



“Quite ironic that even I became a natural scientist”: Students' imagined identity trajectories in the Figured World of Higher Education Biology

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Abstract

Studying biology entails negotiating knowledges, identities, and what paths, more or less well-trodden, to follow. Knowledges, identities, and paths within the very practices of science are fundamentally gendered and it is, therefore, critical to recognize when exploring students' learning and participation in natural sciences. Even though students' numbers in undergraduate Higher Education Biology are female-biased, it does not mean that gendered processes are absent. In this study, we focus on early undergraduate biology students' identity work at a Swedish university, analyzing 55 study motivation texts discursively. Embedded in a Figured Worlds framework, we explore how students imagined and authored themselves in(to) the Figured World of Higher Education Biology along two imagined identity trajectories, the Straight Biology Path and the Backpacking Biology Path. While the first and numerically dominant imagined trajectory entails typical stories of a scientific child striving toward a research career, the latter recognizes broad interests and biology competences to be collected in a backpack for transdisciplinary use. Students imagining the Backpacking Biology

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Path authored themselves in relation to and explicitly *not* as having a linear trajectory, which positions the Straight Biology Path as dominant and culturally recognized. Our findings reveal gendered myths about science practices present in Higher Education Biology, yet also contested through alternative imaginaries. We, thereby, show that it is crucial for Higher Biology and Science Education to be aware of how students imagine their trajectories and how they negotiate masculine norms of science to create spaces for diverse and alternative identity trajectories.

KEYWORDS

discourse analysis, figured worlds, gender, higher education biology, identity trajectories, identity work

1 | INTRODUCTION

Higher Education Biology (HEB) is one of the natural science disciplines at university level with a numerical female bias among undergraduate students in countries such as the United States and Sweden (Eddy & Brownell, 2016; Statistiska Centralbyrån, 2019). However, during the transition from entering HEB into working within academia and reaching senior academic positions, the number of women decreases at Swedish universities from about 64% on undergraduate to 30% on professor level (Statistiska Centralbyrån, 2018, 2019). Eddy and Brownell (2016) highlight that an undergraduate numerical domination of women easily leads to the assumption that the problem of gender (in)equalities is nonexistent and that gender disparities are absent from classrooms (see also Eddy et al., 2014). Reaching numerical gender equality does not mean that gendered processes are absent. Such gender-neutral discourses have been described as rather hiding and denying the disadvantaging of women and minority groups (Eisenhart & Finkel, 1998). It has furthermore been shown that gender gaps resulting from gendered processes are evident in representations in higher positions in academia (Eaton et al., 2020; Fisher et al., 2000; Leslie et al., 2015; Moss-Racusin et al., 2012) and that especially when it comes to participation, achievement and attitude, gender differences still exist in higher science and higher science education (Scantlebury & Baker, 2007).

Natural science disciplines (especially physics and chemistry) have been criticized for their androcentric practices, gender stereotyping, and the hegemonic idea of an inherently objective nature of scientific research (Fox Keller, 1985; Haraway, 1988; Harding, 1986; Schiebinger, 1993). Fox Keller (1985) describes a strong interconnectedness between the construction of science, notions, and norms of masculinity, and the “intellectual endeavour” of science (p. 92). Within biology, Harding (1986) emphasizes natural sciences to be a “social phenomenon (...) created, developed, and given significance at particular moments in history and particular cultures” (p. 84) and highlights an asymmetrical organization of gender in how biological theory is constructed, how biological research is conducted, and what people within biology research are valued. In the context of STEM, as well as social science and humanity disciplines, Leslie et al. (2015) analyzed female participation and found persisting stereotyped field-specific ability beliefs connected to brilliance. Particularly women and African Americans were believed to be less talented and brilliant and therefore less suitable for higher academic positions. According to them, stereotypical beliefs of brilliance and talent required when participating in Higher Education (HE) practices may discourage the aforementioned groups from participation. Consequently and even though biology is a numerically female-biased HE discipline on undergraduate level, it can nonetheless still be considered embedded in



inherently masculine social and cultural norms of natural science (Harding, 1986) that influence disciplinary identities of people in intersecting ways depending on gender, race, and ethnicity (Hazari et al., 2013).

In Swedish HE, educators are obliged to work toward creating inclusive spaces and to educate a diverse student body with different backgrounds and intersecting identities (Higher Education Ordinance, Högskoleförordning, 1993). Processes of both inclusion and exclusion are tied to social hierarchies, distributions of power, and intersecting social categories that position people in different ways, resulting in some positions being more recognized and privileged than (Crenshaw, 1994; Staunæs, 2003) or dominant over others (Gonsalves et al., 2019). To be recognized as certain kinds of people, all of us draw on different resources and discourses and negotiate how we relate to them—we do identity work (Gee, 2000; Jackson & Seiler, 2013, 2018). Doing identity work has been described to be a crucial part of people's trajectories toward central participations in communities of practice (Lave & Wenger, 1991) and competence, performance, and most of all recognition to be central pillars of becoming members of the scientific community and when developing a science identity (Carlone & Johnson, 2007). Exploring students' identity work can thereby disclose explicit and implicit ideas about what is considered recognizable (Carlone et al., 2014), as well as how students' previous experiences influence their positioning within HE communities (Holmegaard et al., 2014). The concept of identity work inherently assumes a fluidity of identity and recognizes the importance of gender and gendered processes, as well as other social categories and their intersectionalities (Carlone & Johnson, 2007; Staunæs, 2003). Furthermore, and as Brickhouse (2001) suggests, identities are gendered and gender is an inseparable part of what we desire for ourselves and our futures.

