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Invisible hierarchies in academic work and career-building in an interdisciplinary landscape

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ABSTRACT

Interdisciplinarity has become one of the catchwords in current higher education and science policies, with the underlying rationale being that scientific breakthroughs and solutions to today's global challenges require collaboration across scientific fields. However, several empirical studies have shown that interdisciplinary promises are not necessarily realised in research practices, due to manifold cognitive, epistemic, cultural and organisational barriers. Drawing on interviews with women academics working in health technology in Finland, this paper traces subtle obstacles, hidden power relations and invisible hierarchies in interdisciplinary research work. A special emphasis is placed on understanding intersections of gender and interdisciplinarity, pointing to gendered implications of the current policy rhetoric of interdisciplinarity.

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Introduction

Interdisciplinarity has become a catchword in current higher education and science policies across the world. Interdisciplinarity itself is nothing new, but its role and status have been substantially strengthened in policy discourses in recent years. On the one hand, interdisciplinary research is seen as necessary to solve today's grand challenges because these global problems are too complex for any discipline to tackle alone. On the other hand, interdisciplinarity is viewed as a space for potential, creativity and intellectual breakthroughs and, therefore, as enabling or even necessary for 'frontier research' (Hellström et al., 2018). Based on these policy trends, major funding bodies have begun to invest heavily in interdisciplinary research, to such a degree that according to Lindvig and Hillersdal (2019, 23) 'interdisciplinarity is now a *de facto* requirement in a successful grant application'.

As a result, academic researchers work in an increasingly interdisciplinary landscape. Several studies have investigated how interdisciplinarity affects research practices,

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academic identities, and career-building in academia (e.g. Albert et al., 2017; Felt, 2009; Lindvig and Hillersdal, 2019; Manathunga, 2009; Müller and Kaltenbrunner, 2019; Salmela et al., 2021; Turner et al., 2015; Woiwode and Froese, 2020). These studies have shown that the interdisciplinary promises assumed in policy discourses are not necessarily realised in everyday work practices. When embarking on interdisciplinary research, academics move beyond their disciplinary comfort zones (Griffin et al., 2013; Salmela et al., 2021) and confront cognitive-epistemological, social-cultural, and organisational-material challenges, which have implications for their academic identities and career progression.

This paper explores the tensions and challenges experienced by women academics working in an interdisciplinary field of health technology in Finland. Based on a small-scale qualitative study, the paper aims to offer a deeper understanding of the subtle obstacles, hidden power relations and invisible hierarchies in interdisciplinary research work. A further contribution to the literature is the focus on the intersections of gender and interdisciplinarity, pointing to gendered implications of the current policy rhetoric of interdisciplinarity. The research question guiding the study is: How do women academics in health technology make sense of their work and careers in interdisciplinary settings and what gendered dimensions are involved?

In the following, I first describe the Finnish higher education context, in which this study is conducted. Then I explain how interdisciplinarity is understood in this paper. Before the results section, I present my data and methodological approach. Finally, in the conclusions I summarise and reflect on the findings.

Finnish higher education context

The Finnish higher education system is rooted in the Nordic Welfare State model regarding higher education as a public good, but over recent decades it has witnessed a series of neoliberal transformations, making Finland one of the most output-oriented higher education systems among the OECD countries (Kivistö et al., 2019, 42). In 2010, the new University Act separated Finnish universities from the state administration and turned them into independent legal entities with financial autonomy and liability. Accordingly, academic staff lost their civil servant status. The system has also undergone structural reforms as several mergers between and within universities have taken place. Furthermore, the core funding from the Ministry of Education and Culture to universities has become performance-based, determined by outputs in education, research, and other policy considerations. Apart from this core budget funding, universities are dependent on external funding. Currently, half of their research funding comes from competitive external sources, mostly from Research Councils, industry, European Union and several foundations ([Suomen Akatemian Tietoaineistot](#)).

These changes have made the institutional environment of academic work increasingly competitive, turbulent, and unpredictable. The majority of academics, currently 70 per cent, work on temporary contracts (OECD, 2021). This indicates that the competition for permanent university posts is tough. Already before the neoliberal changes, getting a permanent position, especially a professorship, was a very selective process requiring candidates to wait for an open post to emerge and then compete for it against many others. Since the number of qualified academics with doctoral degrees

has grown rapidly, the competition has become increasingly stiff. What is more, the introduction of a tenure track model in 2010 has significantly changed career-building dynamics. At a rather early career phase, it distinguishes between those who are recruited to the tenure track leading to a professorship (if performance criteria are fulfilled) and those who are not on this track. Tenure track has become the most common way to recruit professors in Finnish universities (Pekkola et al. 2020), intensifying competition and polarisation among academic personnel (Herbert and Tienari 2013; Pietilä 2019).

In terms of gender, the Finnish higher education system is both vertically and horizontally segregated. The share of women at the professorial and senior academic level has increased between 2013–2019 from 38 per cent to 42 per cent, but the variations between disciplinary fields are significant, ranging from 14 per cent in ICT and electronic technology to 65 per cent in languages and behavioural sciences. In particular, many technological fields are heavily male-dominated at the top of the academic career hierarchy (Suomen Akatemian Tietoaaineistot), mirroring general gender segregation in which women are under-represented in technology-related fields and over-represented in care-related fields (SHE Figures, 2021). In this regard, the field of health technology, the focus of this study, offers a particularly interesting case because it combines male-dominated technology with the more gender-balanced or female-dominated life sciences and social sciences.

