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# “I am a young immigrant woman doing physics and on top of that I am Muslim”: Identities, intersections, and negotiations

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## Abstract

Framed within intersectionality and using science identity as a unit of analysis, in this single case study I explore the barriers, difficulties, and conflicts that Amina, a young Muslim woman, immigrant in Western Europe confronted throughout her trajectory in physics and the ways in which her multiple identities intersected. The main sources of data consisted of three long biographical interviews, which were analyzed through a constant comparative method. The analysis of the data provided insights into how intra-personal, interpersonal, sociocultural factors, alongside a myriad of experiences nurtured Amina's intersectional identities and what this may mean for Muslim women's participation in physics. The findings are summarized in two main assertions: (a) Amina was confronted with various barriers across her journey in physics with the intersection of religion and gender being the major barrier to her perceived recognition due to cultural expectations, sociopolitical factors, and negative stereotypes and (b) Amina's social class, religion, gender performance, and ethnic status positioned her as Other in various places throughout her trajectory in physics, and consequently hindered her sense of belonging. These findings suggest the urgency and importance of: (a) examining the intersection of science identity with other

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identities, especially, religion, gender, and ethnicity for the purpose of extrapolating a more comprehensive understanding of how minoritized groups participate in science; (b) rethinking recognition through an explicit intersectionality lens across various geographical and sociopolitical contexts; and (c) transforming physics into a diverse world where multiple ways of being are recognized, where minoritized groups will not have to compartmentalize parts of their identities to exist, and where they can perform their authentic and intersectional identities.

**KEYWORDS**

intersectionality, life-history, Muslim women, physics, science identity

## 1 | INTRODUCTION

Sometimes I feel that the students don't take me so seriously...they easily stereotype and they easily ignore me...I have to raise my voice. Why? Because I am a young woman in a Physics department. I am an immigrant, and on top of that I am Muslim.

These are the words of Amina, a young, immigrant, female physicist in academia in Western Europe, whose journey in physics I attempt to narrate through this life history, single case study. Amina's words probably echo many other women's voices, and even though I do not attempt to offer any generalizable claims through this study, I argue that it is likely that these voices represent a more collective reality connected to the underrepresentation of women, especially minoritized ones, in the sciences. In what follows I discuss why women's underrepresentation in the sciences is a problem of current urgency in Europe, especially.

Knowledge and skills in science, technology, engineering, and mathematics (STEM) are crucial for dealing with current societal and economical challenges, such as, climate change, biodiversity loss, and sustainable energy. It is therefore not surprising that Europe, where this study is situated, will need 1 million additional researchers in STEM by 2020 (European Commission, 2015). The problem, however, is twofold: Europe is not only facing a shortage of scientists, but there is also a persisting trend of underrepresentation of women among STEM university students and graduates (European Institute for Gender Equality, 2017). As a matter of fact, although the number of university students in STEM (science, mathematics, ICT) rose between 2003 and 2013, the gap between women and men remained consistent throughout this period: women are 50–70% less likely to complete a master's degree in STEM subjects than their male counterparts, and twice as many STEM male graduates continue to STEM employment than female STEM graduates. According to data from Eurostat, in 2014, women mainly graduated in health and welfare, humanities and arts, along with social sciences, business, and law. In contrast, men graduated in engineering, manufacturing, and construction-related fields, followed by technology, science, and math. This is problematic given evidence that the lack of gender diversity limits workplace performance (Eurydice, 2011) and that a more equal participation in STEM is desirable from both an economic and gender equity perspective.

The problem of the underrepresentation of women in STEM is not specific to Europe. Early in 2018, the UNESCO Institute for Statistics (UIS) produced a tool that visualizes gender gaps in the pipeline leading to a research career, from the decision to carry out a doctorate degree to the fields of science that women pursue and the sectors in which they work. What this tool illustrates is that in every region of the world, women researchers remain the minority in STEM fields. The numbers are striking and illustrate that the underrepresentation of women in sciences is still intact on an international level. As statistics reveal, only 30% of the world's STEM researchers (engaging in research and experimental development) are women, and this percentage drops to 17% when it comes to physics, which is the focus of this study. Interestingly, statistics show that while a growing number of women are enrolling in university, many opt out at the highest levels required for a research career. The problem, however, is not related to girls' aptitude for STEM professions. In looking at test scores across 67 countries and regions, Stoet and Geary (2018) found that girls performed about as well or better than boys did on science in most countries, and in almost all countries, girls would have been capable of college-level science and math classes if they had enrolled in them. The question then becomes one of why and how are women constructed as outsiders to STEM? How does that influence their persistence? For science education especially, this question is translated into an exploration of the kinds of experiences women have throughout their lives, which might hinder their participation in STEM. In this study, I am interested in exploring minoritized women's participation in physics, one of the fields in which women are the least represented. I explore participation in physics through the construct of science identity, broadly defined as how an individual sees herself as a science person and how she is recognized by others (Carlone & Johnson, 2007). By adopting an intersectional approach, I examine the ways in which science identity intersects with other identities (i.e., gender identity, religious identity, social-class identity, and ethnic identity), and influence Muslim women's participation in physics.

## 2 | PURPOSE

Quite a few researchers have contributed empirical evidence and theoretical conceptualizations concerning the factors affecting women's university decision-making processes in regards to STEM fields, including social stereotypes and institutional variables (Levy, 2016; Nasir, McKinney de Royston, O'Connor, & Wischnia, 2017; Ong, Smith, & Ko, 2018; Rainey, Dancy, Mickelson, Stearns, & Moller, 2018). Another set of studies have examined female university student's physics identities and career aspirations (Hazari, Brew, Goertzen, & Hodapp, 2017), university students' gender performance in physics classrooms (Danielsson, 2012) and doctoral students' positioning around discourses of gender and competence in physics (Gonsalves, 2014). These studies serve to inform the design of this study, which aims to examine the impact of different experiences, various social markers, and the intersection of multiple identities on a Muslim woman's (Amina, a pseudonym) participation in physics.

In attempting to explore the impact of different experiences on Amina's journey in physics, I pay special attention to how her ethnicity, gender, social class, and religion have intersected with her developing science identity. While in this study, I place an emphasis on how gender plays out in the life of Amina, I acknowledge that "gender" alone, which has been used to frame the majority of studies examining women's participation or representation in physics, provides a limited and partial understanding of why women choose not to engage with physics or to opt out of physics-related careers. Instead, for the purpose of this study, I adopt intersectionality as a theoretical framing and I aim to examine how science identity intersects with other identities. This deeper and comprehensive

understanding of how different identities and social markers might influence women's science career trajectories allows us to shift the focus away from a single-dimensional model where gender alone is considered. For the case study reported in this manuscript, the ways in which Amina's religious identity, ethnic identity, gender identity, social class, and science identity intersect is central. This is precisely where the contribution of the study lies as it provides insights into an under-explored research area: Muslim women's experiences in physics. A deep and comprehensive understanding of how different experiences might influence Muslim women's trajectories in physics offers us insights that are useful when critically examining minoritized women's underrepresentation in science.

### 3 | THEORETICAL UNDERPINNINGS

#### 3.1 | Intersectionality

For the purpose of framing this study, intersectionality is understood as a concept and is used to highlight the inseparability of categories of social differences such as race, gender, ethnicity, and social class (Crenshaw, 1989). Intersectionality also calls for an emphasis on the systemic power dynamics that arise as multiple dimensions of social difference interact across individual, institutional, cultural, and societal spheres of influence in relation to women's participation in science (Collins, 2000). As a term, coined by Kimberlé Crenshaw in 1989 to counter the disembodiment of Black women from Law, intersectionality captured the inadequacy of legal frameworks to address inequality and discrimination resulting from the ways race and gender intersected to shape the employment experiences of black women. This study parallels common ways that black feminist theorists conceptualize intersectionality even though the participant of the study is not Black. In this study, intersectionality is used as a framework to examine how Amina's multiple identities intersect and eventually hinder or support her participation in science: science identity, ethnic identity, religious identity, social-class identity, and gender identity. Ringrose and Renold (2010) argued that feminist researchers invested in understanding women's experiences must continue to develop intersectional approaches that challenge "regulative gender and (hetero)sexual discourses, as these are cross-cut by race, class, cultural and other specificities" (p. 591).

For the study reported in this manuscript, an intersectionality lens is important because of the need to capture the complexity of this extrinsic case that deviates from the norm in different ways. Amina is someone who belongs to multiple minority groups: as a young woman in a predominantly masculine field; as an individual who grew up in a working-class family that did not provide any specific resources for her to participate in physics; as a Muslim in a social context where Islam is generally perceived negatively; and as an immigrant in a white European culture. In Amina's words, as a minority individual in these different communities, she feels like "a constant outsider" who has to navigate through unfamiliar contexts, institutions, norms, structures, and systems where she finds herself in a non-privileged and powerless position. Such complex social positioning can only be examined through intersectionality.