Using identity perspectives in higher science education research has gained momentum over the last years, especially in the context of numerically male-dominated subjects such as engineering and physics (e.g., Danielsson, 2009; Gonsalves et al., 2019; Johansson, 2018). Through the lens of science identity, it is possible to explore students' imaginaries of higher science and biology education, and thereby to map out norms within science and biology as a discipline. Science identity research, including life sciences and HEB, has also increased (e.g., Cotner et al., 2017; Hazari et al., 2013; Hudson et al., 2018; Le et al., 2019) and when interviewing biology students from five introductory courses in a US-American context, Le et al. (2019) found that students draw on both "inclusive and elitist discourses" (p. 13) when working with their science identities. Jackson and Seiler (2013) demonstrated that the science program, which includes biology, is often considered elitist and does not leave much space for latecomers who are then forced into peripheral participation. These studies highlight the complexity of students' development and negotiations of their science identities. In line with previous theorizations of identity, we consider identity not to be a trait that someone possesses but an ongoing process of negotiation of identity work (Carlone & Johnson, 2007; Staunæs, 2003).

Biology interests, attracts, and recruits a majority of female students to start a bachelor's degree. We, therefore, want to explore early undergraduate students' imaginaries of the Figured World of Higher Education Biology at the beginning of their enculturation and socialization into HEB. This study focuses on how students imagine and figure the World of Higher Education Biology in their study motivation texts (SMTs), written in their first undergraduate biology course. We analyzed what typical stories in identity trajectories the students imagine in their narratives as well as how they relate themselves to these imagined typical stories and trajectories. The results contribute to an emerging understanding of how biology students' identity work is affected by gendered processes and norms of and within natural science practices.

2 | THEORETICAL FRAMING

2.1 | Communities of practice and identity work

Positioning this study in sociocultural learning theory, acquiring disciplinary content knowledge cannot be disconnected from the social environment in which learning takes place. We learn to recognize and to be recognized

as “particular kinds of people” (Gee, 2000, p. 110) in communities of practice (Lave & Wenger, 1991) that value certain competences and performances and share common goals. Competence, performance, and their recognition are central to the construction of science identities (Carlone & Johnson, 2007) and their construction is an ongoing process of identity work, rather than a fixed state or in a core sense of self (Gee, 2014).

2.2 | Figured Worlds and imagined trajectories

To explore biology students' identity work at the beginning of an enculturation and socialization into HEB, we embedded this study in the heuristics of Figured Worlds. Figured Worlds are “socially and culturally constructed realm[s] of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others” (Holland et al., 1998, p. 52). These worlds can, on the one hand, represent taken-for-granted norms that influence, yet not dictate participation (Hatt, 2007), while they on the other hand, allow for norm-challenging improvisations that constantly reshape the worlds' landscapes (Holland et al., 1998). Using the concept of Figured Worlds furthermore allows us to theoretically underline that worlds of higher science education are historically shaped and culturally and socially constructed.

Gee (2010) operationalized the concept of Figured Worlds in a discourse analytical frame, prompting to reconnoiter the generic figures and participants constructed in communications. Figured Worlds are simplified “typical stories” that vary between people with different social and cultural backgrounds (Gee, 2010, pp. 174–175) and can also be described as “simulations in the mind” (Gee, 2014, p. 97) through which we prepare for participation in future actions. However different for different individuals, the lens of Figured Worlds can also display people's shared understandings of the very worlds and what is imagined to be typical and typically nontypical stories for these worlds. Applying this tool, we could analyze both what biology students recognize as norms and deviant from the norm, which provides ground for discussions on how those imaginaries shape current and future imaginations of the self (Chaffee & Gupta, 2018). Holland et al. (1998) describe a sequence of events that is taken-for-granted in their example of the Figured World of Romance (p. 53). Engaging these storylines, imagined sequences of acts and events, we theorize identity work in relation to trajectories (Jackson & Seiler, 2013; Wenger, 1998) and could sharpen our analytical lens through examinations of students' *imagined identity trajectories*.

Imagined identity trajectories, sequences of acts and events, are an essential part of how the students recognize and author themselves as (becoming future) members of a community of HEB practice (Carlone et al., 2014; Gee, 2000; Lave & Wenger, 1991). Students display “who they claim to be” (Holland et al., 1998, p. 138), who they claim they were, and who they claim to become through language. Gee (2000) highlights that the words we use are based “on stories, theories, or models in our minds about what is ‘normal’ or ‘typical’” (p. 174). The students thereby position themselves in relation to discourses that they can make sense of (Hall, 1997), stories that they consider typical, which visualizes what past, current, and future stories are available to them (Jackson & Seiler, 2013). Among these imagined typical stories, some are more recognized than others. Hall (1997) describes that,

individuals may differ as to their social class, gendered, racial and ethnic characteristics (among other factors), but they will not be able to take meaning until they have identified with those positions which the discourse constructs, subjected themselves to its rules, and hence become the subjects of its power/knowledge (p. 56).

Acknowledging the power of certain discourses and what typical stories these discourses leave available to different kinds of students, we open up for making both dominant and alternative imagined typical stories and identity trajectories visible.



2.3 | Feminist science critique and masculine science practices

We argue that the abovementioned power structures in science are culturally and socially shaped as well as historically rooted in masculine norms and androcentric perspectives of science (Fox Keller, 1985; Haraway, 1988; Harding, 1986; Schiebinger, 2000). Fox Keller (1985) maps out the circularity of an ideological internalization process in which science becomes connected to a constructed “masculine” (p. 92) that then, in turn, gets valued through the connection to science. Even though revealed and challenged by feminist science critics, masculine internalizations, norms, and values remain repeated and persist hegemonically as, what we here call *cultural myths of science* in what constitutes natural science practices and the people who engage with those practices (Archer et al., 2014; Danielsson & Gonsalves, 2018; Kelly, 1985). Using “myths,” inspired by Becher and Trowler (2001) and Taylor (1976), yet in a feminist theoretical way, we want to emphasize the historically and ideologically shaped androcentric pasts (Andermahr et al., 2000) of a science culture that influence imaginaries of current norms in science practice. Biology as a natural science discipline, even though numerically female-biased among undergraduate students, is not excluded from norms and immune to myths of scientific practice. Thereby, the very identity work of participants in HEB cannot be disconnected from the described circularity, but is historically, culturally, and socially connected to gender. Hence, being in biology and negotiating science identities becomes inseparable from working with gender and gendered myths of science.