Understanding interdisciplinarity

Interdisciplinarity is a blurred and ambiguous concept, one lacking any single definition (Huutoniemi et al., 2010; Lindvig and Hillersdal 2019; Madsen, 2018). The boundary between interdisciplinarity and disciplinarity is fuzzy in itself because they are often mutually dependent and many disciplines are inherently pluralistic and evolve by splitting into and/or integrating sub-disciplines (see Korvajärvi and Vuori, 2016; Madsen, 2018). Thus, interdisciplinarity is understood in different ways across contexts. The term can refer to a cognitive, epistemological, cultural, or organisational dimension of research collaboration, often with political and ideological aspects. This suggests the existence of multiple ‘interdisciplinaritys’ (Huutoniemi et al., 2010, 80).

A variety of interdisciplinarity typologies have been created, evolving from abstract categorisations toward more context-sensitive and complex ones, as stated by Huutoniemi et al. (2010). They propose a typology that differentiates three dimensions: the scope of interdisciplinarity (what is integrated), the type of interdisciplinarity interaction (how it is done), and the type of goals pursued (why interdisciplinarity takes place). Albert et al. (2017), for their part, differentiate proximal and distal interdisciplinarity, with the former referring to collaboration in which epistemological differences are observable but limited, while, in the latter, such differences are larger. In addition, they emphasise the importance of social differences because interdisciplinarity is always embedded in social spaces that are hierarchically structured based on the distribution of power and resources.

Along with interdisciplinarity, multi-disciplinarity and trans-disciplinarity are often used to describe research collaboration between disciplines. They too are ambiguous concepts without clear definitions. One rather common understanding is that multi-disciplinarity refers to collaboration in which each discipline brings its own special knowledge to

a joint effort but disciplinary boundaries are not crossed, while in interdisciplinarity research, some integration between the fields takes place. Trans-disciplinarity means, most often, research collaboration with non-scientific actors (e.g. Felt et al., 2013), whereas interdisciplinary collaboration remains within scientific circles. Sometimes, trans-disciplinary also refers to creating distinct new theories and methods beyond the participating disciplines (e.g. Gibbons et al., 1994), whereas in interdisciplinary collaboration the disciplines are not surpassed.

In this paper, I understand interdisciplinarity in a broad sense, using it as a generic concept that refers to all research collaboration between two or more disciplines. In this, I follow Huutoniemi et al. (2010, 82), who argue that, in generic use, 'research is interdisciplinary whenever the research activity involves several fields'. In the quotes used in this paper, the interviewees speak loosely about interdisciplinarity, multi-disciplinarity, and occasionally also cross-disciplinarity, but for the purposes of this study, I treat them all as instances of interdisciplinarity.

Data and method

This study is based on career interviews with women researchers working in health technology in Finland. The study is part of a larger Nordic project, which investigates women's careers in technology-driven research and innovation within and outside academia. Health technology, as an emerging interdisciplinary field, was selected as the focus of this study because it connects the mixed-gender or predominantly female fields of life sciences and social sciences with the male-dominated field of technology and may, therefore, be more welcoming of women researchers than many traditional technological fields. In addition, health technology is a growing field with promising career prospects due to its potential to produce scientific and commercial breakthroughs.

The empirical material consists of 30 interviews in total. All interviewees had a connection to one Finnish research-intensive university. Half of the interviewees worked in the university and half worked outside in the public, private, and third sectors. Because the focus of this paper is on academic work and careers, only the 15 interviews gathered from academics are included. All interviewees were women because the research sought to understand how female academics make sense of their work in their own terms, not to compare them with male academics. Four interviewees were full professors in permanent positions, and the others worked as research group leaders or researchers, mostly on fixed-term contracts. Their disciplinary backgrounds varied rather evenly between life sciences, technology, the 'soft' social sciences, and the humanities. Most interviewees were born in the 1960s and 1970s, a couple of them in the 1980s and one interviewee in the early 1990s. Correspondingly, the length of their career histories in academia varied, generally covering several decades.

Before the interview, all interviewees were invited to draw a career line of their work histories and almost all agreed to do so. The drawings facilitated the interviewees to recall and reflect on their work experiences and enabled the interviewer to better understand how the interviewees make sense of their career trajectories. The interviews, lasting 1-2 h, were constructed in accordance with the drawings, in most cases proceeding from the beginning to the end of the career lines. The themes discussed covered work practices, motivation, career support and obstacles, networks, the role of gender, and

future goals. Specific questions of interdisciplinarity were not asked, but interviewees frequently brought it up spontaneously in diverse contexts. This indicated that working in interdisciplinary settings significantly shaped their work experiences and should be given closer scrutiny. All interviews were recorded and transcribed verbatim.

Following the sense-making methodological tradition (e.g. Weick, 1995), the data analysis was grounded in interpretative close reading, which aimed to capture how the interviewees themselves attach meanings to their work and careers. After reading the transcriptions several times, the systematic analysis proceeded in two steps. First, all extracts that touched on interdisciplinarity were collected. Second, these extracts were analysed by tracing the commonalities and differences in how interviewees described the role of interdisciplinarity in their work and careers, keeping in mind the context in which they were embedded. As a result of this data-driven analysis, two basic ways to make sense of working in an interdisciplinarity environment were distinguished, concerning: 1. relations between interdisciplinarity and monodisciplinarity, and 2. relations between disciplines, which differed depending on the disciplinary composition of the interdisciplinary research setting.

In the results section, I first investigate what it is like to perform interdisciplinary research in a discipline-driven university environment. Then, I move on to explore how social scientists and humanists experience working with academics from technological fields. After this, I examine the experiences of academics from life sciences and technology in conducting joint research work. Throughout the analysis, I present several quotes to offer a feel for how the interviewees describe their experiences. All quotes are translations from Finnish to English and all names in the quotes are pseudonyms.

