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Dedicating, faking, and surviving: disclosing tensions in how three women university students negotiate collectively celebrated norms across European contexts

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ABSTRACT

Higher education biology (HEB), a discipline where women undergraduates are numerically overrepresented in most Western universities, has been given little attention in exploring norms of scientific practice from a student perspective. This study brings into focus how biology students negotiate identities in relation to figured worlds of HEB. Through thematic analysis of 27 timeline interviews from a Swedish, German, and British university as a collective case, we identified three hegemonic imaginaries across narratives: *showing dedication through sacrifice, faking it to make it,* and *surviving as the fittest*. Using a theoretical framework of feminist science critique, science identity, and figured worlds, we then offer a multiple case approach to how three women students negotiate the collective imaginaries identified, while simultaneously disavowing and challenging them. This conflict suggests they consider themselves successful *despite* the pressure to engage in 'typical' scientific practices they simultaneously contest. Consequently, this study demonstrates that celebrated imaginaries do not remain unproblematised by successful students, but create tensions in their identity work. This provokes discussions on how science imaginaries shape women's participation in HEB and beyond. Visualising these tensions makes it furthermore possible to challenge and change hegemonic academic norms in HEB, moving towards more socially just and inclusive spaces.

Introduction

'Who is allowed in science?' as posed by Lucy Avraamidou and Renee' Schwartz (2021), is a uniting question in feminist research on Western natural science practices and education along identity political dimensions of power. The authors propose questions of

who gets to participate in science practices to be a matter of intersections between (science) identities, natures and goals of science, as well as science education. Sandra Harding asked similar and critical questions already in 1991, dismantling how hegemonic discourses of scientific objectivity not only bias the very production of scientific knowledge, but also exclude historically underrepresented minorities from participation in scientific practices. While norms of participation in male-dominated and masculine marked subjects such as higher education physics and engineering have been extensively explored (e.g. Danielsson, 2012; Ottemo et al., 2021; Silfver et al., 2021), biology explorations have only gained momentum in recent years. We argue that by strongly focusing on male and masculine-biased fields, we risk equating them with science, rather than to nuance understandings and imaginaries[1] of what it means to be in and do science, and what practices, bodies, and identities science is associated with.

Higher Education Biology (HEB) across national contexts is a numerically women biased discipline at undergraduate level (UNESCO, 2021), which has led to assumptions and discourses of an absence of gendered inequalities and identity political processes of in- and exclusion (Eddy et al., 2014; Eddy & Brownell, 2016). These assumptions contribute to the lack of critical perspectives in HEB along axes of oppression such as gender, ability, class, race, ethnicity, and sexuality. Biology is indeed the discipline with the highest percentage of women on undergraduate level in e.g. Sweden, Germany, and the UK (SCB, 2019; Statistisches Bundesamt, 2021b; Universities UK, 2019), yet equally prominent is the progressive decrease in their percentage along the academic career ladder (HESA, 2021; SCB, 2021; Statistisches Bundesamt, 2021a), indicating the practice is not gender-neutral. Discourses of gender neutrality in science are not equal to an absence of gendered practices and rather hide exclusions of underserved minority groups such as women from participation (Eisenhart & Finkel, 1998). These hegemonic discourses have been deconstructed in Euro- and US-centred feminist science critique. Harding (1986) describes science as an androcentric ideology informed by dualisms of objectivity (mind) and subjectivity (body) and inherently connected to social constructions of the masculine and feminine with the latter of each pair subjugated in relation to the other. Gonsalves (2014), building on Salzinger (2004) and Traweek (1988), highlights that gender neutrality discourses paradoxically hide masculine norms. Some studies in HEB explicitly suggest gendered processes are not absent from its practices (Eddy et al., 2014; Eddy & Brownell, 2016; Leslie et al., 2015; Moss-Racusin et al., 2016). If wanting to grow beyond numerical woman biases as proof for an absence of gendered inequalities, we need to get beyond notions of gender neutrality (Chapman, 2022), ideas of biology learning as a neutral science practice, and understandings of natural sciences as objective cultures of no culture.

When entering disciplinary worlds of higher education, undergraduate students display expectations of what it means and entails to participate (e.g. Gregersen et al., 2021). These expectations are negotiated in relation to the explicit but also implicit agendas and practices (Ulriksen, 2009). Some practices and associated identities within can be understood as celebrated (Carlone et al., 2014) and dominant (Gonsalves et al., 2019), shaping 'desirable identities for participants in a figured world' (Gonsalves et al., 2019, p. 14). Early negotiations of imagined celebrated identities and identity trajectories in(to) HEB are described in Günter et al. (2021), who also illustrate that biology is not free from hegemonically masculine norms. Students imagined ideas of straight