3 | METHODOLOGY

3.1 | Participants' background and educational context

Upper-secondary school education in Sweden (called “gymnasium”), is a 3-year program with among other Natural Science (naturvetenskapsprogrammet) and Social Science (samhällsvetenskapsprogrammet) majors. Students graduating from a Natural and Social Science program are eligible to enter the undergraduate biology program at the Swedish university in our study. Though, when graduating from a Social Science program, students have to start their bachelor's (B.Sc.) program with a one-semester introductory course in bioscience.

The first biology course in the B.Sc. program at this Swedish university is a course on evolutionary organismal biology with an integrated communication training part. The latter continues throughout students' undergraduate education and its first exercise is to write a one-page long so-called *study motivation text* (SMT) in Swedish. The students are asked to reflect on their study choice, describe their expectations for the program, and map out their future career plans. Students also write about why they chose this university and elaborate on skills they think they need as biologists. Additionally, students with a social science entry expand on if and how their expectations were met when taking the preceding mandatory bioscience course and a semester of chemistry. As the SMTs form the basis for mentoring talks with a teacher in biology, we consider them actions of writing in the interaction with a recognized other, a language-in-action (Gee, 2014). When writing their texts, students thereby also position themselves for the teacher who reads their texts.

3.2 | Data collection

SMTs were not written for research purposes, therefore, we asked students from cohorts between 2014 and 2018 for their informed consent to analyze their texts in this study. In total, we collected 55 SMTs out of which 30 were written by female students with a natural science, 9 by female students with a social science, 13 by male students from natural science, and 3 by male students from social science entry. While most of the students in our study graduated from Swedish gymnasias, one student highlighted that they had a Swedish background but spent their gymnasium years abroad.



3.3 | Data preparation and analysis

We anonymized the texts, labeled them “A” and a randomly assigned number between 1 and 99. We removed all indicators of the students' gender¹ for the first part of the analysis to acknowledge the authors' positionality (Sultana, 2007). This also facilitated going beyond notions of gender differences during the first part of the qualitative analysis (Andersson & Johansson, 2016; Shen, 2013). Analyses were done on the original texts in Swedish, both manually on printed copies as well as digitally in NVivo (2018). For publication, all included quotes were translated from Swedish to English by the first author and verified by the native Swedish-speaking co-authors with particular attention to preserve the meaning rather than the wording of the translated text sections.

The qualitative analysis was done in two steps. In an initial and empirically driven coding step of the anonymous texts, we searched for “analytical leads for further exploration” (Saldaña, 2015, p. 115) and general themes within the empirical material, paying special attention to similarities and differences in the students' narratives. This exploratory analysis yielded themes such as “nature,” “understanding of higher education,” “biologist,” “interest,” and “breadth of biology.” In this initial coding step, patterns of narrative chronologies started to emerge which together with the identified themes provided leads for the second and theory-driven analysis.

Embedded in critical discourse analysis, we then employed Gee's (2010) Figured World and Identities Building Tools in a second analysis step. First, the Figured World Tool encouraged us to focus on what people, actions and interactions, language, and values the students considered typical (Gee, 2010). This made it possible to visualize their imagined typical stories of the recently entered space of HEB. In this part of the analysis and engaging Holland et al.'s (1998) description of sequences of events in worlds, we identified two *imagined trajectories* within the Figured World of Higher Education Biology. Second, applying Gee's (2010) Identities Building Tool prompted us to pay attention to which identities the students wanted to be recognized for *the selves*. This lens directed our focus from the typical or nontypical in the world to how the students *related themselves* to the typical or nontypical in the world. Combining the two tools helped us shed light upon what imagined identity trajectories the students constructed, how they related themselves to typical stories within, and ultimately, how they related these typical stories and trajectories to each other. In several cases, we identified typical stories within the imagined trajectories that were constructed as “more typical” and thereby dominant over others (Gonsalves et al., 2019).

After we had identified typical stories imagined by the students in the theory-driven coding step, we could map out how students connected them chronologically. In doing so, we found texts that only or predominantly imagined a chronological order of typical stories. These we then labeled as the Straight Biology Path (SBP) or the Backpacking Biology Path (BBP) trajectory. Other texts did not construct a chronological trajectory and drew on both sets of typical stories. These texts were categorized as “both.” The three trajectory categories (SBP, BBP, both) were then quantitatively analyzed against students' program entry and gender. Using a χ^2 test in RStudio, we tested for differences in frequencies of students of a certain entry or gender in relation to the three trajectory categories. One text could not be categorized as neither of the categories mentioned above and was consequently not included in the analysis. The quantitative analysis showed a tendency of female students to draw on the BBP and male students to draw on an SBP. We, therefore, returned to the students' texts both qualitatively and quantitatively not removing indicators of students' gender. We quantitatively analyzed which texts were categorized as the Straight or the Backpacker Biology Path (or both) resulting from the anonymous analysis. This made it possible to visualize tendencies in what was imagined as typical and by whom. Thereby, we could nuance the analysis, exploring

¹Through the students' social security number, the current legal gender is identifiable and was therefore removed from the files and texts. Names and pronouns used in the texts indicating students' gender identity were also removed.



which students contributed to shaping the landscapes of and typical stories in the respective imagined identity trajectory. Taking the students' gender into account consequently pointed toward gender biases in how students imagine the World of Higher Education Biology.

4 | RESULTS

In the Figured World of Higher Education Biology, we could identify two imagined identity trajectories, the SBP and the BBP. In the following, we map out three typical stories about the selves which characterize the respective imagined identity trajectories more closely and which were constructed by the students along each of these imagined paths. We then expand on how the students related themselves to these imagined trajectories and the trajectories to each other. We thereby demonstrate what typical stories and trajectories are imagined by the students as more recognized and how they get positioned in the Figured World of Higher Education Biology.

4.1 | The SBP

The SBP trajectory is characterized by typical stories along a seamless and chronological transition from an interested and scientific, yet naïve child to understanding larger contexts, becoming a knowledgeable person with specific interests, and striving toward a specialization. In this trajectory, participants have always been scientific, sometimes even before remembering the self.