Tensions between interdisciplinarity and monodisciplinarity

The interviewed women researchers in health technology make sense of their work and careers by drawing a distinction between interdisciplinarity and monodisciplinarity. The shared understanding is that disciplines are still firmly rooted in the university structure and academic culture and thereby have power over interdisciplinary pursuits. This makes interdisciplinarity settings vulnerable and academic career building in them particularly challenging. This is illustrated by the employment history of the interviewees. Four of them are full professors, and they all have strong track records in their background disciplines. In contrast, those who started their academic careers in an interdisciplinary environment or even studied in interdisciplinary programmes have been confronted with severe career obstacles and many of them are employed on temporary contracts. Thus, despite policy recommendations to break and surpass disciplinary boundaries, the interviewees have encountered a range of invisible barriers in interdisciplinarity.

Already finding a home base for interdisciplinary research in the dominant discipline-based university structure has been difficult. For instance, Sara, representing a technological field, recalls how hard it was to find a proper organisational location for her research group, which had begun to collaborate with researchers from life sciences in the early years of this millennium. She explains this difficulty via the rigidity of university structures and the reluctance of disciplines to change:

Here, the starting point is that the structure is according to disciplines, not application areas. For many, this was the logic of organising. ... When we started to combine research from the same application area, it was difficult for some to understand it. (Sara, professor)

Several interviewees describe how their institutional location has been in ‘constant turbulence’ and ‘continuous change’. Although changes are flooding all of higher education, disciplines are still seen as representing stability and safety as compared to interdisciplinary research. Hanna says that her work environment has undergone three mergers at a fast pace, starting as a small, entrepreneurially-oriented, and independent research unit and ending as part of a large faculty. This has resulted in a loss of institutional autonomy and adaptation to conventional faculty-based practices. What is more, the top faculty positions are occupied by male professors of the core disciplines who are seen to downplay and diminish female interdisciplinary newcomers (Ylijoki, [forthcoming](#)). Mia experiences this situation very negatively, pointing to the intermingling of the power of disciplines with gendered structures in academia:

There are those men who have arranged everything beforehand. This makes me feel that I am just a small mosquito in their eyes, that is to say, I am nothing at all. (Mia, senior researcher)

Also, academic reward systems are seen to favour disciplinary research over interdisciplinary research. This is particularly evident in peer review, which has a crucial role in decision-making regarding publications, major grants, recruitments, and promotions. The common understanding among the interviewees is that, in these decisions, disciplinary merits override interdisciplinary ones (see, e.g. Manathunga, 2009; Müller and Kaltenbrunner, 2019; Turner et al., 2015). Disciplines are portrayed much like Becher’s (1989) formulation of academic tribes, which protect their territories and safeguard their interests. Accordingly, eminent professors, mostly male, act as academic tribal chiefs, who have the power to define the rules of the game and secure the dominance of their disciplines:

Leading professors represent strictly their own disciplines, and they defend their disciplines’ interests and want to keep them alive despite all the changes. ... I think that disciplines still have a monopoly in the university world. (Linda, senior researcher)

While considering their career futures in academia, several interviewees thought of their interdisciplinary work history as a disadvantage because university positions tend to be granted to those who can demonstrate clear disciplinary adherence in their CVs. The competition for university positions is always fierce, and without strong disciplinary merits, it is all the more difficult or even doomed to fail, as Linda describes:

Over the last years, I have not even applied for posts in my disciplinary field because I know I am too multidisciplinary to be selected for posts in my own discipline. ... In a way, I have done multidisciplinary research, which is wanted, but doing this has drawn me into a situation in which there are no university positions available. (Linda, senior researcher)

Linda’s case is a telling one. Her relationship with her background discipline in the humanities is ambiguous and complex. Originally, she did not find the discipline’s traditional trends personally appealing, so she broadened her research pursuits toward other fields and created new and inspiring collaborative projects. In response to this

kind of disciplinary disloyalty, she felt that her academic tribe turned its back on her. She is in what Manathunga (2009) calls an ‘in-between space’, which is creative and productive but, at the same time, troubled by feelings of homelessness. Linda says that she has ‘really been on my own’ and describes herself as ‘a lone wolf’, who has become almost invisible in the eyes of the elite of her discipline. Here again, gender has a role as the elite is male-dominated. Linda says:

I have got support mainly from my friends and colleagues but not from my superiors or professors. Let’s say that none of them has prevented me from doing what I do. No one has straight forbidden me. Support means that nobody actually trips me up. (Linda, senior researcher)

Moreover, career troubles are related to how proper science is defined. Especially in technological fields, the interviewees have been confronted with strict understandings of what counts as science. In this context, a new interdisciplinary research area raises doubts about its scientific rigour. Katja, for instance, presumes that, because her area is ‘quite cross-disciplinary and not a traditional engineering field, there was a sort of legitimation problem’. Likewise, by comparing her emerging interdisciplinary research area with physics, Maria explains why it has been treated as ‘some kind of humbug’:

In physics, it is not like this. If you think about, say, Einstein’s laws, they are generally approved, and they are taught at schools, and everybody approves that the world is organised according to these laws. No one suspects them. Physics is not questioned. (Maria, senior researcher)

Maria was one of the pioneers of her special interdisciplinary area. Over the years, she has acquired extensive expertise in it, but she feels that it is not regarded as the right kind of expertise in her technological, male-dominated background discipline. Based on the notion of scientific rigour, her know-how is considered too broad and shallow. This has severely complicated her position and made her more or less invisible in her university environment. For instance, when she succeeded in obtaining influential EU funding, no one on the academic staff noticed this. Only ‘the administrative staff were like, ‘wow, this is great’’. As a result, Maria feels that her research is dismissed by her own discipline and her career has no way forward.