trajectories into academia, norms of inherent interest in and talent for the natural sciences, and challenged these norms through narratives of alternative imaginaries of winding and explorative paths. Here tensions between what is imagined as celebrated and what is accessible become visible. Wong et al. (2022) explored what 'typical' students looked like from the perspective of Science, Technology, Engineering and Mathematics (STEM) students in the UK. They describe biology students as focused on degrees and hardworking, but also show that sociability and friendliness are considered 'typical and key characteristic of biology students, rather than (...)a rarity'. Again, we can see tensions between characteristics that have traditionally been associated with femininity such as sociability and friendliness, and historically constructed masculine traits such as narrow focus and hard work. Grunspan et al. (2016) made some of the consequences of these associations visible through social network analysis. They could show that female students are considered less knowledgeable than their male peers in terms of course content. This phenomenon becomes more pronounced over the course of a term, grounded in over-nominations *of* male students *by* male students, while female students didn't show a gender bias. Building on Holland et al. (1998) and Urrieta's (2007) theorisations on figured worlds and identity, Le et al. (2019) described how meaning making and recognition by others influenced undergraduate biology students' conceptual and procedural identity work. They empirically ground their analysis in 26 interviews including demographic dimensions of gender identity and race/ethnicity, yet do not provide closer analysis of how individuals integrate meanings of performances of being a science person in their identity work. Predominantly quantitative perspectives furthermore provide evidence for biology as a discipline to be stratified along the axis of gender (e.g. Eddy & Brownell, 2016), as well as intersecting axes of race, ethnicity, and gender (e.g. Hazari et al., 2013). These impulses have increased the momentum of sociocultural and critical perspectives in/on HEB.

Contributing diverse perspectives to understand sociocultural patterns in biology education, the above-mentioned studies do not offer insights into how individuals negotiate larger patterns. Closer immersions of individual's identity work can offer valuable insights to understand humans' lived experiences and identity work in science education contexts (e.g. Avraamidou, 2020b; Moore, 2008).

We explicitly focus on tensions between what is collectively imagined as celebrated and how three women negotiate celebrated imaginaries. Negotiations influence students' disciplinary identity work and if and how they develop a feeling of being part of the worlds surrounding them. These worlds are historically and culturally situated, shaped via social interactions (Holland et al., 1998; Lave & Wenger, 1991). People within operate on cultural assumptions leading to social actions and interactions being 'interpreted according to a context of meaning' (Holland et al., 1998, p. 52). Within these contexts, we become 'a member, a certain kind of person' (Lave & Wenger, 1991, p. 53), develop a sense of belonging, and (are) recognise(d as) as particular kinds of people (Gee, 2000). Learning means doing identity work in and developing a sense of belonging to culturally and historically constructed worlds.

Here, we explore how students across three European contexts negotiate imaginaries of ways of doing and being in worlds of HEB with a sensitivity to underlying androcentric science ideologies. Grounded in 27 interviews with biology students a Swedish, German, and British university, we first map out three collective imaginaries of celebrated

practices in biology and science. Leaning on Carlone et al. (2014) and Gonsalves et al. (2019), we use celebrated when describing practices and identities that students imagine to be more valued than others, as the *dominant* in relation to others. After mapping out collective imaginaries, we visualise how these imaginaries are negotiated by three women biology students; Willow, Iris, and Lilian. All three consider themselves successful. They aim to pursue a PhD and despite considering themselves successful and ambitions to continue in science, they experience frictions in their identity work when negotiating imaginaries collectively understood as celebrated in worlds of HEB. We ask,

(1) What celebrated ways of being and doing in worlds of HEB do students imagine collectively?
(2) How do three women students negotiate their identities in relation to these imaginaries and where do they experience assent and dissent?

Theoretical framing

We ground this study in critical discourse theory, acknowledging language to be central in productions of meaning and executions of power (Foucault, 2019 [1976]; Laclau & Mouffe, 1985). Discourses are in a constant struggle for hegemony (Laclau & Mouffe, 1985) and shape all domains of social life through interactions with others in historically, culturally, and socially constructed worlds (Holland & Lachicotte, 2007). Discourses shape and are shaped within worlds as 'constructed realms of interpretation, in which particular characters are recognised, significance is assigned to certain acts, and particular outcomes are valued over others' (Holland et al., 1998, p. 52). Figured worlds, rather than being an essential reality, thereby rest on imaginaries or 'as-if realms' within larger institutional systems of power that discursively shape worlds and people's identity work within.

Identity can be described as a 'complex set of practices in the world' (Gee, 2014, p. 22) inherently connected to being and becoming recognised as a 'certain kind of person' (Gee, 2000, p. 110). Identities shape and get shaped through activities that are undertaken in relation to imaginaries within figured worlds (Holland et al., 1998). When theorising identities in worlds of science, Carlone and Johnson (2007) suggest that identity formations rest upon pillars of competence, performance, and recognition intersecting with dimensions of power along axes of, for instance, gender, class, and ethnicity. We focus our analytical lens on what competences and performances students recognise for themselves and what they imagine others to recognise in figured worlds of HEB. Figurings of worlds, discourses, and actors themselves are in constant flux, constituting the 'ground for identity development' (Holland et al., 1998, p. 63). Similarly, identities are understood as fluid, changing through identity work along trajectories, rather than as a fixed state (e.g. Jackson & Seiler, 2013). Understanding identity as a verb rather than a noun, as being done, a process that is fluid and always ongoing, visualises what norms are reproduced and what hegemonic imaginaries as well as alternatives to these hegemonic imaginaries are present in figured worlds (Holland et al., 1998). Using 'imaginaries' instead of 'discourses', we acknowledge figured worlds to be culturally situated 'as social process and in historical time' (Holland et al., 1998, p. 55).

Materials and methods

Our study combines a collective case study (Stake, 2008) of biology students across three European contexts with a more in-depth analysis of the cases of three women biology students and their experiences when negotiating collectively imagined norms of HEB. With this approach, we want to describe both overarching normalised imaginaries that inform biology students' identity work in figured worlds of HEB and as provide insights into how identity negotiations are actualised in women's identity work. In order to do so, this study draws on empirical material collected across European contexts and (gender, class, and ethnic) identities.

