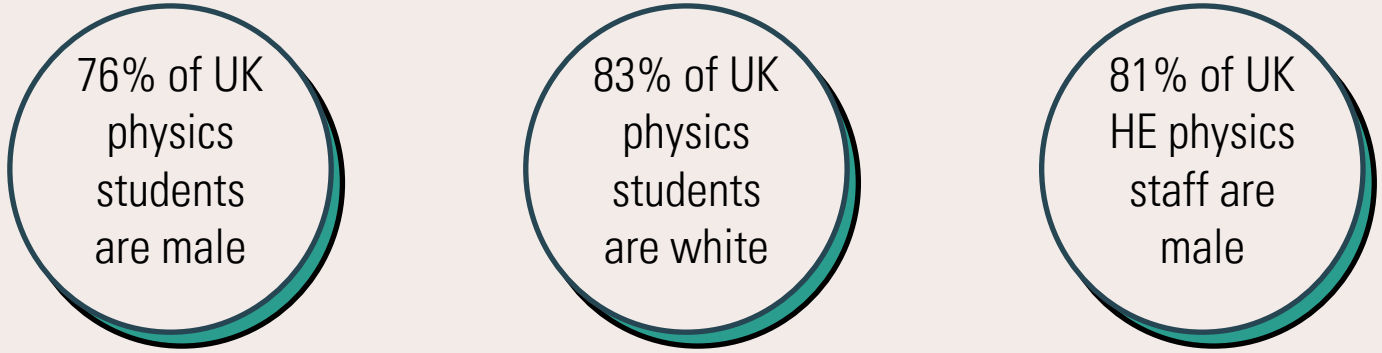
How do physics communities support physics identity development?

Conclusion

Next steps and future research

Introduction

- Despite ongoing EDI efforts, representation of typically underserved groups remains a problem in physics [1]



- Traditional physics stereotypes (e.g. the "lone wolf", or "effortless genius") results in those who do not see themselves in this image being less likely to pursue a physics career [2]

[1] Institute of Physics. 'Students in UK Physics Departments', April 2020.
[2] Archer, Louise, Julie Moote, and Emily MacLeod. 'Learning That Physics Is "Not for Me": Pedagogic Work and the Cultivation of Habitus among Advanced Level Physics Students'. Journal of the Learning Sciences 29, no. 3 (26 May 2020): 347–84.

Physics Identity

- This framework was initially set out by Hazari et al. [3] to explore the relationship between high school experiences and future career choices for physics students
- They identify four dimensions which correlate with an individual's idea of themselves as a "physics person"

Interest

The degree of interest one has in physics-related activities.

E.g., "I loved space when I was younger"

Performance

The ability to perform physics related tasks successfully.

E.g., "I always get good marks in labs"

Competence

The understanding of physics concepts and confidence in physics skills.

E.g., "I think I'm a good problem solver"

Recognition

Being seen by others (such as friends, teachers, etc.) as a "physics person".

E.g., "My friends call me 'the physicist'."

[3] Hazari, Zahra, Gerhard Sonnert, Philip M. Sadler, and Marie-Claire Shanahan. 'Connecting High School Physics Experiences, Outcome Expectations, Physics Identity, and Physics Career Choice: A Gender Study'. Journal of Research in Science Teaching 47, no. 8 (2010): 978–1003.

Communities of Practice

A Community of Practice (CoP) is a concept introduced by Lave and Wenger [4] based on the theory that **learning is a social process**.

Defined as a group of individuals with…

- Mutual engagement
- Joint enterprise
- Shared repertoire

An individual's **identity is shaped by CoPs** through…

- **Negotiated experience** through participation and reification
- **Learning trajectory** (e.g. inbound, outbound, peripheral)
- **Community membership** demonstrated through competence
- **Nexus of multi-membership** and negotiation of multiple identities
- **Local-global interplay** of shared practices

[4] Lave, Jean, and Etienne Wenger. 'Situated Learning: Legitimate Peripheral Participation'. Higher Education from Cambridge University Press. Cambridge University Press, 27 September 1991.