Furthermore, publishing mechanisms also work in monodisciplinarity’s favour (e.g. Müller and Kaltenbrunner, 2019; Salmela et al., 2021; Turner et al., 2015). When the interviewees collaborate with researchers from other disciplines, they may publish ‘in other disciplines’ journals’, which easily makes these publications look less significant or even invisible in terms of their own disciplines. Likewise, new special journals devoted to interdisciplinary research do not tend to be among the top journals with high impact factors. Jenni, originally from the field of medicine, finds the weight put on impact factors especially frustrating. She says that she has been motivated by her research itself and, therefore, she used to pay little attention to publication and career pressures. Only lately, when applying for professor positions, she has ‘faced the reality’:

I have not reflected on my research career before, but now, at this career phase, I have faced the reality, of how these priorities are divided and what things are evaluated. ... If you have a small area, a new area that is still in the process of taking shape, then the journals have small impact factors, but it does not mean that they are of worse quality. (Jenni, senior researcher)

For Jenni and several others, the main reason for engaging in interdisciplinary research in the first place was the chance to do something completely new and create cognitive and epistemic bridges that had not been built before. Due to this newness, quality assessment becomes a tricky issue. For instance, Emma emphasises that ‘no one can evaluate this ... no one has done this before. It is unique’. Adopting a similar tone, Jenni explains that it takes a great deal of time and work before the quality of new interdisciplinary research can be assessed. She makes a distinction between brave but risky interdisciplinary research and playing it safe by following well-known lines of research within disciplinary boundaries. Considering her own bad experiences with university recruitments, she does not expect institutional rewards from the former:

If you do something totally new, the scientific community cannot immediately identify with it and refer to your work because nobody has done exactly this kind of research before. Then, only time shows whether it will become significant. ... It is much easier to produce publications that are safe, to do what you have always done. If you step out of this safety zone, then it takes time ... You start everything from the beginning, develop measurement systems, test them, and search for new knowledge. I think that, at least in this university, this is not valued at all. (Jenni, senior researcher)

Thus, based on this study, academic career building in interdisciplinary research is overshadowed by the dominance of monodisciplinarity. This result supports the findings from other studies (e.g. Manathunga, 2009; Müller and Kaltenbrunner, 2019; Salmela et al., 2021; Salmela and Mäki, 2018; Turner et al., 2015; Woiwode and Froese, 2020). Although managerial power in academia is increasing, disciplines continue to have a significant gatekeeping role in assessing scientific merits. Therefore, despite policy advocacy for interdisciplinarity, academics engaged in interdisciplinary research face the risk of being marginalised and caught in a career trap.

Furthermore, this study makes visible the intersection of interdisciplinary research and gendered patterns in academia. The interdisciplinary settings in which the interviewees are working are predominantly female-dominated, whereas the background disciplinary fields, at the professorial level, are strongly male-dominated. This creates a complex mixture of hidden practices, ideals and values which work to the disadvantage of the interviewees. In this way, being a woman in an interdisciplinary research area produces a liability for double marginalisation, both as a woman and as an interdisciplinary scholar, which reproduces and strengthens invisible power relations in academia.

Tensions between disciplines in interdisciplinary research

Earlier studies have shown that interdisciplinary research often involves tensions stemming especially from cognitive, social, and organisational barriers (e.g. Albert et al., 2009; Manathunga, 2009; Müller and Kaltenbrunner, 2019; Mäkinen et al., 2020; Salmela and Mäki, 2018). The interviewees in this study have encountered similar barriers while working with researchers from other fields. However, this study goes further and shows that the experiences and tensions of interdisciplinary research vary substantially in different disciplinary settings. Two distinct cases can be discerned. The first case illustrates how social scientists and humanists describe their experiences of joint projects with

researchers in technology, whereas the second case concerns collaboration between life sciences and technology. In the following, I explore these cases separately, starting from the former.

The deep divide: 'Humanists' working with engineers

Social scientists and humanists participating in this study work with researchers from technological fields in joint projects aimed at developing health technology. This collaboration is said to involve a myriad of obstacles. The interviewees feel that there is a 'gap', 'dichotomy', or 'boundary' between these two groups because their 'traditions', 'ways of doing research', and 'whole worldview' are completely different. These cognitive and epistemic barriers are felt to be so deeply rooted that communication and mutual understanding become severely jeopardised. Laura explains the difficulties she has confronted by distinguishing them and us:

Engineers don't understand, at all, my starting point to study technology. ... We were unable to find a common ground from which to go ahead. It was really difficult. The kind of technology research that starts from engineering does not consider the impact of culture on technology. They start from product development. They develop a device, then they use it, and then they test it. It is very simple, a simple starting point. ... Their starting point is simple, whereas we who are working on this kind of technology concept, as I do, we cannot think that technology could be something separate from us. We are always part of the technological system. (Laura, senior researcher)

Cognitive and epistemic barriers are closely intertwined with social and cultural barriers, including expected ways of behaving, speaking, dressing, and so on. Leila offers an example of a situation in which she felt particularly strong discomfort and uncertainty because she did not fit in with gendered technology's 'start-up mentality':

I think I was the only woman there, and I was dressed in my typical way, jeans and a cardigan. I really felt that I was different from all the others. And also, the way they talked, I really didn't know how to talk there, how I should talk there. ... Afterwards, I was thinking that, if I could do that again, I would go there and say, without hesitation, what I really think. As a social scientist and an expert in my own field, I would say come down from your day-dreams and your rubbish hype. ... At that time, I did not have the courage to do it. (Leila, junior researcher)

The common experience of the social scientists and humanists in this study is that their way of looking at the issues and doing research is not acknowledged by technology researchers. They feel that they are treated as being of a lower rank because 'the setting is, from the very beginning, that they are so much better'. Accordingly, their voices are not truly heard, and their methodological and conceptual suggestions are disregarded. In this, their experiences support the finding that social sciences have a low status in comparison to hard sciences in the science system (e.g. Albert et al., 2017; Griffin, 2019; Müller and Kaltenburg, 2019; Salmela and Mäki, 2018).