#### 3.2 | Gender performativity

A set of studies in the area of gender and physics, specifically, have explored differences between men and women studying physics; however, they have treated "gender" as a stable category and focused on the differences between the two genders rather than variations within each gender (Danielsson, 2012). Such a conceptualization of gender is also problematic because it views gender as a homogeneous and

heteronormative category, which excludes other genders, such as transgender, non-binary genders, and so forth. Moving away from this binary conceptualization of gender, in this study “gender performativity” and “gender intelligibility” are used as conceptual tools for understanding the context within which women scientists produce gender identities and the social pressures they may experience to perform particular identities, specifically normative, socially sanctioned identities (Davis, Gonick, Gottschall, & Lampert, 2014) especially in the context of male-dominated STEM fields (i.e., physics) as well as in the gendered representation of science. In a study examining people's perceptions of gender issues and access to physics, Francis et al. (2017) identified how the construction of physics as a masculine subject is articulated via five different narratives: (a) certain subjects are stereotyped as being masculine or feminine (and hence as appropriate for different genders); (b) men and women are naturally different and drawn to different subjects accordingly; (c) femininity is antithetical to (masculine) manual work; (d) Femininity as superficial; and, (e) cleverness is masculine and physics is a clever/difficult subject. Inevitably, these narratives associating masculinity with physics have created gendered roles for men and women in physics communities (Gonsalves, Danielsson, & Petterson, 2016). The problem with such an association and narratives is that certain bodies or feminine performances of gender are excluded or less accepted in specific spaces, such as in the world of physics.

These narratives serve to inform the design of the study where gender is viewed as a social construction instead of a personal trait. The concept of gender performance questions the “essence” of gender roles and stereotypes, as, for example, that physics is for men or that women ought to give up their femininity if they want to succeed in physics. Hence, gender identity is viewed as a performance or construction made up of behaviors and roles which are then assigned to a specific gender (Butler, 1990). In conceptualizing gender as performance, in this study, I examine how Amina self-identified in relation to her gender identity, the ways in which she performed her gender, and how that performativity influenced her recognition by others as a physicist. Hence, in looking for evidence of Amina's gender performance I looked at her study and career choices, behavior, speech, dress, power and relations in her life story.

## 4 | EMPIRICAL UNDERPINNINGS

In the past decade, there has been an increased and growing interest in science identity research in different places of the world (Avraamidou, 2016). As argued elsewhere, the construct of science identity is greatly important when studying engagement with science because identity offers itself as a tool for examining the ways in which various cognitive and affective experiences influence the ways in which individuals might see themselves as science persons (Avraamidou, 2014). This study is conceptually framed within Carlone and Johnson's (2007) model of science identity which consists of three dimensions defined as follows: (a) competence: knowledge and understanding of science content; (b) performance: social performances of relevant scientific practices; and (c) recognition: recognizing oneself and getting recognized by others as a science person. This conceptual model of science identity framed the design and the analysis of the data of this study, as it was used to examine how these three dimensions exist and intertwine to shape Amina's science identity with special emphasis on recognition. Recognition becomes of special interest when exploring minoritized individuals' participation in science because of its political dimension, given that it is inextricably bounded to societal norms and cultural values (Avraamidou, 2019).

## 4.1 | Recognition of ethnically and racially minoritized groups

Quite a few studies have offered empirical evidence about the importance of recognition especially for minoritized groups in STEM (e.g., Carlone & Johnson, 2007; Johnson, Brown, Carlone & Cuevas, 2011). In a study with 17 Latina undergraduate STEM majors in the United States, Rodriguez, Cunningham, and Jordan (2017) showed that participants, at times, were successful in their pursuit of outside recognition by peers and faculty, but at other times, they were questioned. Specifically, the participants' competency in science was often questioned because they did not fit the stereotypical STEM profile. For example, male peers sometimes questioned their competence and failed to recognize Latinas as valuable members of the STEM community, while the lack of Latinas within STEM disciplines influenced the faculty's overlooking of Latinas as possible members of the community. This is in agreement with the findings of a study conducted by Johnson, Brown, Carlone and Cuevas (2011) that examined how three women of color (Latina, Black, and American Indian) who worked in science-based professions in the United States, came to author their identities. The findings of this study showed various conflicts that the participants had as women of color in constructing their science identities related to lack of recognition and being assigned undesired identities, such as: loud black girl, not competent in science, being disregarded, feeling excluded etc. An exploration of how lack of recognition and assigning undesired identities might hinder recognition is at the heart of the account of this study, which aims to explore what served as barriers to Amina's recognition as a physicist and how she navigated between desired and undesired identities throughout her life.

## 4.2 | Sources of recognition

Recognition was found to be the most important construct of identity in predicting a choice of a career in engineering in a study aimed at understanding the impact of physics and mathematics identities on engineering choice, (Godwin, Potvin, Hazari, & Lock, 2016). In a follow-up study, Hazari et al. (2017) examined when female undergraduates in physics ( $n > 900$ ) in the United States became interested in physics careers through a survey. The findings showed that the highest percentage of participants became interested in physics careers during high school and sources of recognition included: self-recognition, a perceived recognition from others, and a perceived recognition for other students around them. Interestingly, the most important source of recognition appeared to be the participants' high school teacher, which points to their crucial role in supporting students develop strong physics identities. In a related follow-up study, Wang and Hazari (2018) examined the recognizing strategies applied from high school physics teachers, who participated in a related workshop, and the patterns of the students' physics identity development following the workshop. Through an analysis of surveys and interviews, the researchers identified two strategies that may influence the process of internalizing recognition for students: explicit recognition (e.g., making claims about students' abilities) and implicit recognition (e.g., students' presenting their work to significant others). Similarly, in this study, I examine what factors and individuals served either as sources or barriers to recognition for Amina and how these supported or hindered her identity trajectory in physics.

## 4.3 | Masculine nature of physics and recognition

Recognition is directly related to the representation of physics as a masculine field (Danielsson, 2012; Gonsalves, 2014). Gonsalves (2014) examined the identity trajectories of 11 men and women, doctoral students in a physics department in Canada through an analysis of observations, photo-



elicitation, and life-history interviews. The findings of this study showed that recognition was important to the formation of their identities especially in thinking about themselves as physicists. In addition, the findings revealed that women were positioned as “Othered” because of gender norms, while some women were found to be compromising their feminities and performing gender neutrality or “androgynous” performance in order to fit into the dominant culture of their department. These findings exemplify the problem of the construction of physics as a gender-neutral discipline, which is tolerant of a range of expressions of masculinities, but allows only limited forms of expressions of femininity (Danielsson, 2012). In a study with five women studying physics at a Swedish university, Danielsson (2012) examined how they negotiated their doing of physics and their doing of gender through an identity lens. The findings revealed that all participants engaged in gender negotiations, which were associated not only with masculine norms but also with feminine forms. Specifically, the participants had to negotiate expectations about how a woman is supposed to be in a physics context, as for example, neat, diligent, following the rules, and carrying out secretarial duties. Building upon these findings, in this study I explore Amina's gender performativity in different contexts for the purpose of shedding light on the ways (if any) in which Amina negotiated her gender performance and how that intersected with her science identity throughout the journey in physics.

#### 4.4 | Religion and race as barriers to recognition

Besides gender, the intersection of religion and race has proven to be a barrier to recognition of individuals' as science persons. A search of related literature shows that there are no studies that examine the recognition of religious students or scientists in the context of physics. However, studies in the context of undergraduate biology and high school show that religion does indeed serve as a barrier to recognition. Barnes, Truong, and Bronwell (2017) examined the ways in which students' experiences related to their religious identities could impact their retention in biology. The study took place in the southwest United States where the researchers interviewed 28 undergraduate biology majors, who incidentally were all Judeo-Christians. The analysis of the data indicated that even though the majority of the participants felt accepted and respected in biology classrooms, they also experienced struggles related to the fact that they were religious. Some participants experienced discomfort when instructors made anti-religious comments or when their peers laughed at their expense and mocked religion. Other students felt they might not fit in with the biology community and that they were in a disadvantaged position because biologists would not take their work seriously, and so their scientific work would not be regarded as valuable. Essentially, this points to the fact that students feared their religious identities would serve as a barrier to their recognition as competent science persons by others.

In a study aiming to explain Somali high-school students' perception and experience of racialization in the United States, Abdi (2015) interviewed nine high-school Somali immigrant and refugee students about their school experiences. Even though science was not the focus of the study, its findings offer useful insights into how religion and race might serve as boundaries and as key factors to being recognized as “different”—essentially, a constant negotiation of identity and experience. For Somali students, as the researcher argued, this is more pertinent because they are immigrants, they are Black, and they are Muslim. The findings of the study showed that while some of the lived experiences of difference were based on visibility of race and religion, other differences such as accent, immigrant status, and academic ability also showed to be important in the participants' lives. Moreover, the findings illustrated how the intersection of these identities served as a means for marginalization and feelings of exclusion. One of the boys felt excluded because of his being black,



while for one of the girls the reason was that she was wearing the hijab. What the findings of this study show is how difference becomes a bodily experience. In this study, the students perceived their bodies as unacceptable by others in specific places, conveyed in the words: “you know when you are not wanted, just by the look on their faces” (p. 74). This points to the fact that these Somali students' experiences were shaped by socially ascribed identities based on both religion and race, which offers further evidence for the need to examine identities at their intersection and not in isolation. The ascribed identities and perceived recognition by others in specific places at the intersection of multiple identities is of special interest to this study.

#### 4.5 | Social class and science self-identification

Besides gender and ethnicity, social class is another factor or structural force that might influence STEM engagement. In a large-scale study situated in the U.K. examining what shaped 12-13-year-old students' science and career aspirations, Archer, DeWitt, and Wong (2014), found that socio-economic classification is directly related to students' science aspirations and STEM career choices. The researchers used the construct of “cultural capital” to make sense of students' social class, which they defined based on parental university attendance, leaving school before 16, the number of books in the home, and visits to museums. The findings of their study showed that as cultural capital increased, so did aspirations in science. Similarly, as parental occupational background increased, so did aspirations in science. As the researchers concluded, working-class girls especially, tended to possess lower levels of cultural capital making it even more difficult to see science as something that people like them to do—essentially, being recognized as science persons. These findings shed light on the importance of examining how social class might influence science participation; a factor that remains largely unexplored especially in science identity research. In this study, I examine Amina's social class identity alongside the cultural expectations that her working-class identity raises.