Research Questions

- What are the practices associated with "doing physics" by physicists in an academic environment?
- How does participation in physics communities of practice influence an individual's physics identity?

Methodology

Interviews with Staff and PhD Students

- **25 semi-structured interviews** conducted with staff and PhD students in Physics and Astronomy
- Focus on **storying** each participants journey of developing their physics identity

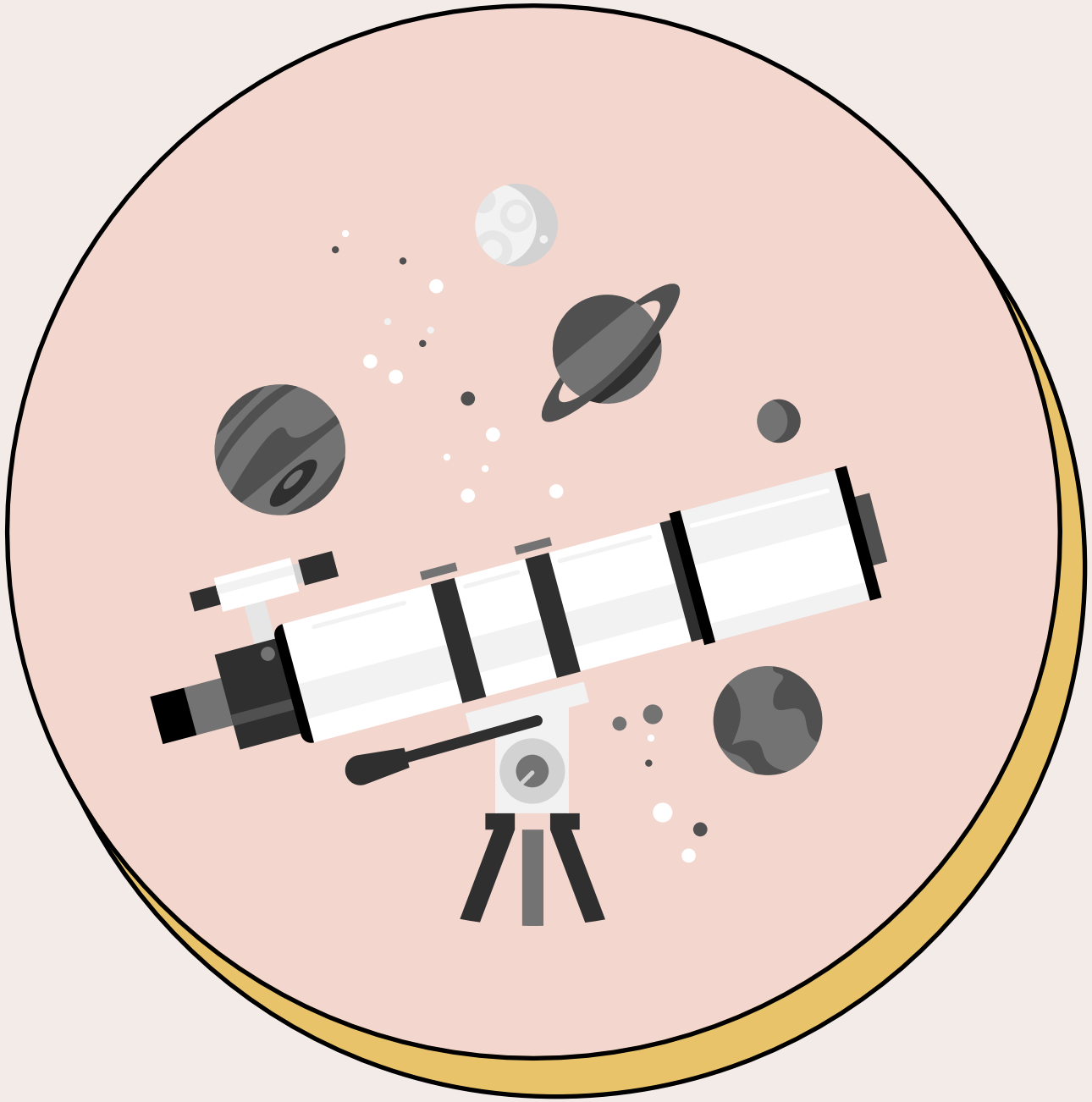
Thematic Coding Analysis

- **First stage**: Coding data using existing physics identity framework [3]
- **Second stage**: Coding data using CoP identity framework [4], with a focus on practices identified with the community of practicing physicists

Construct Extended Identity Framework

- **Final Stage**: Identify correlating dimensions in existing physics identity and CoP identity frameworks
- This work is currently ongoing – happy to answer any questions!

What does it mean to be a physicist?



What makes a Physicist?

- All participants were asked the question **"what do you think it means to be a physicist?"**