This subtle disciplinary hierarchy appears in various ways in the interviewees' accounts of their daily work. One manifestation of such is the engineers' tendency to call all people from the soft fields 'humanists' irrespective of their actual discipline. Culturally, this is linked to a latent gender division between male engineers and female humanists. Although the term humanist is not pejorative, in this discourse, it acquires

a negative connotation, especially when combined with various jokes about humanists. Joking is not mutual as only one party is allowed to use this mode of interaction, while the other must adapt to it, thereby sustaining and strengthening uneven power relations and disciplinary hierarchies. Paula describes how these jokes affected her:

Here, I have always been a humanist for these technology people. ... I had one colleague who also came from the social sciences and had come here a little before me, and we were always the target of their jokes about humanists. From good colleagues who meant well, it was ok, no problem, but I need to admit that, at some point, we started to feel that this was a little bit too much, especially when it comes from our superior. Therefore, it was so nice to go away for a while and be among other social scientists. It had a surprisingly big impact on me, I really felt I was so at ease there. (Paula, senior researcher)

Sometimes, disciplinary superiority is expressed more visibly. Marita says that when she has stood up for her views regarding how to carry out projects it has led to open objections. In the end, 'you run into troubles trying it. I have run, several times, into troubles with them'. Seeing these troubles and conflicts, another interviewee reported that she stayed silent for almost two years because she did not dare to say anything until she had gathered enough self-confidence. This points to emotional tensions and feelings of inadequacy and incompetence after leaving one's own disciplinary home (Salmela et al., 2021). Irene, for her part, provides a particularly tense example of a visible disciplinary hierarchy. She recalls a specific incident that made a profound impact on her:

Even still, it pisses me off that junior men in electronics were really, really arrogant. I mean, they laughed out loud and rolled their eyes when I was talking. We had a seminar in London, and I had a presentation there, and if I said aloud 'gender' or 'culture' their reaction was such that I was thinking, 'Are you three years old or what?' I suppose it was not real science for them or something. It was patronising, women's business, not serious science. (Irene, junior researcher)

In Irene's account, disciplinary hierarchies clearly intersect with gendered hierarchies. This intersection is an underlying assumption in many accounts, originating from the gendered division of the science system between more male-dominated technological fields and more female-dominated humanities and social sciences. From this perspective, being a female humanist or social scientist in an interdisciplinary setting with male technological partners creates the potential for manifold marginalisation. This becomes apparent in Anita's difficulties in securing career promotion. Anita's background is in the social sciences, but she has worked with engineers several years in a technological university environment:

My husband started to ask me if I am really sure that this is not because I am a woman and don't have a degree in technology. The committee wanted to have all kinds of extra accounts from me after the external reviews. ... I worked like crazy. I had produced publications triple what the objective was, but still, it seemed that nothing was enough. (Anita, senior researcher)

It is noteworthy that Anita does not speak directly about disciplinary and gendered marginalisation but raises this question through her husband's comments. Based on this and similar accounts, it seems that it is easier to speak about disciplinary hierarchies than gendered ones. For instance, Irene, who, above, described her bad experiences with men in electronics, states later on in her interview that 'problems spring more from different

cultures than from gender'. In this way, gendered aspects of academic work and career-building may be so sensitive, hidden, and invisible that it is difficult to articulate them. It follows that the interviewees often 'do gender' by oscillating between seeing and not seeing gender as a problem (Korvajärvi, 2021).

Finally, apart from cognitive, epistemic, and cultural barriers in interdisciplinary research, it is also hampered by organisational and temporal obstacles. The collaboration in which the interviewees are participating is project-based and dependent on the success of attracting competitive external funding. Under these short-term and uncertain conditions, it is difficult to create continuity across projects, keep people together and have space for mutual learning even if there was goodwill to cross the disciplinary divide. Moreover, the current audit culture, with harsh performance pressures, complicates the possibilities for temporarily employed academics to commit themselves to time-consuming learning from each other because everybody has 'a monkey on their back', as Anna emphasises, and an urgent need to secure career continuity.

In summary, the social scientists and humanists in this study make sense of their research collaboration with academics from technology by drawing a sharp distinction between these fields, between us and them. This gap is understandable as these fields are located furthest from one another in the academic territory (Becher, 1989): technology represents hard and applied fields, whereas the social sciences and humanities exemplify soft and pure fields. Furthermore, this distinction is gendered, differentiating male-dominated technology and female-dominated soft fields. In daily work, these differences are not neutral. The tone in which the social scientists and humanists speak about collaboration resembles what Salmela and Mäki (2018) call 'disciplinary superiority', meaning that engineers underrate the expertise of the soft fields which makes the starting point for collaboration biased and uneven. These experiences can be interpreted via the concept of 'scientific imperialism' (Mäki et al., 2018). It refers to a type of interdisciplinary research in which one discipline occupies or enters into another discipline's domain and ignores or regards as categorically inferior the expertise available in the other discipline (Mäki et al., 2018). As a consequence, women academics representing social scientific and humanistic fields feel that they are put in a subordinate position, accompanied by experiences of a lack of respect and belonging, all of which undermine successful interdisciplinary research collaboration (e.g. Griffin et al., 2013; Mäkinen et al., 2020).