### 5 | GAPS IN KNOWLEDGE BASE AND RESEARCH QUESTIONS

Collectively, the findings of existing studies provide evidence that the recognition of women, ethnic minorities, people of color, and religious individuals is problematic. Specific findings cut across these studies and can be summarized in the following arguments in the need for further research on how the intersection of identities shapes recognition:

- An examination of race matters since, historically, people of color have been marginalized from science and have experienced discrimination due to stereotypes and biases (Haytar-Adams, Fracchiolla, Finkelstein, & Hinko, 2018; Nasir et al., 2017);
- An examination of gender performativity matters because specific scientific fields remain masculine and heteronormative where individuals who do not perform their genders in such ways are excluded (Calás, Ou, & Smircich, 2013; Danielsson, 2012)
- An examination of ethnic identity matters because ethnic minorities have been consistently positioned as disadvantaged in science participation (Nasir et al., 2017);
- An examination of religion matters because a religious identity serves as a barrier to recognition given the cultural perception that science and religion are in conflict (Barnes et al., 2017)
- An examination of social class matters because students' science aspirations are directly linked to and shaped by their parents' socioeconomic status, meaning that students from lower social classes

(i.e., economically disadvantaged) are not likely to aspire to have science careers (Archer et al., 2014)

Of these identities, the intersection of race and gender has received quite a lot of attention in the field of science education while religion and especially Muslim identity, remains unexplored. As a matter of fact, a review of the literature shows that there exists a wealth of research examining the science experiences of women of color. However, the knowledge base of Muslim women's experiences in physics remains desolate. Most importantly, what is missing in the literature is an examination of how different identities at their intersection might support or hinder Muslim women's engagement with physics. A call for more explicit attention to intersectionality as a framework for studying engagement with physics was put forward by Traxler, Cid, Blue, and Barthelemy (2016) in the context of post-secondary physics education research tradition. These researchers identified three limitations of research that has examined gender differences in participation, performance, and attitudes towards physics. As they argued: "This work does not question whether the achievements of men are the most appropriate standard; individual experiences and students' identities are undervalued; and, the binary model of gender is not questioned" (p. 020114-1). In attempting to address these limitations in existing knowledge base, the researchers offered various recommendations, including the adoption of more intersectional and feminist theoretical frameworks, a conceptualization of gender as performance, and science participation through the lens of science identity. Following on these three recommendations, this study aims to do just that: to provide empirical evidence about the ways in which a Muslim woman's ethnic identification, religious identity, social class, and gender identity shaped how she views herself as a physicist and how she is recognized by others. In doing so, the following research questions are addressed:

- How did Amina form her science identity throughout her studies- and career-trajectory in physics and what served as a barrier to her (perceived) recognition by others?
- In what ways have Amina's multiple identities intersected throughout her studies and career trajectory?

In responding to these questions, I aim to contribute to a gap in existing literature on science identity and Muslim women's participation in physics given that there are currently no studies examining the life-histories of Muslim women in physics. Such an approach promises to shed light on how Muslim women participate in physics, especially in places where they minoritized, by offering a comprehensive, situated, and dynamic exploration of their science identity trajectories across time and within various places.

## 6 | METHODS

### 6.1 | Science identity as a lived experience

This study is framed within a life history or biographical research design, which is situated in cultural–historical activity theory (Vygotsky, 1978). Roth and Tobin (2007) argued that by framing identity within the cultural–historical activity theory, identity becomes an outcome of dialectically engaging in practical activity, rather than being an innate property of individuals. From this perspective, who a person is cannot be divorced from taking into account the social contexts of the environment. Such a perspective is especially important for the purpose of this study given its emphasis on

how recognition, conceptualized as input from various social contexts, affects the formation of science identity. For the purposes of this study, identity is conceptualized as a *lived experience* (what Vygotsky referred to as *perezhivanie*) which is used to describe the ways in which people perceive, experience, and process the emotional aspects of social interactions. As such *lived experience* presents a dynamic, fluid, and complex unit of analysis between personality characteristics and environmental characteristics. Lived experience is used to emphasize how: (a) cognition/thinking/meaning are inextricable from feelings/emotions/sense and (b) learning and experience are intrinsically situated in a matrix of life trajectories and ecological transactional aspects throughout one's life (Esteban-Guitart & Moll, 2014). At the heart of the account of this framework is a conceptualization of identity as a *dynamic process of becoming* instead of a product, and an emphasis on the affective domains of the pathways through which scientists come to form their identities. By conceptualizing identity as a lived experience, emphasis is placed on how Amina's multiple identities intersect and the ways in which experiences situated in various contexts impact or hinder the formation of her science identity.

## 6.2 | Research design

This study seeks to illuminate experiences based on the intersectional identities of Amina, a purposefully selected participant, who is currently a physics instructor at a higher education institution in Western Europe. For the design of this study, I chose to employ a qualitative single case study research paradigm to allow for Amina to give voice to her own identities and experiences. As defined by Merriam (1998), case study is “an intensive, holistic description and analysis of a single instance, phenomenon, or social unit” (p. 21). In this study, the phenomenon under study is the underrepresentation of women in science and the case is Amina's life history. The value of a single case lies in the opportunities for the readers “to experience vicariously unique situations and unique individuals” (Donmoyer, 1990, p. 193). Focusing on only one participant allowed for deep and detailed explorations of the complex processes and dynamics of the formation of her science identity and how it intersects with multiple other identities. More specifically, by adopting a single case study research design, I was able to closely and thoroughly describe, document, and interpret events as they unfolded, and to determine the incidents that were critical to Amina's life history as a scientist. Moreover, in addressing life history narratives in an intersectional analysis, I argue about the importance of life-story narratives and the potential of taking everyday life as a point of departure when adopting an intersectional methodology. As Christensen and Qvotrup Jensen (2012) argued, life-stories are important in empirically approaching not only constructions of identities but also the role that social structures play in people's lives, not as separate entities or distinct categories but as mutually constitutive and interrelated. This is precisely what this study aims to do by examining Amina's intersectional identities throughout her journey in physics.

## 6.3 | Who is Amina?

Amina is 35 years old, and for the past three years (2015–2018) has been living and working at a higher institution in Western Europe. In this context, Amina self-identifies as a White Muslim woman. Even though Amina is technically White, she does not fit neatly into the Western white racial category as Western Europeans do especially in terms of privilege and power. Her sexual orientation is heterosexual, and her ethnic identity is Turkish. She has been wearing a hijab throughout her life, which, as she said, forces her to explain a lot about herself in her everyday and professional

life, as a minority in both contexts. Amina was born in the eastern part of Turkey where Kurdish generally live and she moved to the west when she was three. As a Kurdish-Turk living in the west, where Turks lived, she belonged to the ethnic minority group of the country. Even though she grew up in the western part of Turkey, she was raised with eastern traditions, which translates to living in a progressive context of the country and being raised with more traditional and conservative values. Her parents are both conservative and religious. Three of her siblings are college graduates, and two of them graduated from high school. She characterizes her family as being working class. Her father used to work as barber who depended on a very low income, and her mother was a housewife. Her family had to live in a rental house up until 2010 and her oldest sister worked and supported the family financially for several years. Amina was able to financially support her studies through a scholarship that she received from the government and a non-profit organization. Her brother and sister also received scholarships to fund their studies; otherwise, they would not have been able to afford university education.

Amina completed her bachelor and master's degrees in the western part of Turkey, considerably less conservative than the eastern part, where she had to take off her hijab every morning when entering the university because of a governmental law. Again, in this context, as a religious student, she was minoritized. After graduating from university, with the support of her parents, Amina moved to the United States to pursue a doctoral degree in physics, where she lived for 6 years. When she graduated, she moved to Western Europe to take up a teaching position in physics at a higher education institution, where she identifies as a minority because she is a young Muslim woman in a predominantly white, Judeo-Christian, masculine, and heteronormative context. In the country where Amina currently lives, Muslims with origins in different countries are considered an ethnic minority and they count for 5% of the population. The majority of Muslims are employed as technical workers and some are asylum seekers. In the city where Amina works, there is a very small representation of Muslims (below 2.5% of the population), and the perception of natives on Muslims and Islam is quite negative (Forum, 2008; Velasco Gonzalez, Verkuyten, Weesie, & Poppe, 2008). Amina is the only Muslim in the physics department. In her personal life, Amina is more likely to have frequent social interactions with members of her own group as well as people from the broader Mediterranean region than with natives, which might suggest lack of integration.