Data collection

While ultimately aiming to describe how three women negotiate their identities in relation to practices perceived as celebrated in HEB across national contexts, we ground this study empirically in 27 semi-structured timeline interviews (Adriansen, 2012) with students from one Swedish, German, and British university (2 gender non-binary, 19 female, and 6 male students). Data collection took place over the course of 18 months, starting with face-to-face interviews at the British and German university (late autumn 2019). Interviews with Swedish students (early spring 2021) were moved to an online format because of the COVID-19 pandemic.

In the context of a larger study, we decided to include three geographical contexts to explore similarities and differences in HEB, a discipline situated within higher education evolving towards internationality (de Wit & Deca, 2020). While we transgress national borders, making the first analysis step a collective case, our main aim is to display students' collectively shared imaginaries rather than describing and discussing the specificities of each individual context in this study. However, the locations matter and inform this study, as even the authors have experienced the respective environments.

Participants interviewed face-to-face gave written informed consent to participate in this study, while consent was given orally and recorded during online interviews. The interviews were divided into three parts, focusing on (i) the time until deciding to study HEB, (ii) the time since students started their higher education studies, and (iii) how they imagine their future. We decided to add the dimension of time in order to capture how the students narrate and make sense of their past, present, and possible future selves (prompted by Schinske et al., 2016). With this we wanted to open up for students to 'de- and re-construct' their narratives (Adriansen, 2012, p. 50). In addition, Swedish students discussed their study motivations text (see Günter et al., 2021) with the interviewer. While all interviews inform this collective case study, we use a subset of two interviews from each university (one gender non-binary, four female, one male student/s) when developing three imaginaries found across the interview material, as these interviews were particularly rich and display that imaginaries are constructed across gender identity categories and geographic contexts.

We then explicitly focus on three women biology students and map out in more detail how they negotiate the above-mentioned imaginaries. All three women consider themselves successful and want to pursue a PhD in biology. This means that they display

an intention to stay in academic biology and science, despite, as we later show, disavowing and challenging normative practices associated with it.

In order to protect the students' anonymity, we use pseudonyms for all students and avoid sharing information that would make students identifiable. We also refrain from explicitly mentioning different conditions mentioned, as we consider such detailed information to be irrelevant in this context.

Background on the authors and reflexivity reflections

Each of the authors has experienced at least one of the three universities over the course of their own academic trajectories and we provide further information about the respective universities (Table 1 in the appendix). We all have a background in biology, which makes us insiders to biology as a discipline and some local practices. This provides us with insights into some aspects but also bears the risk of us not seeing others. Simultaneously, and for instance due to our positionalities (Mensah, 2016), the boundaries between insideness and outsideness are blurred (Sultana, 2007). Consequently, while the interview data comprises the empirical material for this study, the authors also reflected on and discussed local practices and environments as well as their positionalities in them (Sultana, 2007). The first author explicitly immersed themselves in the respective Swedish, German, and British settings with a reflexive ethnographic approach, acknowledging their part in the production of this work (Davies, 1996). Ethnographic observations, embodied experiences, reflexive conversations, as well as further interviews conducted in the context of the overarching project influenced the triangulation-inspired data analysis (Cohen et al., 2002).

Data preparation and analysis

The 27 semi-structured timeline interviews (29.5 hours, in Swedish, German, and English) were recorded, transcribed using transcription software, and revised by the first author who is fluent in all three languages. All authors are advanced, fluent, or native in at least two of the three languages (Swedish, English, and German). The transcripts were translated to English if necessary, with particular attention to preserve the meaning of the communications. If ambiguities in meaning occurred, we collectively revisited the anonymised original transcripts during analysis. The first author revisited recordings if necessary. In what follows, we will describe the four analysis steps (summarised in Table 2 in the appendix).

In a preliminary thematic analysis (Braun & Clarke, 2006), the first author got familiar with the interview data through readings of the interview transcripts and listening to the original audio files. Thereby, themes that occur across students' imaginaries could be described, such as '(un)intelligible academic strategies', '(un)recognized science processes', and 'science and/or biology people' based on the full data set.

The first author then chose six particularly rich anonymised transcripts, two from each location and with attention to the diversity of participants' gender-identities, to analyse and discuss in the research group. The co-authors familiarised themselves with the data and did independent thematic analyses (Braun & Clarke, 2006) using open-coding (Saldaña, 2015). Without promptings from the first author, we found overlapping

broader themes such as 'negotiations of what it means to do biology and/or science' and 'students relating experiences to their personhood, family backgrounds, and private lives'.

In order to explore these findings further, we explored the material operationalising the three pillars of science identity described by Carlone and Johnson (2007): competence, performance, and recognition. We asked what competences and performances do students recognise for themselves and for others, as well as what they consider has been recognised (or not) for them by others. In this analytical step, we identified negotiations of recognitions when participating in fieldwork and when working in the industry, understandings of private commitments to academic tasks to be recognised, and negotiations of competences and performances of being a biologist, researcher, and/or scientist. Based on these results, we revisited the empirical material employing Gee's (2000) Figured Worlds Tool, which focuses the analysis on what students considered to be *typical* or even *celebrated* in figured worlds of HEB. This tool prompts to ask,

> what typical stories or figured worlds the words and phrases of the communication are assuming and inviting listeners to assume. What participants, activities, ways of interacting, forms of language, people, objects, environments, and institutions, as well as values, are in these figured worlds? (Gee, 2010, p. 177)

Focusing on participants, activities, interactions as well as values in particular, we found that students negotiated high workloads, compromises in terms of private life, and competitiveness as part of worlds of HEB. Based on these findings, we returned to the initial themes and our empirical material and iteratively refined the initial themes.