- Responses were coded inductively to identify the key practices associated with "doing physics"
- Comparison with the literature shows these results agree with work by Irving and Sayre on student perceptions of what it means to be a physicist [5], whilst extending their framework to include communication of physics

Qualification

Having a degree and / or doctorate in physics, or a closely-related subject

References: 11

Applying Knowledge & Skills

Using physics day-to-day, applying physics knowledge to problems

References: 19

Mindset

Approaching problems with curiosity, "thinking like a physicist", focused on 'why?'

References: 9

Communication

Working with fellow physicists, sharing research, teaching students, explaining concepts to others

References: 8

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Communication

"Can you explain concepts to people so that they understand it? That makes a good physicist."

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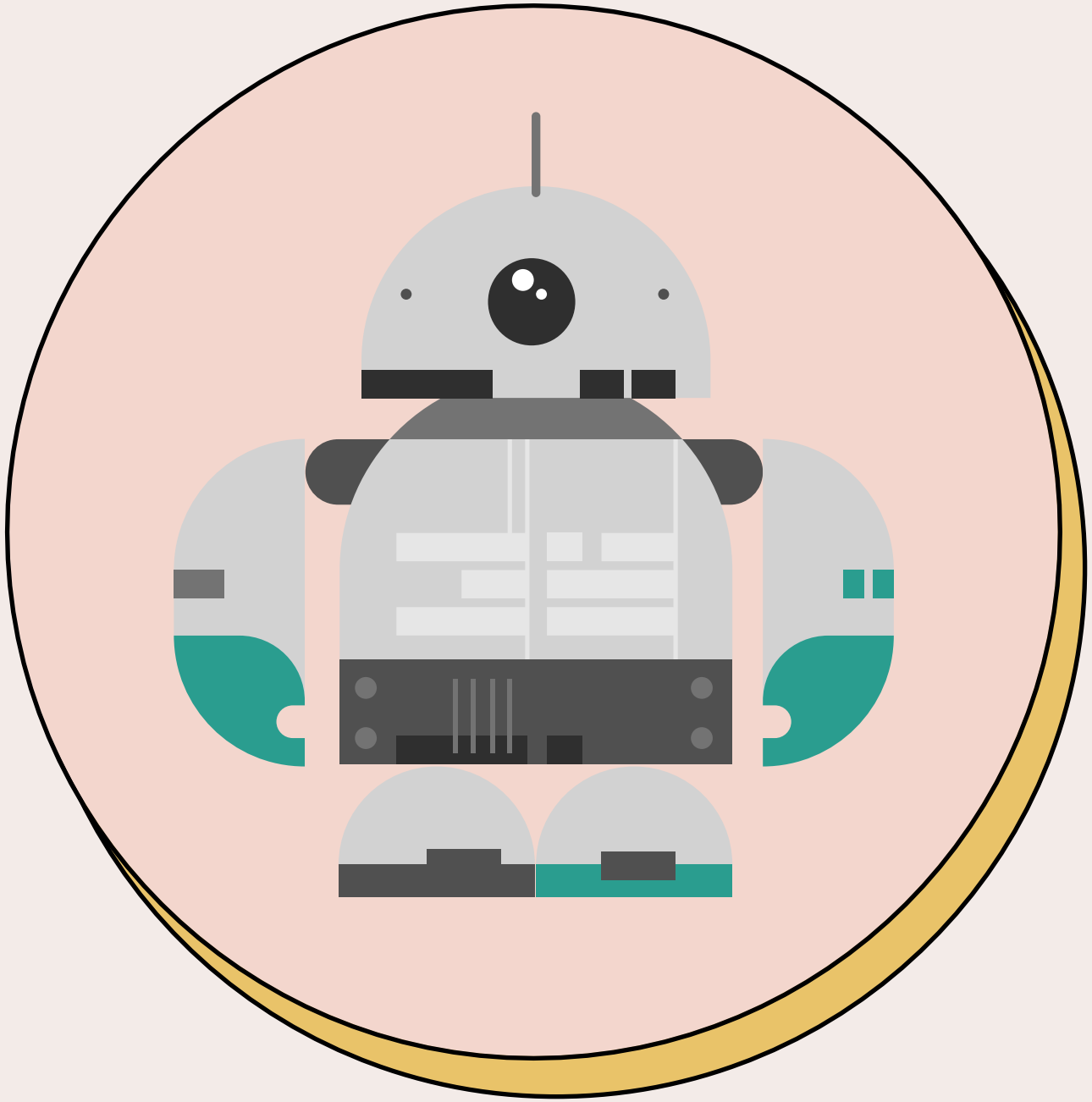
How does participation in communities of practices support physics identity development?