## 6.4 | Data collection and analysis

The main research data for this study were collected through three interview sessions (see Appendix) each between 1.5-hr, while secondary data, mostly for triangulation purposes, were collected through various informal discussions, email exchanges, conversations through social media as well as informal ethnographic observations at Amina's workplace for a period of a year and a half. Before the first interview, I had asked Amina to complete the following task for the purpose of using it as the basis for the interviews: *Can you please draw a timeline of your life? Where were you born, and where did you live, study and work? Who were/are the people closest to you?* Each interview protocol consisted of: (a) questions that aimed at examining Amina's view of self as a scientist, her competence, her performance, and how she was recognized by others (i.e., family, friends, teachers, colleagues, students); and (b) questions that aimed at examining how Amina's different identities intersected at different time frames and contexts (i.e., childhood years, schooling years, university years, professional life). Examples of questions include the following: *Can you share stories about something someone in your family said to you that contributed to your confidence as a physics learner or that discouraged you from pursuing studies/career in physics? Do you feel that your work environment is*

*supportive of women/immigrants/Muslims? Provide examples/stories.* In order to achieve internal validity, different questions aiming at gaining the same kind of information (e.g., recognition by students) were phrased in different ways and inserted at different places in the interview protocol. In addition, the interview protocol was tested first through interviews held with two other women working STEM careers in the same country as the participant. Both of them belong to ethnic minority groups and one of them is Muslim. Following on from the interview, these two women were asked to provide feedback on the nature of the questions and their experience as interviewees. In addition, their interviews were transcribed and analyzed through a thematic analysis for the purpose of identifying which identity structures were more salient in their life-stories. These multiple identity structures were used as input for the redesign of the interview protocol that was used with Amina.

The interviews were semi-structured and each had a different focus. The first one focused on gaining biographical information about Amina as well as information related to her childhood experiences in order to examine the impact of her family environment on her decision to study physics. The second interview focused on Amina's experiences as an undergraduate student in Turkey and as a graduate student in the United States, as a way of examining possible differences between the two contexts and their impact on the formation of her science identity. The third interview explored Amina's present experiences as an immigrant to Western Europe and a physics instructor in higher education. The first interview was carried out at my home over a long traditional Mediterranean dinner given that the purpose of the interview was to extrapolate information about Amina's childhood and family experiences in Turkey: a prominent food-culture in the Mediterranean region. As a result, the interview turned into a natural and engaging conversation and Amina seemed quite comfortable to share personal information. The second interview was carried out at Amina's office at her own request in order to show me her workspace. During the interview, Amina shared stories from her experiences as a student both in Turkey and in the United States. The third interview was held at a café, where Amina shared her present experiences as a young, immigrant, Muslim woman teaching physics in Western Europe.

The approach to data analysis used a combined framework of *matrix analysis* and *within-intersection analysis*. Matrix analysis was conducted in order to identify, through a thematic approach, which identity structures were more salient in Amina's narrative. *Within-intersectional analysis* was conducted in order to explore the unique experiences of Amina, as a member of the broader group of women in physics. To analyze the data, I first organized those in a narrative format, based on distinct chronological periods: childhood, schooling years, undergraduate education, graduate education, and professional life. Following that, I inserted the narrative in the Atlas software, which was used for the analysis. Critical incidents, defined as complex and fundamentally significant experiences, were used as the main unit of analysis. Such incidents included events, interactions, and relationships that are emotionally intense, have a lasting effect, and are inextricably linked to a set of circumstances represented in Amina's journey in physics. The analysis of the data was done through the use of the constant comparison method that comprises the following stages: (a) comparing incidents applicable to each category; (b) integrating categories; (c) delimiting the theory; and (d) writing the theory (Lincoln & Guba, 1985). To analyze the data I looked for critical incidents within different time frames related to the formation of Amina's science identity. Following that, I examined which of her multiple identities were present and in what way they intersected in those incidents. To carry out the analysis, I used *in vivo*, line-by-line coding techniques and so the codes were taken from the content of the data or the exact words of Amina. As a result of this first step to the analysis, 380 open codes emerged. Following that, the data assigned to these codes were grouped

to form five main categories, which are, in fact, the main identity structures or sub-identities of Amina: science, religion, gender, ethnic status, and social class.

## 6.5 | Trustworthiness

The study reported in this manuscript does not attempt to offer an objective account of Amina's life-history. Instead, the goal is to communicate Amina's own account of various experiences, interactions, and relationships, which she recognizes as true. In analyzing the data, I, as the researcher serve as a mediator for Amina's story through the collection and analysis of various data related to her lived experiences in relation to science. In a way, this manuscript represents my narration of Amina's life history in relation to science, through time and across contexts. As such, my subjective interpretations of Amina's story are acknowledged. It is therefore likely that through my subjective interpretations I have highlighted certain dimensions, versus others, of Amina's life history. Being a subjective telling, the story could be interpreted as unfinished, a work in progress, much like Amina's journey in physics: open to question, disruption, reconstruction, and reformation.

In attempting to minimize this subjectivity and in pursuit of establishing trustworthiness I used Guba's (1981) criteria: credibility, transferability, dependability, and confirmability. To establish credibility I used triangulation strategies through: (a) a collection of data from various sources (e.g., different interviews, emails, messages) for the same purpose; (b) an audit check, which was carried out by an independent researcher; (c) thick descriptions of critical incidents throughout Amina's life history; (d) member check by the external researcher; and (e) member check by the participant. The external researcher carried out an independent analysis of a randomly selected segment of the data (20%) for the purpose of cross-checking and refining the coding scheme. The participant-validation was achieved through a discussion of the findings alongside my interpretations with Amina. I had shared with Amina both my analysis as well as the final version of this manuscript and I had asked her to check for accuracy. Following on that we had another interview to discuss her perception of the accuracy of the analysis as well as the extracts that are used in the manuscript. As a result, a few minor modifications were made to the text and some quotes were revised because Amina felt were too identifying. Even though there were no major disagreements, Amina was surprised by my interpretations in a few instances (e.g., feelings of exclusion and otherness), which, however she neither opposed nor find exploitative or distressing (Atkinson, 1997). To achieve transferability of the findings, I provided detailed contextual information (e.g., participant's profile and life history) for the readers to make such a transfer. In addressing the issue of dependability, as suggested by Lincoln and Guba (1985), I provided in-depth descriptions of the research design, the data collection, and analyses. Last, in attempting to achieve confirmability, I describe below my positionality as a researcher.

## 6.6 | Positionality

As a researcher, I challenge objective notions of social research and recognize that achieving pure objectivism in this study is a naïve quest. I self identify as a social scientist who is never able to divorce myself of subjectivity. My epistemological positionality is aligned with the goal of the study, as I am interested in issues of power, equality, and social justice in the context of various social systems, such as schooling and academia. Embarking on this research project, I positioned myself as an insider of the study, from conceptualizing the research questions to designing the data collection and analysis, given my gender identity (woman), ethnic status (immigrant), science identity, and professional identity



(academic). I bring to this study my own life history as a former student who minored in physics, as someone who grew up in the Mediterranean region, and as a researcher who is currently working in a faculty of sciences, collaborating with physicists and teaching courses to physics students. Even though my religious identity as an atheist is not aligned with Amina's, I grew up and studied in contexts that provided opportunities for close contact with Muslims, and incidentally Muslim physicists. Growing up in the Mediterranean region, pursuing graduate studies in North America, and currently working in the same geographical region as Amina, I share similar experiences related to crossing geographical borders as well as navigating through similar cultural contexts. Like Amina, I moved to Western Europe three years ago, and I had multiple opportunities to share my own life-history and current experiences with her prior to the conceptualization of this study, especially because of our developing and caring friendship. At the same time, my life history, research interests, and experiences in science identity research, sufficiently equipped me with an attentiveness to how my personal intersectional subjectivities shaped my own science identity, which I shared with Amina as a way of locating and placing myself inside this study. This eventually enhanced the credibility and rapport of our research relationship, which adds to the trustworthiness of the study.

## 7 | FINDINGS

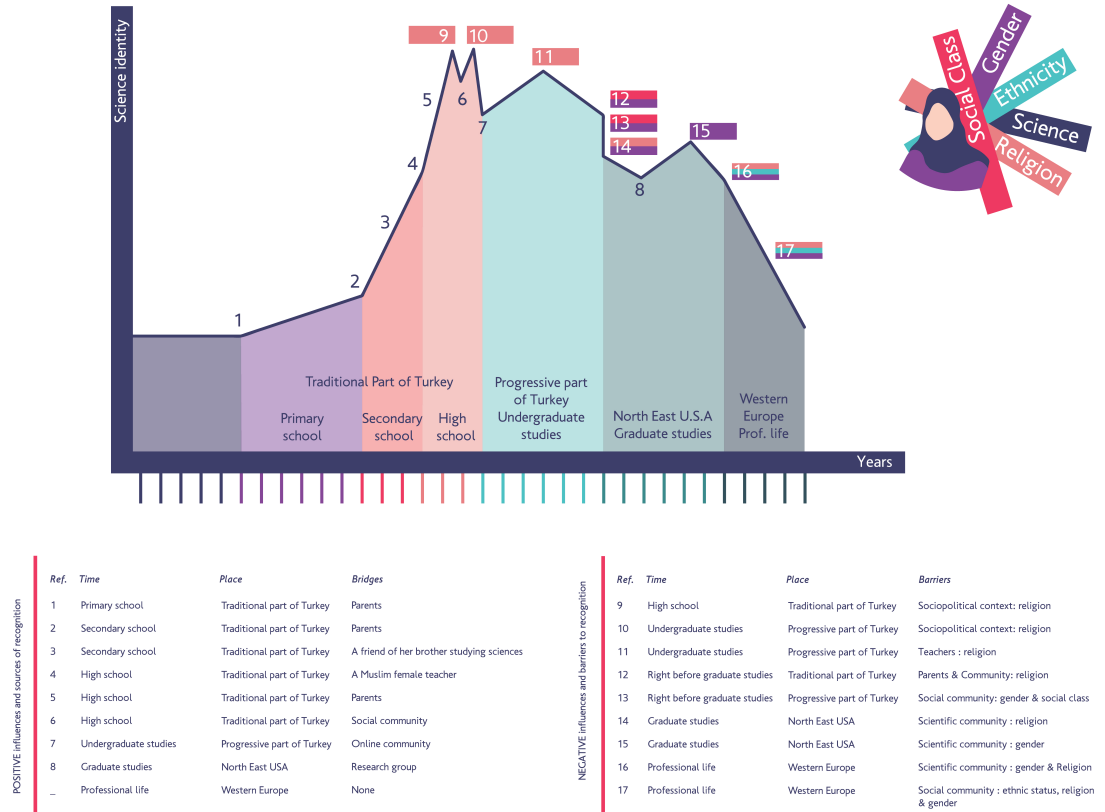
The outcomes of the analysis are presented next in a narrative format in an attempt to retell Amina's story in a chronological order. As such, this narrative aims to capture the complexity and hybridity of Amina's life history and places emphasis on the continuous process of constructing meaning instead of presenting the findings in the form of distinct identity categories. The latter would, in fact, contradict the very nature and emancipatory potential of intersectionality. Overall, the analysis of the data illustrated that Amina encountered different kinds of obstacles, barriers, difficulties, and conflicts throughout her life, studies, and professional career. These were associated with social- and gender-science stereotypes, conflicts related with religion, and difficulties related to studying and working in a male-dominated, Judeo-Christian contexts as Muslim. More narrowly, the analysis of the data indicated that, as a learner of science, Amina had a strong science identity throughout her schooling and university years. She identified as a competent learner of physics during her childhood and throughout her university studies and she performed specific social performances of relevant scientific practices (e.g., taking a leadership role in the laboratory). Amina viewed herself as a science person and she was also recognized as such by specific others (i.e., a high school teacher, a family friend) at the time that she entered graduate school. As a physicist in academia, in Western Europe, she experienced identity tensions and conflicts due to lack of recognition, cultural stereotypes, and cultural expectations. In what follows I narrate Amina's journey in physics from her childhood until the time the last interview was carried out through a chronological order (see Figure 1). By using the two research questions as a guide, in discussing the findings I highlight the following: (a) how Amina came to form her identity and what served as barriers to her perceived recognition and (b) the ways in which her multiple identities intersected across time and place.