4.1.1 | The Scientific Child

Recognized in the SBP was a Scientific Child that has always been, meaning never not been, interested in nature and/or biology. This strongly valued "alwaysness" is reinforced by, for example, A06 who wrote, "[m]y parents said that I have always had an aptitude for biology and when I was younger liked it a lot to look at animals and watch documentaries." A06 uses the parents' description of the child-self as a resource to show that there is no self that precedes that scientific self. An interest in watching documentaries is part of being the Scientific Child, as well as recognizing particular nature-related programs such as National Geographic (A43) and people in them like David Attenborough (A90). Interests were highlighted as collectively shared. A23 emphasized the interest in objects such as dinosaurs, as they had a big interest in dinosaurs "like many others." A44 also emphasized a very strong, voracious fascination for dinosaurs in their narrative. Books were recognized objects for the Scientific Child in the SBP. However, a difference was made between "ordinary books" (A85) and popular scientific literature that the Scientific Child reads "thoroughly" (A44). This underlines that the use of not just any, but scientific books from the beginning of the SBP trajectory is recognized.

Also, knowing the name of animals is valued for the Scientific Child. A90 reasons about how knowing the names of a bird is connected to interest, rather than knowledge:

When I was about 5 years old, I was left with an acquaintance who was babysitting me. It was summer and we went around in the garden when we all of a sudden saw a bird in a tree. 'Look what a pretty bird,' my babysitter called out and pointed up at the tree. 'That is not a bird that is a blue tit,' I responded innocently. This little story I have heard many times after that—it apparently is still equally entertaining. This anecdote, I find, fits as a good example for interest and knowledge (but most of all interest) for animals and nature, which I have inherited and learned from my father. (A90)



Highlighting that A90 was *innocently* responding to the comment of the babysitter by stating the name of the bird underlines that identifying and knowing it is a given for the Scientific Child, an inherited knowledge. A44 describes further activities and values of the Scientific Child such as being active in and having a closeness to nature in combination with an intrinsic curiosity. Some students elaborate on their thoughts about closeness to nature, narrating that their interest has developed when growing up in close proximity to nature (A06) such as on the grandparents' farm (A47).

As other students with an imagined SBP, A47 had access to outdoor activities and outdoor clubs as well.

I was a member in Friluftsrämjandet [Swedish Outdoor Association] for many years and have hiked in the mountains, climbed mountains, built shelters, and kayaked. In my free time I have always been drawn to nature with walks or running or just for some quiet time in the forest. (A47)

Outdoor activities such as hiking, kayaking, diving (A43), and going for walks (A43, A85) were highly recognized activities for the Scientific Child in the SBP.

4.1.2 | The Self-Evident Science Student

This typical story in the SBP entails developing an awareness of contexts, interrelations, and bigger pictures. Understanding wider contexts and interactions, more complex systems and fundamental concepts as well as *how* things work is a transitional position of the SBP trajectory. In a few cases, teachers are explicitly recognized as mediating this transition during secondary school. A52 highlights that the teacher fostered interest and curiosity, as a former researcher in genetics:

The teacher I had was unbelievably good at making me more and more interested in the subject. He is a biologist himself and has done research in genetics, something I directly became curious about. I most often felt that I did not need to study biology at home as much as other subjects because I understood quickly in the lessons. Instead, I read out of my own interest. (A52)

In the SBP, learning biology and doing biology comes naturally to the participants. One does not have to study as hard as in other subjects and it is the participants' own, intrinsic interest that leads to reading beyond the curriculum. It is also in comparison with other students that learning biology was easier for them. A93 connects that interest and the knowledge attained to both parents being biologists, which led to them being more interested in biology and inherently better than their classmates.

Interest is a frequent concept of high value, present throughout the texts. It is part of the descriptions of a transition toward biology university studies and plays a major role in choosing biology as a subject to study. A52 summarizes the value of interest by referring to a PhD student in their family, a meaningful scientific other, speaking from an insider position. A52 wrote, "I got to hear of a relative who is PhD student in biotechnology that biology is not an education that one chooses by coincidence, but that one chooses most often because one is very interested in it." Again, interest is what is recognized. In this case, it is not about having an easy time with biology, or the already existing understanding of the subject; it is an almost innate interest, which is both a necessary and sufficient prerequisite for studying biology.

For a majority of the students narrating their selves in this manner, the decision to study biology came at the latest during gymnasium and we found a tendency in the SBP to narrate a taken-for-granted study choice. Choosing biology is not considered a coincidence but rather self-evident. Being interested in and good at biology and the natural sciences comes naturally and makes even the choice to study biology a self-evident and easy one.



4.1.3 | The Academic Science Student

After describing a transition from a Scientific Child toward entering HEB, students no longer narrate an interest in animals and nature. It is no longer a naïve, but a deeper understanding of biology content and concepts as well as biology as an academic discipline with different subdisciplines that is valued and connected to the use of higher language registers. We identified three different areas of recognized competence for the Academic Science Student. The first area of competence was knowing and using biology key concepts and terminology. The use of concepts like biodiversity (A44), immune response (A21), niche, and ecosystem (A37) showed that understanding and using this terminology was recognized. The second area of recognized competence refers to the university as a well-known international university that has “really good reputations [where] many definitely have aspirations to study” (A06). This displays both an understanding but also a figured recognition of the university's quality and reputation as well as knowledge about academic competition and status of this particular university. The third area of recognized competence was knowledge about education and program structures. Participants in the SBP often narrate a desire to continue in a Master's program, aspiring to a researcher career. To become a researcher, A52 wants to continue their studies and displays both, knowledge and a concrete interest in specific subjects to pursue after the bachelor's degree. Additionally, they plan to study biochemistry and mathematics, recognizing that those subjects are beneficial when wanting to go into genetics. Higher biology is generally figured as being connected to other STEM (Science, Technology, Engineering, and Mathematics) subjects and an interconnectedness of natural science disciplines is recognized as being particularly difficult. A37's narrative showed that a certain level of difficulty was expected and that if that level is not reached, a legitimate reaction is disappointment:

The chemistry semester I have enjoyed a lot and the work in the lab suited me well. Therefore, the studies were not as heavy as the chitchats before implied (not only I had that reflection but also my classmates even though there were some that really struggled). I was disappointed by that and felt understimulated in a completely unnecessary and bad way; that is why I am studying math fulltime in parallel now. (A37)

The Academic Science Student builds on both the Scientific Child and the Self-Evident Science Student in the SBP. In this trajectory, it is a given that one has an easy or easier time going through natural science programs than what a seemingly generally known idea implies. A37, however, also highlighted that there were other students for whom it was not as easy. By connecting to a group in a shared narrative (others that experienced it to be easy) and making a difference between the self that had an easy time, and others that had to work hard (and struggled), the student emphasized even more that there is a taken-for-granted idea about the Academic Science Student to have a proclivity to natural sciences in general and biology in particular, to whom knowledge comes easily, almost intuitively. It is also narrated as an experience shared with others for whom it was easy and who thereby have access to this typical story. The student's disappointment and highlighting to study math in parallel and fulltime is a consequence of being understimulated. This is what A37 imagines as recognized, as a legitimate way of doing something against being understimulated, biology undergraduate studies and chemistry being too easy, and rather being stimulated appropriately when studying math as well.

In the chronologically constructed Straight Path Trajectory, students imagine themselves as always having been a Scientific Child to developing a deeper understanding of the world as the Self-Evident Science Student and finally navigating university biology and science with a clear and narrow career goal as an Academic Science Student. Narratives of an almost born-to-be biologist suggest an underlying idea of “alwaysness” as a taken-for-granted model where one has *always* been an interested, curious, intellectual, and scientific person with the choice of studying biology at university and having an easy time doing so as a *natural* consequence.



4.2 | The BBP

In the students' texts, we found narratives that constructed a trajectory different from the SBP. In the BBP trajectory, choosing to study biology is often described as happening through inspiration during certain life events and not necessarily during childhood and in school. Biology competences act as a knowledge foundation to build on and to combine with other skills and knowledges in the future. The subject of biology was recognized as broad and breadth to be a useful resource for later decisions on what to continue with or, if even, specialize in. In this trajectory, participants' interests are recognized as being more cross/trans/interdisciplinary, connected to environmental and health subjects, politics, ethics, or philosophy, as well as to activities such as diving and photography. Filling a backpack with knowledge and skills was a metaphor used by students in this study and inspired the name of the BBP trajectory.

4.2.1 | The Explorer Student

Recognizing the breadth of biology as a subject and program as a resource is central to the Explorer Student explaining why they want to study biology, what they expect from their studies, and how they imagine making use of their education. After writing that the choice to study biology was not a straightforward one, A24 continues:

The choice ended up being biology because it is a broad subject in a positive way. Good for me who does not 100% know what I want to work as but anyway knows a little what I want to work with. Most important for me is to be able to work with the conservation of nature (and the environment). (A24)

Students describe to *not* have a clear-cut goal as to whether they want to pursue an academic career or what to specialize in later, in their trajectories, when starting to study biology. They use the disciplinary breadth of biology as a resource either to explore subdisciplines within biology or to take the accumulated knowledge into an environment outside of HEB. Students do not recognize themselves as already having that particular and narrow interest, deep knowledge, or already set goals for specialization after their studies as described for the SBP. Instead, education is recognized to support one's personal development and exploration of environments and knowledge, as well as to be able to support one's opinion scientifically in discussions and to underline one's arguments. Yet, another recognized benefit constructed to be of value for the Explorer Student is highlighted by A65 who wrote that knowledge in biology can be used to "make a change" in environmental degradation and biodiversity loss. University studies are imagined to support the students in understanding the process of environmental change and how to solve problems arising through, for example, climate change. A26 describes that they want to build a scientific knowledge foundation and strive toward an education that contributes to a better future, which is valued generally for the BBP.

4.2.2 | The Transdisciplinary Student

Making connections to other disciplines is at the core of the Transdisciplinary Student. A01 expresses the hope to combine their biology education with the humanities and A05 goes further stating, "I am still a humanist in my heart and it is not going to disappear, but I have also always been a natural scientist which led to my many casts from different programs since gymnasium." It is the very negotiation of *not only* being a natural science person, as a singular natural science identity, but also a humanist. This quote we will return to below. In the BBP, a transdisciplinary interest that exceeds and compliments natural sciences is a central part of negotiations of the self and the Transdisciplinary Student. Students did not only narrate themselves as for instance being both, a humanist and a natural scientist, but also talked about concrete examples of how they want to use knowledge from their biology studies in a transdisciplinary way. This can be in combination with other natural science disciplines and math, as



A26 writes in the context of becoming a biologist, “it of course takes an understanding of and knowledge in for example chemistry and mathematics because that goes hand in hand.” But it can also be that students narrate wanting to combine their biological knowledge beyond natural science disciplines such as A46 who wrote that they want to “dedicate [themselves] to engage with one unexpected but interesting project and immerse [themselves] in important life questions (philosophy and ethics).” This typical story is not constructed around being a natural scientist which includes the notion of being good at all distinct natural science disciplines and math. It is rather constructing disciplines as fluid and intertwined and the self as being transdisciplinary even rather than interdisciplinary. Combining biology and writing, a combined interest for the humanities and biology, delving deeper into important life questions, as well as supporting politicians consultatively are goals of the Transdisciplinary Student and valued in the BBP, using biology knowledge in variegated and multilayered contexts and projects.