In the following, we first develop the findings deriving from these analytical steps and present three collective imaginaries, referring to Oliver (male) and Iris (female) from the German university, Sage (female) and Willow (female) from the British university, as well as Oakley (gender non-binary) and Lilian (female) from the Swedish university. Second, we map out how these imaginaries are negotiated in detail by three white women: Willow, Iris, and Lilian.

Results

Three natural science imaginaries as a collective case

Grounded in all 27 interviews as a collective case study, we describe three imaginaries of recognised performances that students collectively negotiated when figuring worlds of HEB: *showing dedication through sacrifice, being forced to 'fake it to make it'*, and *surviving as the fittest.*

Showing dedication through sacrifice

This imaginary relates to performances of dedication, which are understood to come at different costs. These sacrifices are imagined in terms of giving up personal aspirations, sacrificing free time for the purpose of studying, or for instance taking strategically sensible courses over those one is interested in. Another critical sacrifice, considered rather normal when studying biology, is one's health. Oliver highlights having made it through the programme in the standard period of study time. He claims that this was only possible through hard work and discipline, through sacrificing his free time, and making

strategic choices, rather than choosing courses that he was actually interested in. Oliver says, 'And then one just has to do things that one doesn't necessarily want to do. That is just part of it'. Oliver emphasises that he succeeded as opposed to many others, highlighting the perceived intention of undergraduate programmes to sort out people and emphasising the strong competition even amongst students. Being able to identify this mechanism becomes a competence that turns into a resource to navigate one's studies, a competence ultimately recognised. Willow expresses how important her private life and family time are to her. Yet, she sacrificed vacation time with her partner for an academic job interview, a performance of dedication that she expects to be recognised by the scientists who interview her. Iris discusses common practices of extending project work beyond the official project duration as a cost when choosing what she wanted to do. Making time is understood as another form of recognised sacrifice. Lilian has experienced particular pressure to perform as the only child of two natural scientists. After a long period of working in a lab and simultaneously reading several advanced courses, she says that she 'was very close to going into the wall' and burn out. She explicitly mentions to compromise her health in the process, an act of sacrifice, a performance imagined as recognised.

Faking it until one makes it

Students negotiate tensions of competences and performances in relation to imaginaries of what they imagine to be recognised knowledges and accomplishments associated with legitimate participation in science practices. One facet of imaginaries of rather involuntarily *faking it until one makes it* is explicitly expressed by Willow who wants to be 'good at things', yet doesn't feel like she is good enough. Discomfort derives from mismatches between what she imagines as the recognised level of competence in university research practices and the level of competence she recognises for herself. Similarly, Sage expresses 'not being there, yet', when negotiating recognising herself as a biologist and scientist. Across the data, being a scientist is imagined as achieved through reaching academic milestones like writing a Master's thesis, publishing a paper, or pursuing a PhD degree. What it means to be a biologist appears to be less easily defined and was often associated with abstract depths of knowledge and rather narrow research foci.

Another nuance of this imaginary is related to practices that are perceived as cheating. In the context of the German university, both Iris and Oliver describe the common practice of studying for exams based on former exams. Oliver distances himself from that practice, seeing it as a way others 'cheat themselves through their studies'. He emphasises that he made it through with hard work and dedication instead. This 'honesty', as he phrases it, comes at the price of less institutionalised recognition in the form of bad marks. He perceives his approach to studies, emphasising understanding concepts and their connections, to not be recognised. Committing to the subject is understood as more central to the practice than committing to the curriculum. Iris distances herself from studying with former exams, saying that she is an 'honest person'. At the same time, she extends the length of her Bachelor thesis (6 months instead of 10 weeks) by not registering the project before being almost done. This is a practice that despite undermining the rules for thesis work is considered typical and appropriate while studying with old exams appears inappropriate for legitimate participants in worlds of HEB. Negotiating this tension adds to a sense of being forced to fake it and derives from a perceived

mismatch between institutionalised competences and required competences when becoming legitimate participants in the world of HEB. Consequently displaying an understanding for and use of (some of) the system's loopholes through insider knowledge of academic processes can be understood as a means to achieve recognition as a legitimate and intelligible participant.

Surviving as the fittest

Surviving, narratives of living through events, has occurred in literal senses of living through for instance health assessments and high workloads and symbolic sense describing academic sorting processes, in which only the most dedicated and predestined participants achieve their goals. Lilian receives help from the academic environment that she is in when being close to burn out, and highlights the constructive and supportive dynamics in the research group that she works with. Lilian takes on many independent tasks beyond expectations and study levels of the programme, and thereby performs according to what she understands as recognised in HEB and science. She positions herself as central to the practice, as rather unique and aware of the exceptionality of her achievements asking, 'how in the world did I do this?' Lilian considers an almost impossible workload as typical for biology and science. Oakley, a gender non-binary student that expected to manage their studies 'gallantly' went through both a gender identity and a neuropsychiatric assessment and consequently pursued their studies half-time. The programme, however, was not adjusted to their needs in terms of study pace, resources provided, and programme structure, which made them feel like they 'cannot study'. It also led to feeling disconnected from the content and other students, which they eventually overcame. Oakley considers themselves successful as they have managed to push through the second semester with an awareness that most students 'most likely (…) didn't have to go through a neuropsychiatric assessment'. Oliver's goal was to finish the Bachelor programme in the standard period of time, a performance that he considers recognised but almost impossible. He is particularly proud that he 'pushed through' the first semesters which 'were hell', which according many students and Oliver 'weed out people'. He legitimised that practice as 'not everyone can achieve the same accomplishments', meaning accomplishments that qualify for continuing in the programme and the sciences. Oliver considers himself a very competitive person, and while he 'mostly competes against [him]self', he emphasises that he wants to be above average, better than others. According to Oliver, academic environments are inherently competitive and classmates will become the biggest competitors. He positions himself as having understood implicit and explicit cultural rules; pairing competitiveness with hard work and the right kind of dedication towards science and one's studies are central to this imaginary.