### 7.1 | Schooling years: Intersections of social class, religion, and study choices

During her childhood, Amina was often asked what job she would like to do when she would grow up. As she explained, a typical response in the specific cultural context of the more conservative part of Turkey was to be a doctor and a mother. Amina's response was the same as other girls of her age. As she recalled:



Experiences influencing science identity trajectory across time/place



**FIGURE 1** Experiences influencing science identity trajectory across time/place [Color figure can be viewed at wileyonlinelibrary.com]

When I was in primary school everyone would ask me what job I would do when I would grow up. And you know, most girls would say: *I want to become a doctor first and then a mother.* My response was the same for quite a few years.

When I asked Amina to explain why this was a typical response she mentioned that a doctor's job is highly regarded as a socially valuable profession, and that it is also atypical for a woman to not become a mother. On the one hand, this indicates how social traditions and expectations, as part of specific social contexts, might influence girls' formation of identities. On the other hand, this provides evidence of the intersection of multiple identities even at a very young age: science identity (i.e., aspiration to become a doctor) and gender identity and social class identity (i.e., aspiration to become a mother).

In secondary school, an important source of recognition was a friend of Amina's brother who was attending high school at that time, who admired her as a competent physics learner. In one of the interviews, Amina shared the following:

That guy saw me as someone who shared a passion for science. He was quite smart and he used to study with my brother. I remember them being in the room studying physics, chemistry and math together...he was like a good example to me. And I remember my father talking about him a lot. I kind of admired that guy. And, I received the same sense of admiration from him because I was also good in physics, chemistry and math.

It is possible that this person, who was a friend of the family, served as a resource or an asset for Amina especially because he explicitly recognized her as a strong science learner. But, why was this specific friend influential? A possible explanation might be the fact that Amina had a sense of admiration for him or as she said: “a good example.” Moreover, her father would often talk about him implying again a sense of admiration. In the context of Amina's patriarchal, working-class family, her father's point of view is crucial.

Going to high school, Amina found herself facing discrimination. As a Muslim student in high school in Turkey in the 1990s, she was discriminated by a national law related to the requirements of university entry. Specifically, the law stated that all students who attended a specific type of religious high school (Imam-Hatip) would have points deducted from their university entrance examination results if they chose to study any other subject than religion. This was the case with Amina who attended this high school as a religious person and who also chose to wear a hijab. However, Amina did not want to study theology, and she was therefore confronted with a conflict. As she described, a student with exceptionally high scores could make choices in medicine and engineering, while a student with lower scores could choose between physics, biology, and chemistry. Had it not been for this law, Amina stated that she would probably have chosen to study medicine or engineering. This provides evidence of not simply a tension between specific study choices and religious identity, but indicated how choosing to study medicine and to perform a Muslim religious identity was in fact forbidden. During high school, Amina viewed herself as a competent physics learner. As she stated during the first interview:

I was generally good in science and math during high school. I liked physics because it was challenging, and also because it was much broader than other subjects. Math was too abstract for me to study. I also found physics to be “cool” compared to other fields.

It is important to notice how Amina found physics both challenging and cool, which might suggest that she was not intimidated by the challenge. This could be attributed to the fact that she felt confident and competent as a physics learner. This self-confidence contradicts a stereotyped construction of Muslim women as lacking agency and as performing their gender conservatively under cultural pressure (Wagner, Sen, Permanadeli, & Howarth, 2012).

In the last year of high school, a physics teacher appeared to have served as an asset for Amina's recognition. This teacher was a Muslim woman also wearing a hijab and probably someone with whom Amina could identify as a religious woman herself. She was also a highly respected family friend. This teacher explicitly recognized Amina as a competent physics learner and appeared to exert influence on her decision to study physics. Amina described a long conversation they had, which she still recalls as one of the most supportive acts of her life:

I was 17 years old when I talked with my physics teacher about my choices of study. I told her that I was between Biology and Chemistry. And she said, *Why not Physics?* I responded: *Physics is really hard, I won't succeed in that field.* I don't know why I didn't feel competent since I actually did really well in high school physics. But, she said: *why not, you are a smart girl, you can definitely do it.* And, that was it. I was persuaded!

It becomes evident in this extract that this teacher explicitly recognized Amina as a smart student who could study physics. It is evident from the above that the influence of this teacher was critical. However, the question becomes: how it got to be so easy for Amina to be persuaded to choose to study physics? Was it because she felt competent as a physics learner even though she wasn't

particularly confident? What was so particular about this teacher that made her words so influential? In a follow-up interview, I asked Amina to reflect on this:

She was a *good* physics teacher. So, I had the impression that she knew about the field. And, she knew a little bit about me. So, I trusted her when she said that I could do it.

It is important to notice in the excerpt above Amina's trust in this teacher, not only because she regarded her as an expert, but because she was a family-friend. This surfaced again in an email exchange I had with Amina:

The physics teacher who persuaded me to study physics was a family-friend. She is Muslim and she also wears a hijab. I always thought she was very smart, and since I felt close to her and respected her as a teacher her words influenced me easily. I think I needed a small push to start believing in myself. Sometimes I need reassurance from the people who are close to me.

In addition to Amina's trust in this teacher, it is possible that the fact that this teacher was Muslim and also wearing a hijab had something to do with Amina's decision. Essentially, this teacher was probably a person with whom Amina could culturally relate as a Muslim woman from her social community, or who could have served as her role model. It is also interesting to pay attention to Amina's admittance that quite often she needs reassurance about her abilities if it comes from people who are close to her. This might lead to the conclusion that such reassurance could not have come from teachers who were not close to her or to whom she could not relate, as for example, an atheist male teacher.

## 7.2 | University years in Turkey: Intersections of gender, religion, and study-choices

Going to university Amina chose to study physics—a choice that contradicted her working-class and religious identity. Nonetheless, her decision to study physics was met with admiration in her social community:

Whenever someone would ask me the question: “what is your major?” I would say physics, and the response would be: *Ohh you must be smart!* [smiles]. They would usually follow this with something like: Physics is not my subject, or, I hate physics or, isn't that hard?

This excerpt provides evidence that physics was perceived as a clever and difficult subject in that specific context. This is problematic given that the literature shows how cleverness is masculine, as discussed earlier. Hence, one might argue that this admiration could have served as a way of placing Amina, a student exhibiting more feminine gender performance as evident through her traditional clothing and non-dominant personality, as an outsider in the world of physics. However, Amina did not experience this in this way. In fact, during the interview, she smiled about this with a sense of pride and she went on to explain why she likes physics. This might imply a more masculine gender performance as exhibited through self-confidence, high self-esteem, and individual agency. Such gender performance contradicts cultural expectations of working-class and covered Muslim women as traditional and lacking individual agency (Fursteth, 2011).

At university, similarly with her high-school years, Amina faced discrimination as a religious student attending a non-religious university in the more progressive part of Turkey:

I had to take my scarf off when entering university because it was forbidden. I felt discriminated against. However, it was obvious that I wore a scarf outside. Anyone could recognize from my clothing or even from my undone hair that I were Muslim. Some teachers would recognize this and say things deliberately to hurt us. For example, one day I was in a History class and our teacher started to talk about how the change in university entry exams changed the student population. He gave statistics about students with a religious background, and said we don't have any among us now thanks to the system. He mainly looked at me while saying this...it was very uncomfortable to listen to it.