4.2.3 | The Winding Student

Several students with BBP trajectories mention at the very beginning of their texts that their educational history did not follow a straight path, but was “multi-colored” (A05), “everything but” (A16) or rather winding than “straight.” In the very first line of their text, A24 highlights that studying biology was not an obvious choice:

To become a biologist was not a clear-cut choice from the beginning. I went back and forth between different directions but have still always stayed within animals, nature, and environment. After working and travelling for a few years, I started to read more about different educational programmes. (A24)

In comparison to the SBP, it is more common that interest in biology as a subject that one can professionally engage with and study, was discovered after being in school. Narratives included notions of having been fascinated by, interested in, or close to for instance nature and animals, however, less strongly attuned to the “alwaysness” of being a scientific nature person which even precedes the own memory as described in SBP. Some students discovered their interest long after graduating from gymnasium and when for example traveling. A74 described a sudden realization of a long-term interest in the sea and plants and the “beautiful nature” in connection to a general fascination that had been there before. For them, however, these interests were not considered a subject for HE. These notions were found in a broader context of showing rather little familiarity with academia and academic structures.

Students drawing strongly on the BBP were at times describing the self as a natural scientist but also emphasized that natural science courses were difficult for them and not coming naturally (A01), as well as explicitly stating that they were not good at math (A74). A01 wrote “some subjects were harder than others because I do not have a certain ‘talent’ in the natural science disciplines.” This illustrates the underlying idea about beliefs of others to have an innate talent for natural sciences and biology as well as being good in those subjects and mathematics as something that is recognized in opposition to the self who does *not* and is *not*. It is central to the Winding Student to know about the norms of a straight science path, innate natural science talent, as well as narrow interests and the goal of specialization, yet opposing these norms. Opposing many other students that they construct as already knowing what to specialize in, in an almost set-in-stone manner, A01 understands the program’s breadth to help shaping future understandings and goals:

[A]s opposed to many others, what I have heard, I am not sure about what I want to specialize in during my education. I think that I maybe have an idea now that later might change as the education proceeds. (A01)

It is not about specializing in a certain biology subdiscipline, but about finding out how existing interests can be developed. However, writing that they think they have an idea again visualizes the tension between the typical stories imagined in the SBP, having a clear and narrow science goal, and those imagined in the BBP, having space for an uncertain



future, and how they are related to each other. Here, a typical story from the SBP reappears in the BBP as typically nontypical; being on a winding path and not having clear-cut goals being typically nontypical. Typical stories from the SBP thereby become imagined as dominant over the typically nontypical stories in the BBP. What typical stories become imagined dominant over others and by whom we will explicitly return to in the following section and in the discussion.

4.3 | Gender biases in the two imagined identity trajectories

In this section, we explore the two trajectories resulting from our analysis above disclosing students' gender and applying a gender lens both quantitatively and qualitatively. In a quantitative step, we analyzed texts assigned to the two imagined identity trajectories in relation to the students' gender and program entry to then qualitatively unfold how these quantitative tendencies were visible in the texts.

4.3.1 | Numbers of students assigned to the SBP and BBP according to entry and gender

We found that of the 54 texts in the analysis, almost half (46%) were assigned to the SBP, 35% assigned to the BBP, and 19% categorized as drawing on typical stories from both trajectories (Table 1). There was no significant difference related to whether students had a natural science entry or a social science entry into the university biology program and whether their texts were assigned to the SBP or the BBP (Fisher's exact test, $N = 44$, $p = 0.71$; Table 1). Independent of study entry, we compared the number of female and male students' texts assigned with the SBP or BBP. We found a tendency for male students' texts to more frequently be assigned to the SBP, whereas female students' texts were more evenly distributed between SBP and BBP (Pearson's chi-squared test with Yate's correction $\chi^2 = 3.36$, $df = 1$, $p = 0.07$; Table 1). It is notable that of the 19 BBP texts, a majority, that is, 89%, were written by female students.

These findings suggested us to go back to the material and qualitatively unfold nuances in how female and male students imagine trajectories in the Figured World of Higher Education Biology.

4.3.2 | Taking gender into account

As laid out in Table 1, we could find that primarily female students both shape the landscapes in and draw on typical stories of the BBP trajectory. While 17 texts of female students (44% of all female texts) were categorized as

TABLE 1 Number of texts, and percentages in brackets, assigned to the straight biology path (SBP), the backpacking biology path (BBP), or both and total, in relation to study entry of the participating biology students (a; Fisher's exact $p = 0.71$) and gender (b; $\chi^2 = 3.36$, $df = 1$, $p = 0.07$)

	SBP (%)	BBP (%)	Both (%)	Total (%)
Entry				
Natural science	21 ^a (49)	15 ^a (35)	7 (16)	43 (80)
Social science	4 ^a (36)	4 ^a (36)	3 (27)	11 (20)
Gender				
Female	15 ^b (38)	17 ^b (44)	7 (18)	39 (72)
Male	10 ^b (67)	2 ^b (13)	3 (20)	15 (28)
Total, n (%)	25 (46)	19 (35)	10 (19)	54 (100)

predominantly imagining a BBP trajectory, only two of the male students' texts (13% of all male students' texts) were likewise. Consequently, mainly female students display tensions of explicitly authoring the selves as *not* having a straight path, by not relating to an alwaysness of being a science person, and a narrow interest for their future.

The article's title "Quite ironic that even I became a natural scientist" refers to a female BBP-categorized student text (A16) with a strong natural science family background, who wanted "to find [her] own way" and *not* study natural sciences. After exploring other subjects, she ended up in the biology program anyway—something A16 described as being "quite ironic" and to happen after being on an "anything but straight" path. This is one example which illustrates the idea of an innate proneness for science and a consequent straight path into biology that can be challenged and rejected, yet in her case unavoidably leads into a science trajectory anyway. Even though we could find several female students predominantly drawing on SBP trajectories, it was mainly female students in the BBP trajectory who explicitly figured themselves as *not* having natural talent and a proneness to follow narrow natural science paths, their typical stories being imagined as typically nontypical. A16's example, however, can also be read as a culturally shaped idea about the self as having to be a certain kind of person, a science person, to legitimately participate in science negotiating the self in relation to typical stories of the SBP as dominant stories along imagined identities trajectories. A16 finds herself in the negotiation of not having a linear path, yet imagining a certain proneness that led to her finding back to biology, a path that yet is "anything but straight," anything but one-faceted, and typically nontypical. This is also highlighted by the female student A05 who wrote that her path was "multi-colored" as opposed to single-colored (deriving from a Swedish idiom) and linear. These negotiations of *not* being the typical, imagining the self as typically nontypical, were present in several female students' texts. Another example that makes these negotiations in relation to the SBP visible is a female student, A01, who explicitly describes that she, as opposed to many others, does not have a clear career goal and narrow specialization interest as mentioned above.