Mutual dependence: relations between life sciences and technology

The second case of interdisciplinary relations concerns research collaboration between life sciences and technology. In many respects, the descriptions of this collaboration are contrary to the collaboration between technology and social scientific and humanist fields. The interviewees describe positive experiences and report that their joint work is smooth, functional, and inspiring. For instance, Sanna, who works in life sciences, states that from the very beginning her collaboration has taken place 'naturally' under favourable circumstances:

I don't remember exactly at what point engineers came to this same table, but they came very early. Somehow, it just started to develop so naturally. ... No none of us had any terrible

burdens related to this university, so it was perhaps easy to start, and we didn't have enemies, so it was really a good situation to start to develop this together. Everyone wanted to do this. No one had been in a similar situation before, so we genuinely worked together and pondered and mulled over how to take this further. (Sanna, senior researcher)

The painless start did not mean that there were no cognitive or epistemic barriers. However, although the interviewees acknowledge differences in their traditions, theories, concepts, methods, tools, and standards, they do not speak about a boundary, gap, or dichotomy, as the social scientists and humanists did. This can be interpreted in light of Becher's (1989) classification: both life sciences and technology represent 'hard' scientific fields, and their cognitive and cultural distances are shorter than in the previous type of collaboration. Accordingly, the interviewees describe the complementarity of their knowledge bases:

People in engineering had studied programming and things like that. They really had different kinds of qualifications, but they didn't understand much about biology, so you could feel necessary. (Katja, junior researcher)

Importantly, this interdisciplinary collaboration was institutionalised early on in a separate unit within the university. Although the unit underwent several mergers over the years and its organisational location was repeatedly under negotiation, it offered institutional backup for researchers. Research was also linked with teaching by creating, first, courses and, later, study programmes in this emerging area. Furthermore, the research was well funded from several sources (Vehviläinen et al., [forthcoming](#)) because it belonged to policy priority areas in Finland. Due to having material and organisational resources at their disposal, researchers were able to build enduring connections, learn from one another, and commit themselves to interdisciplinary work. Emphasising the importance of long-term concentration, Krista, representing life sciences, and Johanna, representing technology, describe their experiences in a similar vein:

We met for the first time almost ten years ago, and now, we collaborate a lot. In the beginning, the ways of thinking and the starting points were totally different. It takes time to understand what the other party is doing. (Krista, professor)

We have done research together almost in the same group, plus or minus a couple of people, for more than ten years, fifteen years, so we know what people think about the other party, and surely, there is trust on both sides. (Johanna, professor)

The key feature of this interdisciplinarity is strong mutual dependence. Because expertise from both fields is needed, neither could succeed alone. This generates a balanced relationship, in which both parties have equal status and authority. Neither party can afford to seek dominance over the other, because they both have a strong interest in keeping collaboration functional and not endangering its smooth continuation. This requires time-consuming work because it does not happen in itself:

This business does not continue by itself. You must, in some way, continue adding something new to it, to boost it. Collaborative patterns do not run if you don't take care of them. It requires mutual interest to keep this alive. (Johanna, professor)

Mutual dependence creates specific dynamics in joint research work. Researchers must be alert to ensure that collaboration continues to be relevant and sufficiently intellectually

interesting for all parties. Therefore, one must know how to maximise self-interest but also how to do it so tactfully that the other party is not driven away and nobody feels that one is only serving the other (see Felt, 2009; Salmela et al., 2021). This sensitive balancing may require sacrifices to keep everyone motivated. In particular, group leaders must ensure that ‘research continues to be relevant and interesting enough for the other party too’. It is like calculating the ‘epistemic pay-off’ (Salmela et al., 2021) of the collaboration between ‘cell people’ and ‘materials people’, as Riitta remarks:

There are things that are more in our focus and other things that are the focus of the other group, but the overall pattern benefits us all. I need to analyse some samples in order to get the cell people ahead in their research, and they have to do experiments with cells so that we can test new materials. (Riitta, professor)

This delicate balancing entails very subtle forms of competition for control and authority concerning who is truly leading the collaboration and what knowledge counts most. For instance, there are underlying differences concerning the proper rhythm of research: who sets the timeline and who needs to adapt to it. Likewise, there are slightly different views on whether basic research or applied research is the most valued. This kind of competition creates occasionally hidden tensions between the fields. For instance, Johanna, coming from technology, makes critical remarks about medicine:

We had clinicians in the project, and it has taught me a lot about how difficult it is to control them. Although we have agreed on common rules ... they begin so easily to change them because they must get their own thumbprint on it. It is demanding. (Johanna, professor)

Despite this kind of delicate struggle for authority, daily work experiences are not very affected, and the interviewees feel that the collaboration proceeds steadily almost out of habit. However, career-building in the shadow of monodisciplinarity poses severe problems for all interviewees without a permanent position. As discussed in the first part of the results section, career worries are interrelated to gender. Female interviewees in temporal positions experience that their career advancement is hampered by influential neighbouring disciplines in technology and medicine, both of which are male-dominated at the professorial level.

In addition to gender, career worries are also related to generation (see Martimiakis and Muzzin, 2015). All interviewees of the older generation are full professors, and they have strong credentials in their background disciplines. In contrast, those at the middle-career level, having a long work history as principal investigators and research group leaders in interdisciplinary research, experience particularly strong career strain. They have secured funding for their groups for years or decades but feel trapped in their current positions in disciplinary-biased recruitment assessments. Early career researchers, for their part, are hesitant about whether to stay in academia at all because competition for funding and positions is demanding and employment insecurity is high. (Ylijoki, *forthcoming*).