A point to consider is that Amina felt she had to sacrifice her religious identity, a fundamental aspect of who she is, for the sake of her career aspirations, essentially, to develop a science identity. This illustrates the identity negotiations she had to make and essentially how her religious and science identity were in collision in this context. Moreover, Amina's words point not only to a lack of respect by her instructor but also to a lack of a sense of belonging on her part; as a religious student in a school where religion was banned she was constructed as an outsider. This provides evidence that Amina was actually forced to choose between two conflicting identities as she realized that these two identities were forbidden to coexist in the specific context. As a matter of fact, Amina's religion served as the major factor of exclusion throughout her university years. As she said: "Most people, including the Turkish government and universities, were just bullying us because we were religious". This might be interpreted as an implicit recognition of systems that can be oppressive to those who are not part of the dominant group; in this case, religious students or more narrowly, female students who chose to perform an Islamic religious identity as evidenced through their clothing.

This, however, does not mean that Amina found herself belonging to the group of Muslim women who chose to cover themselves. On the contrary, during her university years in Turkey, Amina did not exhibit a sense of belonging even within the Muslim community of women because unlike her, they were conservative: "But they are really closed-minded, and I hate being around them. You can be religious and still be open-minded, I think." This provides evidence of yet another conflict Amina faced as a progressive Muslim woman, in terms of worldview and values, who chose to exhibit a more traditional performance of her gender and religious identity by choosing to wear a hijab. This intersection of progressive worldview and values, religion, and gender performance caused Amina feelings of oppression because in the context of her social community these identities were in conflict:

I felt oppressed. I felt that my role was to represent this progressive group of religious people, the more open-minded ones. But, I felt oppressed especially as a woman. Because, you know, nothing ever happens to men. They can enter the building without any problem because they don't wear a hijab. But as a woman wearing a hijab, you can't hide it. I felt and still feel discriminated against because of that.

These words reveal the ways in which the intersection of Amina's gender and religious identity performance caused feelings of discrimination as a religious woman who chose to wear a hijab, unlike religious men in Turkey whose religion might be covert. In the university classroom, as a woman, Amina was once again a minority in male-dominated classrooms, which caused her feelings of exclusion:

For most of my life I was the only female student in the classroom. For example, in my chemistry class at university I was the only female...I was always the only female in these classes...so, I always felt like a minority...you know, an outsider.

This statement might also imply Amina's feminine gender performance. Assuming that had she exhibited a more masculine performance of her gender identity she would not have self-identified as an "outsider."

Amina graduated among the top 5% of her undergraduate class and was admitted in the master's program in physics at one of the top-rated universities in Turkey, which points to her strong competence as a physics learner. Following her graduation, she was determined to follow a career path in academia and she wanted to pursue doctoral studies in the United States. This might imply a gender performance that contradicted cultural expectations of a working-class Muslim woman.

In one of our conversations, she shared how academia was a place where she felt she would belong, and at the same time, could also serve as a place from where to bring about social change. This was, in fact, her long-term goal when choosing a career in science:

I wanted to follow a career in academia because that was the place where I could find other people like me [concerned about social issues] and do research. I used to think that from such a position I could represent a group of people [religious, left-wing academics], which is not represented in the right way.

What is interesting to notice above is not only Amina's self-identification with research, but also a view of her self-role in representing the group of religious academics that are misrepresented in science. This provides evidence of a strong sense of individual agency, career aspiration, and leadership, which contradicts cultural expectations of Muslim women in terms of identity performance as being meek, lacking individual agency, and being uncommitted to their careers (Jones, Catto, Kaden, & Elsdon-Baker, 2018).

Amina's father was not supportive of her decision to enroll in a doctoral program. However, he did not actually forbid her to do so. In essence Amina was not viewed as a physics person by her father. Instead, she was merely viewed as a future mother, a common prejudice for individuals of her social class. In Amina's words:

He advised me to stop. You know...as a woman, he thought I should just find a job and be a mother. His dream was that I'd become a teacher, have the summers off and a lot of free time in order to raise my family. He did not want me to go to the US.

This highlights the intersection of her gender and social-class identities and the cultural expectations that are associated with this intersection. Interestingly, her mother was supportive, although silently—typical behavior of mothers in a patriarchal family. As Amina said, her mother did not openly express her opinion but she felt that by not opposing her decision she was being supportive. This was important to her, as she admitted:

My mother does not know what science is; she did not even attend primary school. But she always thought that I was doing a good job, I guess, and the title of "Professor" is quite powerful in Turkey. So, she had a sense of pride in me even though she never understood what I was doing.

Amina's experiences point to different sources and forms of recognition. First, it is obvious that being highly educated in Amina's social context was perceived positively. In addition, even though it is apparent that her family could not provide her with specific resources that would support her trajectory in physics, her study choices were not met with opposition. Even Amina's father, who did not appear supportive, did not in actuality, insist that Amina did not follow her dream to carry out doctoral studies, as might have been expected in a patriarchal society. Moreover, Amina's network recourses in the form of social relationships was quite strong. A narration of an experience while she was a master's student in Turkey exemplifies that. In this narration, Amina described feeling anxious about pursuing doctoral studies in the United States because of the lack of financial resources and the fact that she did not feel confident in her English language abilities. In order to practice, she would log on online-forums to chat with people in English. Through this experience, she met a Turkish man who at the time was pursuing a master's degree in physics in the United States, and appeared to have served as a support network and resource for Amina:

I felt a bit hopeless at the time because I did not have the money to study in the US. He advised me to take the GRE exams, to study hard in order to get a high GPA and to work further on my English. He told me that it was possible to receive a scholarship from a university in the US. So, he helped me a lot and I started feeling hopeful that it might be possible to pursue my dream.

This provides evidence of not only the explicit support by this person but also an implicit recognition that Amina had the potential to obtain a competitive scholarship and to pursue graduate studies in the United States.

### **7.3 | Graduate studies in the United States: Intersections of ethnic status, religion, and gender**

A year later Amina finds herself in graduate school in the North East of the United States and engaging in new kinds of identity negotiation and identity work as an international, religious, Muslim female student in a physics program. In this context, however, she was recognized as a competent physics person. As she said, her experiences as graduate student were overall positive even though she, like other members of her research group, was not receiving much support from her supervisor. In that context, she felt that her research group recognized her as a "smart person" and as a competent physicist, as she said. In her social circles, she did not experience discrimination as a Muslim woman because, as she explained, there was a large Turkish religious community in place. However, the intersection of her religious and science identity raised questions. Her religious identity often came up in discussions about her choice to study physics. The extract below describes the nature of an interaction that she had with a fellow graduate student:

When we first met he was surprised that I was a physicist. He said: I am really shocked, how can you be both a physicist and Muslim? All physicists that I know are atheists.

What becomes apparent through these words is that Amina's religious identity served as a barrier to Amina's recognition as a physicist by this graduate student because of a common misconception that physicists are atheists. Essentially, this provides further evidence that her religious identity was in conflict with her science identity.

Her gender identity, again, positioned her as a minority in graduate school. As a female student, Amina found herself again in male-dominated classrooms. However, she did not seem bothered because by that time this felt normal to her:

Most of the time we were only 1-2 women in the class. In the chemistry lab, for example, I was the only woman. But, this wasn't something new to me. I was used to it by then; and though I did not hang out with the male students, it didn't bother me.

It is interesting to note that even though this did not bother Amina she did not hang out with the male students. This might imply that Amina did not change her gender identity performance by, for example, adopting a more masculine identity performance in order to better fit in the classroom and hang out with the male students.

Moreover, Amina was the only female student in her doctoral research lab. When I asked her if she felt she was treated differently because of her gender, she responded:

My advisor was quite harsh to everyone, but he was less harsh to me. In fact, I think he was a little nicer to me because of that. He thought that as a female I was more sensitive than the male students [laughs].

It is interesting to notice above not only the advisor's gender bias but also Amina's perception of being treated favorably because she is a woman. While other women might have felt uncomfortable or upset about being treated differently than their male counterparts, Amina laughed about it. This did not seem to be a treatment that she either liked or disliked, which might point to a less feminine (and feminist) performance of her gender identity. At the same time, this might point out to how her advisor, influenced by social stereotypes of Muslim women, perceived Amina as lacking individual agency and needing extra support.

While one might assume that Amina's gender performativity did not serve as a barrier to her sense of belonging in a male-dominated classroom, evidence found in a follow-up interview, points to a different story. In this story, Amina's gender identity is found to be intersecting with her ethnic identity. As an international female student, Amina would usually find herself in a group of international female students:

Men were on their own and we, women, were on our own. We would meet quite often and share our experiences as minority women at university...most of the time we were international students only, Americans would hang out on their own.

This points to how Amina positioned herself in relation to normative versions of femininity in a male-dominated setting. In addition, it illustrates how Amina positioned herself as an international student in the United States, being in the group of international students, which might suggest a lack of integration.

#### **7.4 | Professional life in Western Europe: Intersections of ethnic status, gender, religion, and possibility of motherhood**

In her current academic environment, Amina experiences *difference* in an environment that is populated by White western males:



I feel like I'm different. I feel that *all* the time because of who I am. It's not common for someone of my background [referring to her social class] to undergo graduate studies, especially because I'm a woman.

This was only one of the many instances when Amina emphasized the intersection of her social class and gender identity. She identifies as an underprivileged, working-class individual, who managed to break away from the borders and constraints constructed at the intersection of her social class and gender identity. This caused feelings of isolation and loneliness, as evident in her own words: "I didn't feel like I fitted in any social group or communities. So, I felt alone for a long time". At the same time, it is interesting to notice that Amina does not have a sense of belonging as a member of her ethnic group. She elaborated on this in the third interview:

I don't feel like I'm a typical Turkish woman. I see myself different to them. And really different to most religious Middle Eastern women because my ideas about the world are more progressive.