The SBP trajectory is shaped by 15 female (38% of female texts) and 10 male (67% of male texts) students' narratives. Even though not invisible in female students' texts, this set of chronologically narrated typical stories is thereby particularly prominent in the SMTs of male students. One student figuring the self as an Academic Science Student wrote about being understimulated in the introductory bioscience course and university studies to not being as challenging as expected. Notions of biology to be easy and knowledge coming naturally were constructed as recognized by the Academic Science Student and tied to the preceding Scientific Child and the Self-Evident Science Student. This line of argument, drawing on a strong "alwaysness" of interest and being a certain person with an intuitive (read easy and effortless) understanding for biology and science and a taken for granted choice to study biology dominates how male students in this study negotiate their identities.

In the SBP, we can see a tendency of narratives aiming toward continuing in HE with a Master's or a PhD degree and imaginaries of the future to be centered around steps on the academic career and research ladder. We again find these notions in both female and male students' texts, however, aspiring to a science career was particularly recognized by male students. A15, a student who loves to study biology, emphasizes that it does not matter what kind of researcher he will become, but that it is "for sure" that he wants to become "some kind" of researcher. A96 goes even further and talks about the self as already being part of the science community by explaining that he wants to share his work with "other colleagues" with which he positions himself as a central participant in the practice.

The tension between a not only numerically but also discursively dominant and taken-for-granted science trajectory of the SBP and an alternative imagined identity trajectory of the BBP, which is constructed in relation to the SBP, will be at the center of our discussion.

5 | DISCUSSION

Our findings suggest several directions for discussion. First, they direct us toward discussing the imagined trajectories found in the students' Figured World of Higher Education Biology and particularly how typical stories within imagined trajectories were related to each other, what typical stories were imagined as typically nontypical.



A second direction is how historical and cultural masculine myths of science emerge in the students' identity work and imagined identity trajectories. In our discussion, we aim at combining these two directions to acknowledge their intertwined character, to discuss temporalities of identity work, and how students in this study imagined and connected their past, present, and future imagined identities.

In the SBP that emerged from our analysis, we found imaginaries of a proneness for natural sciences connected to beliefs in talent and brilliance (Leslie et al., 2015) that already are present in early undergraduate years. This reminds of the discursive masculinity performance of the "young professor" described by Archer et al. (2014, p. 12). According to Archer et al. (2014), young professor identities were characterized by "displays of knowledge and superior intellect, particularly in relation to science and mathematics" and students to position themselves as "mature" (p. 12). The way the SBP students narrate being a naïve scientific child and developing into mature and knowledgeable science participants as well as already centrally participating in the very science practice, draws on and reproduces the myth of a born-to-be a scientist or "young professor." It reproduces ideas of the scientist as someone with raw innate talent and a narrow subject interest, which is deeply rooted in Western and masculine norms of science (Scantlebury & Baker, 2007). Even though not prompted by the instructions for writing the SMTs, the students here heavily figure an early, yet naïve proneness to then become and already be intellectual professionals as natural scientists and future researchers with narrow specializations. Hasse (2008) describes physics researchers to understand childhood experiences to be the initial step for a career and the development of a professional identity. However, particularly the imagined recognition of innate scientific talent was hypothesized and confirmed to be an underlying factor in the gender distributions in STEM subjects (Jackson & Seiler, 2013; Leslie et al., 2015). When notions of raw talent and brilliance are considered crucial for being successful in a science field by practitioners, Leslie et al. (2015) describe that we find fewer women PhDs; in other words, those who are not stereotyped as embodying myths of masculine-coded raw scientific talent and owning brilliance may be discouraged from participation.

Central to the BBP trajectory is the collection of knowledges in a backpack for academic or nonacademic use. Rather than recognizing a myth of innate talent, narrowness of interests, and an alwaysness of being a science person for the selves, it is broad and transdisciplinary interests, explorations of educational landscapes that are valued. Thus, not necessarily talking about and considering themselves as latecomers, the students in the BBP often do not come straight out of school but have, for instance, studied another subject before or have vocational training, which in that sense makes them late(er)comers. Jackson and Seiler (2013) followed three latecomers over the time of one year and described the science program to be figured as elite which did not leave particularly much space for central participation in science if students were marked as, as they say, "atypical." In our study, we could find that a non-straight path was labeled as typically nontypical, which indicates a hierarchy in discourses, the SBP to be dominant over the BBP. We could find a variety of ways in which particularly female students figuring a BBP trajectory related themselves to typical stories highlighted in the SBP. Most prominently, students explicitly marked themselves as nontypical, as deviating from the norm, when they referred to themselves as *not* having a particular talent and a narrow interest (e.g., A01) as well as *not* having a linear or straight educational path (e.g., A16). At the same time, when authoring themselves as *not* (only) being an imagined natural science person with a straight path, as A05 does, drawing on alwaysness (connected to typical stories of the SBP) provided a tool to legitimize themselves as still being the right "kind of person." In contrast, narrating the selves as *not* being a particular kind of person is rare in typical stories of the SBP. One student makes ideas about "the other" to a straight path identity and the centrality of raw talent imaginaries visible by explicitly mentioning that for him and many of his peers, biology was easy and un(der)stimulating (owning raw talent), while highlighting that others struggled (*not* owning raw talent). The very absence of negotiations of what one is *not* for students drawing on an SBP other than *not* struggling, displays the taken-for-granted in and power of these dominating stories of innate talent. Thereby and not only through the numerical domination of the SBP over the BBP, but especially through BBP students relating to the SBP and not vice versa, we could show that students construct and recognize the dominating typical (read the SBP) and the typically nontypical (read the BBP) in the Figured World of Higher Education Biology.