In summary, research collaboration between life sciences and technology is characterised as ‘serious’, ‘natural’ and ‘real’ interdisciplinarity. Both parties are mutually dependent on one another’s expertise and see collaboration as the best way to advance science in their specific areas. In this, the interviewees’ descriptions are in line with what has been found to be important for positive interdisciplinarity, especially complementary

expertise, mutual trust, shared interests, time availability, and collective excitement (Hellström et al., 2018; Mäkinen et al., 2020; Salmela and Mäki, 2018). The closer scrutiny reveals that there are also some tacit power struggles between the fields and subtle hierarchies between career categories and generations of academics. Yet, the common challenge is male-dominated monodisciplinarity, which overshadows women academics' experiences in their interdisciplinary work.

Conclusions

In higher education and science policy discourse, interdisciplinarity is often presented as a unified and 'an all-inclusive category' that obscures local heterogeneities, as pointed out by Lindvig and Hillersdal (2019). The findings of this study support this argument. Interdisciplinarity received substantially different meanings depending on the fields of the collaborating partners. The distinction between proximal and distal interdisciplinarity drawn by Albert et al. (2017) helps to understand these differences. Joint research projects between the soft fields and hard technological fields represent distal interdisciplinarity, in which cognitive and social barriers are obvious, whereas collaboration between life sciences and technology represent proximal interdisciplinarity, which makes it easier to build common ground for research collaboration. Therefore, when advocating for interdisciplinarity it would be important to clarify what kind of interdisciplinarity is in question and consider its specific characteristics.

Apart from cognitive and social barriers, this study also shows that the nature of interdisciplinary research is dependent on organisational and material circumstances. Social scientists' and humanists' collaboration with technology presents an example *par excellence* of the projectification of science (Ylijoki, 2015). Their joint research was project-based and carried out on insecure and competitive external funding, which hindered the building of long-term and trusting relationships needed for mutual learning. By contrast, the collaboration between life sciences and technology was institutionalised in the university structures with some permanent positions, providing organisational support and resources for joint projects. Based on this result, it can be claimed that functional interdisciplinary research would require long-term institutional commitment and sufficient resources from universities.

Despite these differences in interdisciplinary research, the shared understanding among the interviewees in this study is that interdisciplinarity is overshadowed by the power of monodisciplinarity. In line with previous studies (e.g. Felt, 2009; Müller and Kaltenbrunner, 2019; Turner et al., 2015; Woiwode and Froese, 2020), this became particularly acute in academic reward structures and career building. Thus, it can be argued, in accordance with Manathunga (2009), that significant changes must be made to academic appointment and promotion processes to pave the way for career-building in interdisciplinary research.

Another key contribution of this study concerns the intersection of gender and interdisciplinarity. In the interviewees' experiences, the tensions and barriers in interdisciplinary research were deeply rooted in persistent gendered structures in academia, particularly related to vertical and horizontal career segregation, subtle hierarchies between disciplinary fields, and gendered work cultures and values, which all worked against women academics. This created a risk for getting trapped in double

marginalisation, both in terms of gender and discipline. To support the inclusion of more women in technology-driven research and innovation, these visible and invisible biases need to be urgently exposed, reflected on, and counteracted so that these areas become more welcoming for women academics.

This paper is based on a small-scale qualitative study enabling access to subjective experiences and cultural meanings of work in interdisciplinary settings in health technology in Finland. The results, however, cannot be generalised to apply to various kinds of interdisciplinary research in different institutional contexts and higher education systems. In future research, it would therefore be important to expand the research methods and empirical coverage to produce more generally applicable knowledge. Another limitation is that the empirical material of this study comprises only women's experiences since the aim was to understand women's perspectives, without comparing them with men. Yet, in future research, it would be important to also include men's experiences to acquire a more multidimensional understanding of the gendered structures and practices of interdisciplinary research work.