Mapping out multiple women's cases

In this section, we outline how three women negotiate the above-mentioned imaginaries and visualise tensions in their identity work by left-aligning parts of quotations indicating identity work in friction with and away from collectively understood imaginaries. Statements indicating identity work in line with and towards collectively understood imaginaries are right-alignin.

Willow (British university)

Willow is in her early 20s and grew up in an urban environment close to the British university. She has started her undergraduate when she was 17, is a first-generation university student, and has a strong working class identity, which at times alienates her from academic practices. She studied veterinary biosciences and sports science before moving into biology and describes this trajectory as having been 'all over the place'. Willow reflects about herself in ambivalent terms, displaying scientific competence and interest in science and research, yet feeling like she does not fit in. However, when reflecting about her trajectory, Willow stresses having gradually participated more centrally in the HEB practices, not learning content by heart anymore, but understanding contexts and connections, something that has 'changed in her head'. Willow contrasts her plans for the future to do a PhD, with the fact that she did not want to study at university in the first place. Willow considers this development a success in combination with other factors.

Early in the interview, Willow displays ambivalent feelings negotiating private and professional aspirations. She stresses that she only wanted to get married after graduating from high school, yet that she did not have any strong feelings for or against studying as long as what she did was 'at least interesting'. When sharing experiences from the sports science programme, Willow points out that others did not realise that it was a 'science degree' and dropped out, while she explicitly liked the science parts of it and consequently started moving towards biology. This displays her understanding of science as a practice and a competence to navigate its practices.

While initially not feeling like she belonged to the biology programme, Willow started to feel a sense of belonging after three years, when she was able to apply her biology competences in practice. Even though she positions herself as a likeable student and teachers to appreciate her being a 'little nerd' with high grades, Willow positions herself as generally working hard to achieve high grades and to work even harder when trying to get a job in a lab. During her third year, she started working as a research assistant in a lab and describes her experience as follows:

> I started helping in the lab (…) and it was like the same thing
> last year actually. So I did help during Christmas time. (…) And
> then it was also so cool because it was a natural thing. Like it is
> an actual research project.

> I felt sooo uncomfortable to start with! I am a person who hates
> not being good at things. I hate not knowing what I am doing. I
> just hate that feeling.

Willow earlier on in the interview highlights that one only gets a job when being good and experienced enough. She stresses that she felt very uncomfortable when she started, not considering herself competent enough and not knowing how to perform. Willow positions herself as a legitimate participant in a science practice as she was working during Christmas, a sacrifice that she understands to display her dedication to science. Christmas holidays reoccur as Willow applied for a research assistant position in a central European university and when visiting her partner living close to that university during the holidays, her partner suggests asking for an in-person meeting. Willow describes her reaction:

But it is Christmas, like, it's a holiday! And then also because it
was *our* holiday [spent with her partner] and we hardly had seen
each other as I don't want to be like, oh, let's go and do uni
stuff.

(…) I messaged and emailed [the host for the research position]
and we went to [the university] for the day.

And she actually only ranked me third out of 15 because I was
not passionate enough. (…)

Like because I took all that time on my holiday to see her

but I still was not passionate enough.

For Willow, spending Christmas holidays and valuable time with her partner to visit the
university displays high levels of commitment and sacrifice, which strongly collides with
the assessment of not having been passionate enough. Furthermore, Willow is aware that
it takes commitment, working during holidays and working extraordinarily hard, which
she describes as having a certain kind of working 'mentality'. Imaginaries of what
sacrifices it takes to show dedication to science, the commitment to spend one's
private time on science and university matters, collide with Willow's imaginaries on
private life and being a private human being.

Willow is not only working as an assistant in a research group, but also participates in
the group's weekly informal meetings. While she recognises the PI and other group
members as highly successful yet approachable scientists, she especially negotiates her
own identity in relation to a PhD student that, according to her, has a 'Jack the Lad'
attitude:

He has a lot, like, he is also funny.

But I am very aware that he is also very intelligent.

But because he comes across as so funny and jokey. It is kind of.
I don't know. I mean. I have never spoken to him in an actual
like really "sciencey" way. It is always just like a conversation
(…) where it's not always super detailed. So I believe like, that
it is like, he really gets away like he does.

But I think for me it is hard to think, (…) he's like, he is a
biologist. But you know what I mean. I am well aware that he is
smart and he like, works, I mean, he just had like two papers
published already. (…)

But it is just like. He feels more like me, than as if he is halfway
through. Not like half way through his PhD but you know what I
mean? It feels more like my sort of mentality.