Constructing imagined trajectories as typically nontypical and opposing the SBP when constructing the BBP trajectory has two consequences. First, such constructions position the SBP and its typical stories as superior to the BBP. Second, the tendency of female students to shape the landscapes of BBP trajectories and male students to heavily draw on SBP trajectories reproduce the very circularity of the ideological internalization process described by Fox Keller (1985) in which science becomes connected to a constructed masculine that then, in turn, gets valued through the connection to science, leaving some people as typically nontypical, them “to deviate from the well-trodden paths” (Ahmed, 2016, p. 52).

However, students drawing on the BBP create spaces for alternative trajectories, alternative typical stories, and alternative paths. Creating legitimacy to refuse dominant discourses, they thereby also create spaces for alternative identity work. Carlone (2004) describes students that accepted dominant science paradigms as well as those that rejected them when exploring if alternative and broader school science would lead to more inclusive ways of doings of science. Answers to the question of who gets to participate successfully, Carlone (2004) concludes, are not straightforward and both broader and “prototypical” meanings to be reinforced. However, the rejection of the promoted “Western, masculine worldview” in science, thus not science itself, has been described particularly for girls and women (Scantlebury & Baker, 2007, p. 279). When exploring ways of doing science, it is important to shed light on both the reinforced and rejected. The SBP trajectory reinforces and reproduces hegemonically narrow spaces for participation, while the BBP trajectory bears the potential to diversify HEB, rejecting hegemonically narrow spaces, suggesting alternatives.

Mapping out the two paths in this study, we could show *implicit* gendered imaginaries about HEB. Fisher et al. (2020) describe that even though biology was not explicitly perceived as gendered by students, they still experienced and described *implicit* gendered biases, which resonates with our findings. Johansson (2018) emphasizes the risk of not seeing perspectives from those that do not strive toward a narrow physics identity and rather resist them. We, in line with Johansson (2018), argue that if educators are less attentive to perspectives from those that do not strive toward a narrow identity, they especially risk to be blind to what BBP students, and thereby often female students, imagine as recognized identities. This ultimately contributes to the circularity of gendered ideological internalization process and maintains gendered hierarchies in natural science and natural science practices which contributes to the hegemonic idea that a specific kind of science identity is valued over others.

Using an eclectic framing of *imagined identity trajectories* within the Figured World of Higher Education Biology and focusing on constructed typical stories within made it possible to explore temporalities along which students constructed the described trajectories. We could find that students draw on past, present, and future imaginaries of recognized selves in their identity work. Imaginaries and ideas of past selves influence present identities, but so do imaginaries and ideas of possible future selves (Markus & Nurius, 1986; Strahan & Wilson, 2006). We, therefore, argue that it is important to not only explore currently present typical stories in students' imaginaries and how they are gendered. What students imagine in the present for their pasts and possible futures is equally important when analyzing how gendered processes influence students' identity work. Acknowledging that students' imagined trajectories are subject to change, the students also construct their identities retrospectively in different and ever-changing ways. In an analogy of traveling in a car on a winding road, Holmegaard et al. (2014) illustrate “the road behind the car appears at a different angle through the rear-view mirror” (p. 767) as much as new opportunities and directions can be seen ahead through the windshield at different times. However, this also assumes a road to be there in the first place, it has its history. We could find that even on paths and roads in worlds of biology, a natural science discipline with female-biased undergraduate participation, the very road is built upon and enclosed by normatively masculine foundations and guard rails.

6 | CONCLUSIONS AND IMPLICATIONS

In this article, we mapped out two both opposing and sometimes overlapping storylines described as imagined identity trajectories in the Figured World of Higher Education Biology. In the imagined trajectory of the SBP, students presented three chronologically aligned typical stories of the Scientific Child, the Self-Evident Science Student, and the Academic



Science Student. An already scientific child develops an understanding for bigger scientific contexts and transitions into having a professional interest and language to talk about biology, becoming knowledgeable about program and academic structures, and ultimately wanting to pursue a science career. Rather than having a straight educational path, narrating an innate talent for natural sciences, and having specialized interests, the BBP trajectory develops around the idea of filling backpacks with knowledge, skills and experiences, exploring biology, and imagining to combine biology with other disciplines and interests, opposing ideas of narrow specializations and innate talent. Typical stories constructed in the BBP are the Explorer Student who seeks to discover biology and values the breadth of the discipline as a fundament upon which further knowledge can be built. As a Transdisciplinary Student, disciplinary borders are transgressed and biology knowledge and skills in non-biology contexts and projects recognized. The Winding Student actively opposes notions found in the SBP such as an innate talent and narrow interests. The explicit opposition and rejection by BBP students of the SBP is particularly interesting as it shows shared ideas of participants in this world that are positioned in an imagined intradisciplinary hierarchy of recognition that strongly builds on historically rooted masculine-coded norms and myths of science. BBP students, which more often are female, draw on alternative imaginaries to the dominant SBP trajectory. Not recognizing these alternative narratives and who figures themselves as typically nontypical may consequently mean to a lesser extent recognizing female students' aspirations in biology.

We could map out how students' identity work is entangled with gendered myths of natural science practices, temporalities of identification of the selves, as well as how alternatives for being in and doing biology are constructed. It is important to recognize that students have a variety of ways of seeing themselves in the past, present, and future and that they already enter HEB with hegemonic ideas about what it means to do science and who it is that does science. Our study indicates that students negotiate their identities in gendered spaces of science practices, which requires educators and facilitators to provide a spectrum of strategies for the students. The questions, therefore, remain if and how educators take into account the diversity of imagined identity trajectories as well as how students' identity trajectories develop during their education. If our goal is a diverse higher biology education, we need to pay attention to the imaginaries held by both students and teachers and how we contribute to the reproduction or reshaping of exclusive and inclusive worlds. As Haraway (cited in Angus et al., 2001, p. 198) stated, "We are living in a world of connections—and it matters which ones get made and unmade."

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DATA AVAILABILITY STATEMENT

The data supporting the findings of our study are available upon reasonable request and from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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