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References

- Albert, M., S. Laberge, and B. D. Hodges. 2009. "Boundary-Work in the Health Research Field: Biomedical and Clinician Scientists' Perceptions of Social Science Research." *Minerva* 47 (2): 171–194.
- Albert, M., E. Paradis, and A. Kuper. 2017. "Interdisciplinary Fantasy." In *Investigating Interdisciplinary Collaboration: Theory and Practice Across Disciplines*, edited by S. Frickel, M. Albert, and M. Prainsack, 5–24. New Jersey: Rutgers University Press.
- Becher, T. 1989. *Academic Tribes and Territories*. Buckingham: Society for Research into Higher Education and Open University Press.
- Felt, U. 2009. *Knowing and Living in Academic Research*. Prague: Institute of Sociology of the Academy of Sciences of the Czech Republic.
- Felt, U., J. Igelsböck, A. Schikowitz, and T. Völker. 2013. "Growing Into What? The (un-)Disciplined Socialisation of Early Stage Researchers in Transdisciplinary Research" *Higher Education* 65: 511–524.
- Gibbons, M., C. Limoges, H. Novotny, S. Schwartzman, P. Scott, and M. Trow. 1994. *The New Production of Knowledge*. London: Sage.
- Griffin, G. 2019. "Intersectionalized Professional Identities and Gender in the Digital Humanities in the Nordic Countries." *Work, Employment and Society* 33 (6): 966–982.
- Griffin, G., K. Hamberg, and B. Lundgren. 2013. "Introduction." In *The Social Politics of Research Collaboration*, edited by G. Griffin, K. Hamberg, and B. Lundgren, 16–52. New York: Routledge.
- Hellström, T., E. Brattström, and L. Jabrane. 2018. "Governing Interdisciplinary Cooperation in Centers of Excellence." *Studies in Higher Education* 43 (10): 1763–1777.
- Herbert, A., and J. Tienari. 2013. "Transplanting Tenure and (Re)construction of Academic Freedoms." In *Studies in Higher Education*, 38 (2): 157–173. London: Routledge.
- Herschberg, C., Y. Benschop, and M. van den Brink. 2019. "The Peril of Potential." In *Gender and Precarious Research Careers*, edited by A. Murgia, and B. Poggio, 111–142. London: Routledge.
- Huutoniemi, K., J. Thompson Klein, H. Bruun, and J. Hukkinen. 2010. "Analyzing Interdisciplinarity: Typology and Indicators." *Research Policy* 39 (1): 79–88.
- Kivistö, J., E. Pekkola, L. Nordstrand Berg, H. Foss Hansen, L. Geschwind, and A. Lyytinen. 2019. "Performance in Higher Education Institutions and Its Variations in Nordic Policy." In *Reforms, Organizational Change and Performance in Higher Education*, edited by R. Pinheiro, L. Geschwind, H. Foss Hansen, and K. Pulkkinen, 37–67. Cham: Palgrave Macmillan.
- Korvajärvi, P. 2021. "Doing/Undoing Gender in Research and Innovation – Practicing Downplaying and Doubt." *Feminist Encounters: A Journal of Critical Studies in Culture and Politics* 5 (2): 27. doi:10.20897/femenc/11164.
- Korvajärvi, P., and J. Vuori. 2016. "A Classroom of Our Own." *Women's Studies International Forum* 54: 138–146.
- Lindvig, K., and L. Hillersdal. 2019. "Strategically Unclear? Organising Interdisciplinarity in an Excellence Programme of Interdisciplinary Research in Denmark" *Minerva* 57 (1): 23–46.
- Madsen, D. 2018. "Epistemological or Political? Unpacking Ambiguities in the Field of Interdisciplinarity Studies" *Minerva* 56 (4): 453–477.
- Manathunga, C. 2009. "Post-colonial Perspectives on Interdisciplinary Researcher Identities." In *Academic Research and Researchers*, edited by A. Brew, and L. Lucas, 131–145. Maidenhead: Society for Research into Higher Education & Open University Press.
- Martimianakis, M. A., and L. Muzzin. 2015. "Discourses of Interdisciplinarity and the Shifting Topography of Academic Work: Generational Perspectives on Facilitating and Resisting Neoliberalism." *Studies in Higher Education* 40 (8): 1454–1470.
- Mäki, U., A. Walsh, and M. Fernández Pinto. 2018. "Introduction." In *Scientific Imperialism*, edited by U. Mäki, A. Walsh, and M. Fernández Pinto, 1–10. London: Routledge.
- Mäkinen, E., E. D. Evans, and D. A. McFarland. 2020. "The Patterning of Collaborative Behavior and Knowledge Culminations in Interdisciplinary Research Centers." *Minerva* 58 (1): 71–95.

- Müller, R., and W. Kaltenbrunner. 2019. "Re-disciplining Academic Careers? Interdisciplinary Practice and Career Development in a Swedish Environmental Sciences Research Center" *Minerva* 57 (4): 479–499.
- OECD. 2021. *Reducing the Precarity of Academic Research Careers. OECD Science, Technology and Industry Policy Papers, no. 113*. Paris: OECD Publishing.
- Pekkola, E., T. Siekkinen, E.-N. Kujala, and J.-P. Kanninen. 2020. *Professoreiden rekrytoinnit*. Helsinki: Professoriliitto.
- Pietilä, M. 2019. "Incentivising Academics: Experiences and Expectations of the Tenure Track in Finland." *Studies in Higher Education* 44(6): 932–945.
- Salmela, M., M. MacLeod, and J. Munck af Rosenschöld. 2021. "Internally Incentivized Interdisciplinarity: Organizational Restructuring of Research and Emerging Tensions." *Minerva* 59(3): 355–377.
- Salmela, M., and U. Mäki. 2018. "Disciplinary Emotions in Imperialistic Interdisciplinarity." In *Scientific Imperialism*, edited by U. Mäki, A. Walsh, and M. Fernández, 31–50. London: Routledge.
- Suomen Akatemian Tietoaaineistot. <https://www.aka.fi/suomen-akatemian-toiminta/tietoaaineistot/tieteen-tila/>.
- Turner, V. K., K. Benassaiah, W. Scott, and D. Iwaniec. 2015. "Essential Tensions in Interdisciplinary Scholarship: Navigating Challenges in Affect, Epistemologies, and Structure in Environment–Society Research Centers." *Higher Education* 70 (4): 649–665.
- Vehviläinen, M., H.-M. Ikonen, and P. Korvajärvi. *Forthcoming*. "Changes in Funding and the Intensification of Gender Inequalities in Research and Innovation." In *Gender Inequalities in Tech-Driven Research and Innovation: Living the Contradictions*, edited by G. Griffin. Bristol: Polity Press.
- Weick, K. E. 1995. *Sensemaking in Organizations*. Thousand Oaks, CA: Sage.
- Woiwode, H., and A. Froese. 2020. "Two Hearts Beating in a Research Centers' Chest." *Studies in Higher Education*. Advance online publication. <https://doi-org.libproxy.tuni.fi/10.1080/03075079.2020.1716321>.
- Ylijoki, O.-H. 2015. "Conquered by Project Time?" In *Universities in the Flux of Time*, edited by P. Gibbs, O.-H. Ylijoki, C. Guzmán-Valenzuela, and R. Barnett, 94–107. Abingdon: Routledge.
- Ylijoki, O.-H. *Forthcoming*. "Navigating Career Imaginaries in Academia." In *Gender Inequalities in Tech-Driven Research and Innovation: Living the Contradictions*, edited by G. Griffin. Bristol: Polity Press.