Willow identifies with the laddish PhD student, however, she also tries to make sense of
him as a legitimate researcher. Willow shows ambivalences when negotiating what she
imagines as legitimate ways of being, doing, and knowing in HEB in relation to
herself. While she recognises her competence and is aware of performative norms, she
has an easier time recognising intelligible competences and performances in others,

the masculine-coded laddishness that she recognises in herself preventing her from recognising herself as sciencey, while accepting it for the male colleague. Willow negotiates science competences and performances in relation to possibilities of being a certain kind of person, showing dedication through sacrificing some of the things that are (most) important to her.

Iris (German university)

Iris is in her early 20s and a first-generation university student. She has already defended her Bachelor thesis, and collected all credits necessary to graduate from the German university. However, Iris is still enrolled in the programme as she actively decided not to submit a final assignment in order to stay enrolled. This is for a variety of reasons and because she would like to do an internship as 'others have done in their fourth or fifth semester'. Iris stresses that she has finished her studies in the prescribed period, but only because she did not need to work as she was supported by and lived with her parents. Iris authors herself as having known, from early on, that she would like to specialise in a specific biology field, while at the same time having a broad interest in all fields of biology. She decided not to graduate, yet, exceeding the prescribed period of studies, as 'it is better to get some experience rather than to continue one's studies right away'. In order to gain experience, she works as a research assistant in the same group in which she wrote her Bachelor project. Iris is furthermore already in touch with researchers that she would like to collaborate with, as she aims to continue her studies and aspires to do a PhD.

Iris positions herself confidently as a rather central participant in the biology practice, highlighting that she has finished her studies in time and contributed to research through her Bachelor thesis. She thereby positions herself in line with what is imagined as recognised. She has very concrete aspirations and knows what she wants her career to look like. While Iris considers herself successful, she experiences tensions between practices that she imagines to be common in relation to practices that she considers appropriate.

According to Iris, it is common that instead of understanding content and connections, one must study old exams to pass exams, as it appears impossible to learn everything addressed in the course within the time given. Iris says,

> I am not that kind of person. I would say I am an honest person
> and I just don't like that one should only learn from old exams.
> Instead, I hate it. I want to know what is taught and I want to be
> able to use it. But it is so much that one cannot do it. (…)

> I prefer learning everything even though I am exhausted
> afterwards. It is only a few weeks that you have to focus on it.
> And yes, you just do it. Repeat everything. (…)

> But that is almost impossible. If you don't do it continuously
> throughout the semester, which was a mistake of mine. (…) But
> no matter how much time one has. It does not work, even
> though one plans to do it.

> But I mean, it has always worked. Somehow.

> One then has to do all-nighters if you do it before the exam. (…)
> It is so, so much learning matter.

> I mean. One can somehow do it and yes,
> one grows with one's tasks.

While Iris positions herself as a student that can handle extensive amounts of information, she criticises the norm of studying with old exams. She considers this practice to be dishonest, against her values. Exams would only test memorising multiple choice answers, rather than actual and complex knowledges. She feels forced to fake evaluations due to vast amounts of information compressed in limited amounts of time when wanting to finish the programme within the given three years. She shares her experiences of not having time to process information during seminars and says,

> Well [reading] comes way too short. (…) So when one has a
> weekend or two-week compact course, everyone just 'spew out'
> their presentations. I don't think that is the point of all this.

> Well, I did this myself. As it saves time.
> Of course.

This is an example of how Iris navigates normalises practices, while at the same time criticising them as not contributing to her learning. A third context in which Iris negotiates her values in relation to supposedly normative practices is when writing her Bachelor thesis. At the German university, the degree project is registered and then meant to be completed within a set period of formerly eight, currently ten weeks. However, it occurs that projects are registered after they were started, extending the project time, and thereby bypassing the set period and university rules. Iris explains,

> I did choose what I wanted to do during my Bachelor thesis in
> regard to my interests. What is interesting. Yes, and then one
> has to do it for half a year. (…)

> Even though they are theoretically only supposed to be eight
> weeks. (…)

> It is good that [the professor] is not committed to that [laughs].
> (…) They have already increased it to 10 weeks.

> Which is total nonsense if one thinks about me already needing
> one week to grow fish. (…)

> Well, I have done my contribution to research.

> But I haven't really done research, I'd say. As I haven't really
> brought in my own ideas.

Iris negotiates practices, which she both agrees and disagrees with. She agrees that writing Bachelor theses of appropriate quality is not possible within the allotted time. This perspective, she emphasises, is also shared by professors at the German university. However, she is aware that these practices are against university regulations. Iris finds herself in fields of tension, performing and executing strategies that are not aligned with her own sense of honesty and justice, however, considered common, indispensable and appropriate. Hence, Iris shows competences of navigating university and science practices that she disagrees with, sacrificing time and stretching the rules, something that Iris perceives as still not being enough to be recognised as legitimate participant in the practice.

Lilian (Swedish university)

Lilian is in her mid-20s and about to graduate from the B.Sc. biology programme. Her parents are research biologists and Lilian describes herself as 'having grown up in the academic world', spending time at the workplace of her parents, meeting their friends and colleagues. Even though Lilian wanted to study biology already as a child, she stresses that as a teenager she did not want to go into research the way her parents did, since she got very tired of always having academic conversations at the dining table at home. She highlights, 'I just found that unpleasant as I felt forced to perform and especially thinking about me being an only child, it was even more pressure'. Six years after graduating from high school, her parents decreased the pressure letting Lilian go 'her own way'. She explains, '[biology] became something natural that I got interested in and now I am here and want to do research'. Lilian is very enthusiastic about her studies and already knows that she wants to do a PhD and research. Generally, Lilian is happy with her achievements, considers herself to be good at studying, and says, 'nothing else in my entire life feels more right than this'.