It becomes clear in Amina's words that she does not feel connected to her ethnic group because her worldview is more progressive when compared to what is culturally expected of a Muslim working-class woman raised in a patriarchal society.

As a Muslim woman, she faces various challenges in her current geo-socio-political context and academic community. These challenges are associated with the fact that she does not perceive that she is recognized as a science person; more precisely, she perceives misrecognition. In the last interview, she stated how she feels that her religious identity has been one the most prominent features by which she is recognized by her academic community:

I think for most people religion comes first because of my hijab. I could be a Muslim man but they wouldn't know that unless I'd tell them. It's the first thing that comes to their mind: *oh, she is Muslim*. And then, they easily stereotype. That's the thing I am mostly concerned about...it's a feeling that I cannot describe, but I feel like people have less respect for me.

This provides evidence of Amina's perceived recognition by others and how her religious identity is contesting her science identity possibly due to negative social stereotypes. Though there are no data in this study to examine how others actually recognized Amina, her perceived recognition is important because it defines her lived experiences and sense of belonging. Another barrier to her perceived recognition as a physicist is that she is a young immigrant woman in a physics department, a male-dominated, Judeo-Christian environment in which she does not feel that she belongs or is valued:

Sometimes I feel that the students don't take me so seriously...they easily stereotype and ignore me...I have to raise my voice. Why? Because I am a young woman in a physics department. I am an immigrant, and on top of that I am Muslim. I cannot say that it's only the religion... it's *all* of me.

Amina's last couple of words encapsulate how her multiple identities intersect and which, in spite of their internal differences, are impossible to dismantle. However, it is evident that she finds her science identity contesting with her gender, ethnic, and religious identities. In fact, it is at the

intersection of these identities that all social stereotypes are found, and effectively might indeed serve as barriers to her recognition as a scientist. This excerpt is important because it provides evidence of different markers that might serve as means for recognition by Amina's students: age, ethnic status, religion, and gender. When asked how she thinks others within her current social community see her, Amina stated that she does not feel she is recognized as a scientist. Instead, she believes that she is recognized based on her ethnicity and religion, and both are loaded with negative social stereotypes:

I am not recognized as a scientist in society. Instead, all that people can see is that I am Turkish and Muslim. And both are negative. People are negatively biased towards Middle Eastern individuals, especially if they are Muslims, because of politics and what they watch on TV.

When elaborating on this, Amina shared incidents where she felt that she was discriminated against. The following extract from her interview is the most representative of how she emotionally experiences a sense of Otherness and discrimination:

I feel discriminated against all the time, especially by older locals. The way they look at me sometimes is so...I don't know how to phrase it...*cold*. It's the same look they have when they see a Black person. There is a sense of disgust, I guess. They see us as "foreign" creatures because we do not look like them.

What is evident in this quote is how Amina's multiple identities intersect, are calibrated, and negotiated by prevailing social stereotypes and essentially, cause feelings of exclusion. Overall, these findings suggest that through her life history, Amina experienced various incidents as identity threats due to her atypical positionality as a member of the physics academic community. As she said, she "feels different *all* the time, like a constant outsider", because of perceived misrecognition. The importance of (perceived) recognition in shedding light on salient "push" and "pull" effects that various experiences might have on the formation of science identities deserves further research attention especially when studying underrepresented groups in dominant contexts, such as Muslim women in physics. These findings also point to a lack of a sense of belonging and how that serves as a barrier for minoritized women participation in physics.

Looking into the future, Amina shared her desire to become a mother—an identity that she feels is in conflict with her professional identity given the demands of a physics career in academia (e.g., traveling for conference attendance, working at the lab at atypical hours). As she admitted in the last interview, she is considering leaving academia because she wants to have children very soon. "The demands of academia are so crazy that it is impossible to be both a good scientist and a good mother." As revealed in these words, Amina feels that these two identities are in conflict. Related to this, within her family environment Amina has experienced a sense of Otherness because she chose a path different to the one expected from a woman of her social community and class (i.e., to raise a family instead of following a career in academia). She said: "I feel like I'm constantly being criticized by my family. My aunts always ask: Why don't you come back to Turkey and have children?" In the third interview she elaborated:

I feel that I'm a failure for my family because I don't have children yet. They always ask: why are you still living abroad? You and your husband are all alone there...they feel that I sacrificed my personal life for physics and they portray a sense of pity towards me.

What is evident is a tension between identities that are perceived to be in conflict: science identity, social-class identity, which relates to the expectations of her family circle, as well as gender identity, which is attached to the possibility of motherhood. This provides evidence that Amina has to negotiate between these intersectional and often contested identities and work with the social contradictions involved in her becoming a physicist. In the particular cultural and social class context from where Amina comes, the activity of mothering, which is portrayed through a more traditional feminine gender identity performance, is in conflict with professional ambitions. Hence, Amina's desire to be both a mother and a physicist forces her to negotiate and eventually have to choose between these two perceived contested identities.

## 8 | DISCUSSION

The findings of this study provide evidence that Amina exhibited resistance and resilience throughout her journey in physics, and that she was able to overcome certain difficulties and form a strong science identity that would drive her to follow a career in physics. The barriers that Amina faced throughout her schooling and career-trajectory are associated with specific intersections of her multiple identities, which differed in the various geo-sociopolitical contexts in which she lived. The findings of this study exemplify how various social markers, relations, and identity structures intersected with Amina's science identity and served either as bridges or as barriers to her journey in physics. Five main identity structures appeared to be in constant intersection and at times in conflict throughout Amina's journey in physics: science identity, religious identity, gender identity, ethnic identity, and social-class identity. An examination of these identities at their intersection addresses not only the complexity and heterogeneity of identity but also how such intersection crosses existing identity categories and might hinder recognition.

### 8.1 | Gender and religion intersections hindering perceived recognition

Amina perceived a lack of recognition as a competent physicist because of the negative gender, religious, and ethnic stereotypes attributed to these identities. As a woman, Amina had to challenge assigned identities while navigating through the exclusionary culture of physics. There exists a wealth of research evidence that shows how the structures and culture of schooling and university are alienating and intimidating for women in STEM (Gonsalves, 2014). This is especially true for physics, which remains a heavily male-dominated field characterized by a very masculine culture, and which essentially requires women to give up their femininity in order to enter the field (Francis et al., 2017). In this study, Amina did not negotiate her gender performance in order to blend in the world of physics. Instead, she constructed herself as a forever-outsider. This finding contradicts Danielsson's (2012) study findings, illustrating how women at university engaged in gender negotiations in order to fit in the physics context.

Beyond barriers connected to her gender identity, Amina faced barriers connected to her religious identity throughout her journey in physics in various contexts. While one would assume that Amina would not face barriers as a Muslim student in Turkey where 98% of the population is registered by the state as Muslim, she actually did face not only barriers but also discrimination because she chose to attend a non-religious school, which would offer her an advantage in entering the university. In the United States, even though Amina was the only Muslim female student in her undergraduate and graduate studies she did not perceive any specific behaviors as discriminatory due to her religion. She attributed this to the fact that there was a large Muslim community in the city where she studied,

which might have led to minimizing possible negative biases. However, in her current context, in Western Europe where anti-migrant islamophobia is on the rise and in a city where there is not a large Muslim community, Amina perceives her religion as serving as major barrier to her recognition by both her academic as well as social community. In elaborating on this she referred to how others look at her while expressing a sense of disgust. This is in agreement with Abdi's (2015) findings that revealed how a Muslim female student experienced exclusion. Based on her interpretation of the look of other students she did not feel welcomed: *you know you are not wanted just by the look of their face*. Abdi (2015) referred to this as the violence of gaze and more precisely how certain bodies, the colonized ones, feel and interpret the gaze. Likewise, Amina experienced this gaze as a form of perceived misrecognition and received it as discriminatory.

Moreover, the fact that Amina chose to perform her religious and gender identity in specific ways by choosing to wear a hijab raises specific cultural expectations. A cultural stereotypical expectation of Muslim women who cover is that they are conservative and lack agency (Fursteth, 2011). This is a stereotype to which Amina had a strong reaction because she self identified as a progressive woman in terms of her worldviews, and especially against patriarchy. For her, wearing a hijab simply served as a symbol of religious devotion. This points to a conflict between her perception of her religious identity and gender performance on the one hand, and the cultural perception of Muslim women on the other, which might hinder recognition.

## 8.2 | Negotiations between desired and perceived assigned identities

The findings of the study point to the importance of examining how both perceived and actual (mis)recognition might affect the formation of science identity, especially for Muslim women. As evident in the findings, Amina viewed herself as a science person. However, she did not perceive that others (e.g., colleagues, students, social community) recognized her in the same ways she viewed herself: as a competent physicist. Throughout her life, the barriers to her perceived recognition were connected to her gender, religion, and ethnic status because these had been attached to perceived assigned identities. These identities were linked to social stereotypes and were in conflict with her perceived recognition as a scientist. This mismatch between her self-recognition and how she perceived that she was recognized by others, as for example, her colleagues who are mostly white men, is problematic because it not only perpetuates the cultural dominance of these groups in physics but also hinders minoritized groups' sense of belonging in physics.