Key Themes from Interviews

Belonging to a group of physicists supports identity development, particularly in **undergraduate** years

When surrounded by others who view themselves as physicists, and finding belonging within that group, it is easier to hold a strong physics identity for oneself

Sharing work within physics communities strengthens physics identity, even for **senior physicists**

Across the board, it was referenced that communication of physics ideas (e.g. teaching, giving conference talks, discussions with colleagues) is vital in 'feeling like a physicist'

I think it really depends on who you have surrounded in your sort of peer group… So, you felt like you were surrounded by other people who I guess felt like physicists, or at least identified as physicists in some way, which certainly makes me go, "**I'm surrounded by these people, what does that make me?**", you know?

Kepler, Teaching Support Staff

...the shared kind of cultural memes that surrounded what it was like being an undergraduate physicist. It wasn't so much about the content of what we were doing, **it was about the attitudes and the kind of shared experiences** between people that made me think, “oh, no, **these are my people actually, I'm meant to be here**.

Michael, Lecturer

…if I if I give a talk and there's some people in the audience who I know, and **who's sort of opinions I care about, and they're sort of engaged**, then yeah, I really like that. And again, OK, that's just one of the few places where you're actually sort of **externally exposed the people outside your group**, so it's, you know, sort of out of the day-to-day.

Geoff, Lecturer

Summary & Next Steps

- The definition of the term 'physicist' is **multifaceted**; thus, care must be taken to recognise **what ideas an individual has about being a physicist**, and how these influence their physics identity
- The key practices associated with doing physics are
  - Holding a **qualification** in physics
  - Having a '**physics mindset**'
  - **Applying** knowledge and skills
  - **Communicating** with other physicists
- Being a part of physics communities of practice are instrumental in developing a strong physics identity, particularly through
  - Fostering a sense of belonging among fellow physicists
  - Providing opportunities to share work with others in the field

Summary & Next Steps

- This research forms part of a larger PhD project on the relationship between physics identity and communities of practice

- Current work involves developing and verifying an **extended physics identity framework**, which encapsulates dimensions from both Hazari's and Wenger's frameworks
  - Once verified, the framework will be used to perform a longitudinal analysis with quantitative student data on physics identity development

- How can we use this insight to **improve physics pedagogy**?

Thank you for your attention!

Any Questions?

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