Lilian positions herself as belonging to the higher education practice in a variety of ways: Being friends with PhD students, having an advisor who teaches the course that she is most interested in, and not feeling shy about contacting people in academia as they 'only are people'. Furthermore, she stresses her academic competences and achievements and states that she has an 'easier time than others'. She works as a research assistant while writing her Bachelor thesis and reading a Master's level course simultaneously. Several times during the interview, she emphasises that she has finished her Bachelor degree half a year ahead, and that she reads extra courses 'only to have something to do' as she would 'otherwise go crazy'. Time in general plays an important role in Lilian's positioning. Lilian explains that she wanted to be done early to have 'time to choose a Master's program' and says,

> You cannot. One cannot do research in the same way, I mean,
> one cannot apply for a PhD with one's Bachelor, and if one
> wants to do that, well, then one must do a Master's. (…)

> And I sit and I look at PhD positions all the time. Like, in
> different countries. And just look at what there is. I actually
> applied for a new position in the fall that was in Spain, and there
> I did not need a Master's education. It was my supervisor. (…)
> And he was just like. But apply! And I just went. Okay! [laughs]

> I applied, even though they took somebody else who already had a Master's.

Lilian is aware that especially in a European context and with a three-year Bachelor degree, it is unusual if not impossible to win a PhD position. Yet, as she rather quickly wants to do research, she applied anyway with the encouragement of her supervisor. After not being offered the position, she applied for Master's programmes and has made a plan. Lilian says,

> Well, I am not in a hurry with finishing my Master's. But it
> would be nice to finish it early so that I can start applying for
> PhD positions.

> But it is like this. I take whatever comes. (…)

> It does not matter if I do my Master's in two or one and a half
> years. Like. Generally, I will look for PhD positions somewhere
> else in Sweden.

For her Master's, Lilian is planning to be ahead of schedule and has already started to take free-standing Master's courses in biology. Lilian emphasises, 'I actually did all of this. I was just like, how. How in the world did I do this, like? [laughs]. But I did it'.

While positioning herself as a high-performer, as rather exceptional, doing many full-time activities at the same time, she eventually slows down during the interview, which even physically marks a change of narrative. Lilian talks about the time when she was a research assistant and took a Master's course at the same time,

> In the beginning of the fall semester. I have never been so bad in
> my entire life. I was very close to going into the wall, as I had to
> do like all, my regular job, the university job and on top of that
> there was a Master's course. So, that was really tough. It was
> like, I had breakdowns every day. I had breakdowns in the
> bathroom and here [at work]. And I just sat there and cried and
> cried and cried. (…)
>
> But I had a lot of support.

Even though only a short comment during the interview and a small point on Lilian's timeline, it is here Lilian displays how deeply all three collectively imagined norms inform her performance. Lilian displays her dedication, eventually discloses the sacrifices, which are strongly connected to ideas about surviving as the fittest. It is an insurmountable amount of work that is imagined to be required for legitimate participation, being faster that everyone else, working on multiple projects, committing to research, and sacrificing one's health. While the pressure from her parents got less, she pushes herself very far to meet her own expectations negotiaing imaginaries of scientific practice. Performing all of the above, and eventually disclosing the struggle, also manifests ideas of faking it until one makes it. Hitting the wall in that process is understood to be common and the community is aware of these struggles – hence they show support. A support that recognises.

Discussion

Kristina Andersson (2018) identified HEB discourses to be influenced by overarching meritocratic academic norms of for instance competitiveness, high performance, and narrow but deep knowledge. These science discourses emerge in the students' identity work through negotiations of celebrated imaginaries in relation to the self. While Andersson suggests negative impacts of hegemonic discourses for students who (consequently) do not want to pursue a research career, we show how three women who rather successfully negotiate hegemonic science norms struggle to fully relate to and embrace them. We argue that this tension in students' identity work contributes to *alienations* of highly motivated and ambitious women from participating in biology and natural science practices and discuss how our findings speak to Avraamidou and Schwartz's (2021) question of *who is allowed in science*.

Ahmed (2016) discusses how *alienations* from a world work as a 'mode of directionality, a way of orienting bodies in certain ways' (Ahmed, 2016, p. 43). In our analysis, we could show how Willow, Iris, and Lilian are confronted with, relate to, and are directed by celebrated collective imaginaries of legitimate participation in HEB, including performances and competences that are not aligned with how they understand themselves. Negotiating oneself in relation to dominant narratives means to renegotiate boundaries, doing boundary work as ways that place people 'outside their comfort zones' (Carlone et al., 2015, p. 1524). The three women become directed to leave their comfort zones, sacrificing private lives, values, and their health, constraining them to fully embrace the academic science practice. Who is allowed in science? Those who are willing to sacrifice.