For Muslim women especially, this is important, given that their religious identity becomes visible through their gender identity performance as expressed through clothing (i.e., choosing to wear a hijab) unlike other religious identities that are covert. Why is this important? Because, even though this makes it easier for Muslim women to identify as such, at the same time it might serve as a barrier to their recognition given that Islam has historically been vilified with negative stereotypes (e.g., oppression, terrorism). As revealed through this study, this perceived misrecognition caused Amina to lack a sense of belonging as a religious physics student during her studies in Turkey and a physics instructor in Western Europe. Similarly, previous studies provided evidence that underrepresented groups within STEM, such as women and students of color, report less of a sense of belonging than men and white students (Johnson, 2012; Smith, Lewis, Hawthorne, & Hodges, 2013). For example, similar findings were revealed in Rosa and Moore-Mensah's (2016) study, which explored the life histories of six African American women in physics through interviews. The findings revealed specific commonalities in their experiences, one of those being that all participants felt isolated in the academy, especially as members of study-groups, in which they felt excluded. In contradiction with Rosa and Moore-Mensah's study showing that all participants had invitations to engage in science through participation in after-school where they were exposed

to a science environment at an early age, and summer research programs along with their academic training, Amina had no such experiences in her early life. This might point to the lack of resources that she had as a member of a working-class family, and at the same time, it might suggest her strong competence as a physics learner and her persistence to study physics.

### 8.3 | Relational-resources as bridges to the world of physics

The findings of the study revealed how Amina's journey into physics included different forms of resources, as for example, family resources, influential teachers, intellectual relationships, a network of friends, and so forth. Her parents, even though not openly supportive, did not oppose her study and career decisions. This sheds light on another contradiction in terms of cultural expectations of a traditional working-class family in a patriarchal society. For Amina, the most important resources were the ones found in relationships, and specifically, her Muslim female teacher and family friend who explicitly recognized her as a competent physics learner. This is in agreement with Wang and Hazari's (2018) findings, which showed the importance of the teacher's explicit recognition of high-school students' physics identity development, illustrated through expressing faith in ability and encouraging engagement with science. Beyond the importance of recognition, in this case, it is possible that Amina could see herself in this teacher who was also a religious woman, someone that she could identify with. This was also illustrated in Mensah-Moore's (2019) study, which examined the journey of an African American female in science teacher education. Being Black, the participant in this study found herself being "the only one" throughout her education, and this made her feel anxious, discouraged, and drained. The one exception, which turned out to be a transformative experience for the participant in this study, was her participation in a science methods course, which was taught by an African American professor with whom she could relate, and who provided her with educational and emotional support at a critical time in her life. In this study, Amina had only one long conversation with the Muslim female teacher who explicitly recognized her as a competent physics learner. However, that conversation was critical and as evidenced in the findings, it was crucial for Amina's decision to study physics. This is in agreement with empirical evidence revealing the strong influence of female instructors on female student motivation and performance in STEM fields (Solanki & Xu, 2018). This suggests how important the role-model effect is and implies the need for recruiting more female faculty as one way of addressing gender disparity in STEM.

Moreover, these findings related to forms of resources are also in agreement with the findings of Hyater-Adams et al. (2018) who examined how race impacts the ways that people identify with the physics discipline by picking up differences in the experiences of Black and White physicists. The findings of the study revealed the following connections: (a) recognition and relational resource connections, often in discussions of a relationship with a person, such as a colleague, gave the participants some form of recognition; (b) relational resource and ideational resource connections, where participants discuss an idea that people they know hold about them; and (c) connections between recognition and ideational resources, which commonly occurs when participants are negotiating their positioning within the physics field. The ways in which specific resources might serve as form of recognition for Muslim physicists deserves further research attention for the purpose of extrapolating whether and how an Islamic religious identity might demand additional forms of resources. This is important given that popular understandings of science remain bound up with conceptions of Western cultural superiority (Jones et al., 2018).

## 9 | CONCLUSIONS AND IMPLICATIONS

In this article, I have attempted to accomplish two goals. First, I shared a concrete life-story of a young, immigrant, Muslim woman in physics for the purpose of exemplifying the pathways by which she came to be, the various struggles and barriers she had to confront throughout her life, and the conflicts she had to navigate in her everyday life. Second, I provided evidence of the complex ways in which her multiple identities intersected and at times contested with each other throughout her journey in physics. The findings of this study have offered insights into how intrapersonal, interpersonal, sociocultural factors, relationships, and a myriad of experiences nurtured Amina's intersecting identities, and what this may mean for Muslim women's participation in physics. The findings can be summarized in two main assertions: (a) Amina confronted various barriers across her journey in physics with the intersection of religion and gender being the major barrier to her perceived recognition given cultural expectations, sociopolitical factors, and negative stereotypes and (b) Amina's social class, religion, gender performance, and ethnic status positioned her as Other in various places throughout her trajectory in physics, and consequently hindered her sense of belonging. There are various implications regarding the contribution of the findings of this study to the fields of science education, gender studies, and science identity research.

One main theoretical implication calls for a reframing of the discussion about women in physics beyond gender and for a deeper understanding of the complexities of science identity and how it develops. This study offers a theoretical contribution to studies of Muslim women's science identity development by adopting an explicit intersectionality lens for conceptualizing and examining science identity development, as an alternative narrative, as a prism that allows us to look deeper into Muslim women's lives. As other studies have done (Hyater-Adams et al., 2018) this study also shows how important it is to look beyond gender when examining minoritized women's participation in physics. With findings drawn from this study, I would argue that this is only possible through adopting an explicit intersectionality lens, which provides us with the tools to examine the nexus of social positioning and intersecting identities, that we can explore inequality and marginalization of women in science. For science education, this calls for a reconceptualization of science identity in conjunction, and not in isolation, with other identities, and to examine how these intersect with each other and either support or hinder the process of becoming a science person (Avraamidou, 2019). Such conceptualization provides space for multiplicity, diversity, subjectivity, heterogeneity, and hybridity to exist, and to, essentially, acknowledge that there exist infinite ways of becoming a science person.

From a methodological perspective, the life history approach to tracing Amina's developing science identity did yield rich insights and excavated data not easily accessible otherwise. As Amina's life-story illustrates, to become a physicist is a distinctly personal, emotional, and intimate involving in which multiple identities are intersecting and at times contesting. Such a close and detailed exploration into Amina's unique past, present, and future self would not have been possible without a single case study narrative inquiry approach. More such in-depth case studies are needed that examine the unique nature and complexity of how minoritized women in physics come to form their science identities for the purpose of shedding light on both the personal and the sociopolitical dimensions of becoming a science person.

From a research perspective, a promising area of further exploration is found at the intersection of *science identity* and *the politics of recognition*, both perceived and actual, which remains underexplored in science education research. Such research exploration calls for rethinking recognition through an explicit intersectionality lens across various geographical contexts for the purpose of examining the complex mixture of political, social, cultural, and personal factors on the formation of a science identity, especially by



minoritized religious groups. Even though quite a few researchers have examined how students as well as teachers view themselves as learners of science, future scientists or future science teachers (Avraamidou, 2014), the knowledge base of how Muslim students, teachers, and scientists are recognized as science persons by their personal, social, and professional communities is scarce. With evidence drawn out of this study and rooted in existing literature (e.g., Carlone & Johnson, 2007; Lock, Castillo, Hazari, & Potvin, 2015), I put forward an argument for an examination of how recognition supports or hinders the development of science identity, and especially how assigned and undesired identities connected to negative social stereotypes might serve as barriers to the recognition of Muslims as physicists. Such an understanding is important, because, as Gee (2000) argued, individuals should be free to choose and form their own identities and be recognized by others in that way as well:

...people must choose and form their own individual identity as a life “project,” rather than accept a set of positions determined by “outside” forces. People author their own identities...in the sense of creating identities. In turn, this leads to a dilemma: If I work to achieve a certain identity, a certain sense of myself (for example, as a certain type of male or female, gay or lesbian, Asian American or African American), I need others to recognize me in this way. I cannot any longer count on institutions or traditional authority to underwrite my identity. (p. 112)

This exemplifies the importance of recognition and how people are forced to negotiate between self-assigned identities and identities assigned by others, society or institutions. Further research would be useful to develop theorization on the salience of the politics of recognition in the process of becoming a science person, which will shed light on the question of who is considered an insider or an outsider of physics in specific contexts. Understanding where, when, how, and why minoritized groups may experience inclusion, connection and belongingness, or exclusion, isolation, and marginalization in physics offers great potential to the field of science education at different levels (e.g., teaching, learning, curriculum, policy, higher education, etc).

Concluding, the findings of this study encapsulate the pathways by which Muslim women might form and negotiate their intersectional identities and shed light on the struggles, difficulties, conflicts, and barriers they face throughout their studies and careers in physics. Amina has been deemed an outsider in the world of physics because of her foreign clothing, cultural practices, and gender, and she faced multiple identity performance challenges, conflicts, and tensions. These findings speak to the need for improving science learning and work environments, from school level to the professional level, ultimately providing inclusive and safe spaces for minoritized groups to develop a sense of belonging in physics. Currently, as a female Muslim immigrant in Western Europe, Amina feels foreign: a forever-outsider in the world of physics. The psychological and physical health costs of such social positioning of Muslims, especially in Western societies are significant (Sheridan, 2006). Hence, one might assume that Amina is currently at risk of “falling between the cracks” due to the inability and unwillingness of Western academic institutions to recognize monolithic and normative power hierarchies, which do not allow multiple identities and subjectivities to co-exist, especially in male-dominated, and predominantly White fields, such as, physics. To challenge this, academic institutions in general and physics in particular need to be reimagined and redefined as diverse worlds where multiple ways of being are recognized, where minoritized groups will not have to compartmentalize parts of their identities to exist, and where they can perform their authentic and intersectional identities.



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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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