As highlighted in further work by Avraamidou (2020a), 'science identity is not an identity on its own; its meaning derives from a complex, polycontextual, emotional, and intersectional self' (p. 341). Students continuously negotiate themselves and their values in and out of the contexts the very values emerge in; in this case biology contexts that are historically, culturally, and social constructed (Günter et al., 2021). The students' identity work is also emotional work that is mentally exhausting (Lilian is exhausted by performances of imagined legitimate science identities), that is disappointing and upsetting (Willow when sacrificing her private life and still not getting the job), and unsettling and dissociating (Iris who does not want to draw on competences that she considers dishonest). Jessica Wren Butler (2021) proposes the concept of unbelonging to describe how students are oriented towards and alienated from imaginaries of hegemonic academic practices. Unbelonging is 'the experience of disconnection, dislocation, disjunction between the self and one or more aspects of the immediate or wider environment' (Wren Butler, 2021, p. 19), an experience that the students, despite considering themselves successful, negotiate. Who is allowed in science? Those that build a science identity, despite negotiating unbelongings.

As highlighted above, emotional identity work is intertwined with intersecting axes of power, such as gender, ability, and class – it matters who we are when negotiating collectively shared imaginaries about practices that reach beyond recognitions of performances and competences. Avraamidou (2020a) puts forward that 'the danger of not acknowledging emotions is that forming a science identity becomes a dehumanizing experience' (p. 338). While the data analysis in this study was grounded in the three science identity pillars of competence, performance, and recognition, our findings demonstrate the emotionality of these negotiations and how a sensitivity for emotions helps us understand students' lived experiences. We show examples for where students cross boundaries in order to receive recognition and where hegemonic imaginaries about science lead to directing students into alienation and dehumanisation. One student, Oakley, finds words that ask for humanising experiences, saying, 'Biology must become better at seeing the human beings behind it', a call to rethink who is allowed in science. A call for action.

Concluding remarks

In this study, we map out typical stories of biology practice that students across HEB contexts imagine and negotiate. While they are collectively imagined as recognised, they are

negotiated in conflicting ways by Iris, Willow, and Lilian, troubling their identity work. A focus on competences and performances, as well as their recognition helped us to make visible tensions in the three women's science identity work, yet we also show how science identities are strongly intertwined with the emotional and with the personal. It is here the professional and the private sphere overlap despite hegemonic discourses of science as an objective culture of no culture. Students as human beings experience dehumanisations through scientific practices. Matters of identity become political.

Retaining women and other minoritised groups in the sciences is not a phenomenon that is unique to for instance physics (e.g. Avraamidou, 2022), but also present in biology (e.g. Eddy et al., 2014). We show that and how successful women students in HEB do troublesome identity work, constantly negotiating boundaries while maintaining a sense of belonging. They want to pursue a career in science, *despite* the tensions they experience when negotiating hegemonic recognised competences and performances. Our findings thereby provide more evidence for a need to rethink recognised competences and performances in science education contexts, and even more so prompt reflections on practices of recognising participants in science to be human beings.

As bell hooks (1994) wrote, 'I have witnessed a grave sense of disease among professors (…) when students want us to see them as whole human beings with complex lives and experiences, rather than simply seekers after compartmentalized bits of knowledge' (p. 15). Our study provides further evidence that and why it is important to transgress compartmentalisations of knowledge and the knower and to see the students as whole human beings. Concluding this article and inspired by the concept of figured worlds, we want to ask: What if there were worlds of higher biology and science education, in which being human was at the centre of the practice?

Limitations

This work helps us to further understand biology students' identity work when negotiating hegemonic norms of doing science. Yet, several limitations provide openings for further research, three of which we want to highlight here.

Methodologically, timeline interviews bear the risk of forcing stories into a simplified linear shape that overlooks inherent complexities (Adriansen, 2012). This kind of 'straightness' of imagined trajectories can also be found in biology students' narratives as described in Günter et al. (2021). However, narratives of linear trajectories were not necessarily prompted by starting with a straight timeline, but often emerged independently in students' texts. In this study, we could at several points observe how participants noticed this emerging linearity to not represent their actual trajectories leading them to de-constructing and re-constructing their timelines. Hence, and when conducting the interviews, the interviewer could pay particular attention to emerging linearities, probing if they were artefacts caused by the timeline or as an organic shape of their trajectory.

Furthermore, while conducting a cross-national study, interviewing students across academic contexts, we do not explicitly compare culture-specific narratives and discuss them, but were interested in cross-cultural and collectively imagined ways of being in worlds of HEB. Respecting and appreciating the students' generosity, resulting in rich empirical material, a cross-national comparative approach would strongly contribute to bodies of knowledge in science education.

We first describe imaginaries that are collectively shared across gender identities, class-backgrounds, age, and ability. However, we chose to make visible how three white women with different class backgrounds experience tensions when negotiating these collectively shared ideas. While some of these axes of power and oppression intersect for Lilian, Willow, and Iris, this study would have benefited significantly from including more diverse perspectives as well as an explicit intersectional lens to better understand students' identity work in sociocultural worlds of science education.

Note

1. We use the term *imaginary* (plural *imaginaries)* as a noun, rather than *imagination* in order to emphasize the students' ideas and narratives about biology as a practice to be situated within the larger socioculturally and historically constructed societal practices, that are marked by for instance gender (Rahm, 2016).

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Geolocation information

This work was conducted when the first author was placed at the Centre for Gender Research, Uppsala University, Villavägen 6, 752 36 Uppsala.

Ethics statement

This manuscript resulted from a study, which has been approved by the Swedish Ethical Review Authority (Etikprövningsmyndigheten, 2020-04470).

Data availability statement

Due to the nature of the data and in order to protect the participants' anonymity, the data supporting the findings are not publicly available. However, the anonymised data can be obtain upon reasonable request from the corresponding author.

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