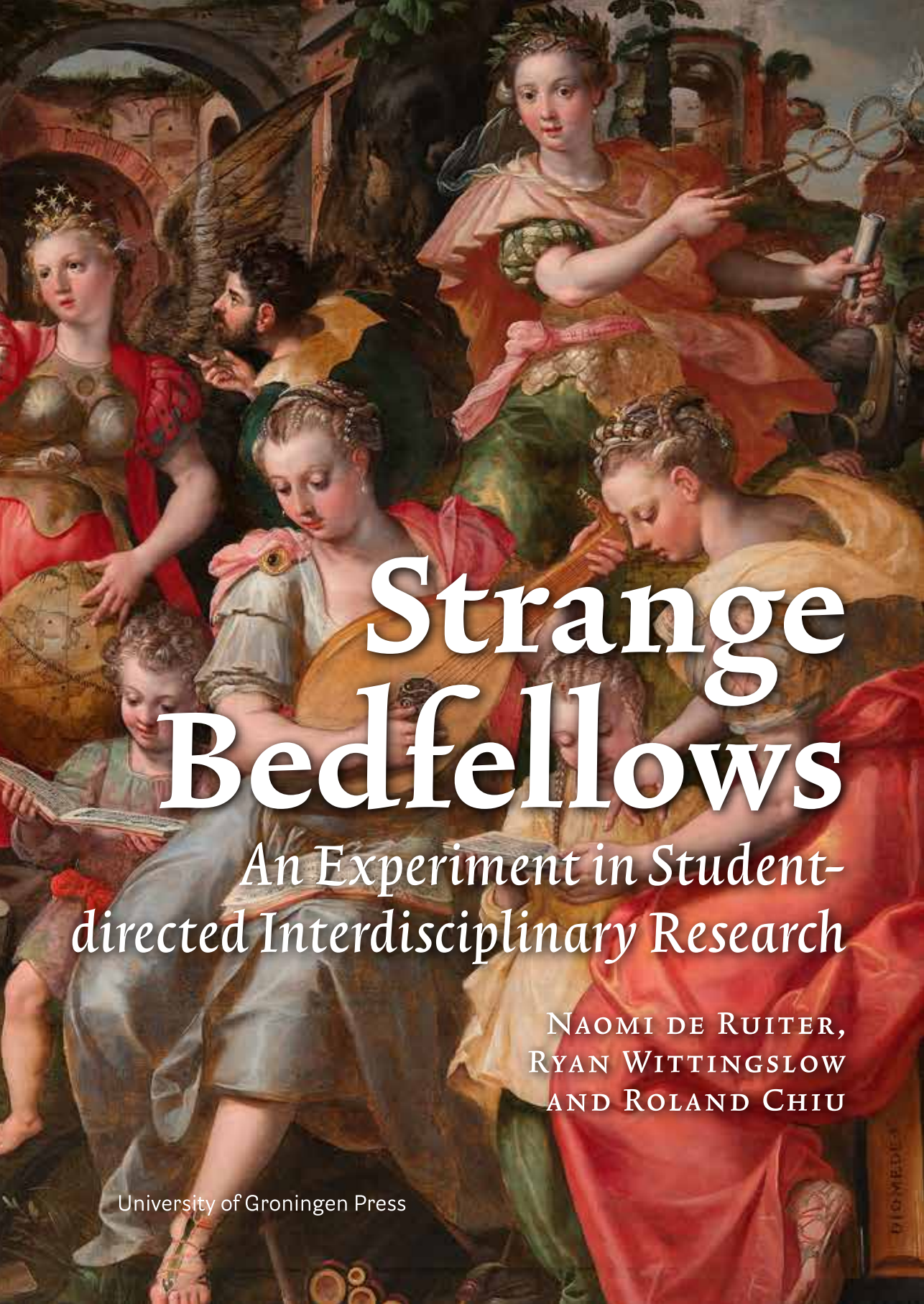

Strange Bedfellows

An Experiment in Student-directed Interdisciplinary Research

Naomi de Ruiter,
Ryan Wittingslow
and Roland Chiu

University of Groningen Press

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This book is for Advay. We owe a great deal to the kindness, inquisitiveness, and encouragement that he brought to the early days of this project.

Advay, you are dearly missed.

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INTRODUCTION:

Making Strange

Naomi de Ruiter, Ryan Wittingslow & Roland Chiu

In Theory...

According to an entry in *Notes*, the Social Science Research Council newsletter, the first attested use of the word 'interdisciplinary' appears in a 1937 notice advertising postdoctoral research fellowships that furnish "training of an interdisciplinary nature" (Sills, 1986, p. 18). It is clear even in this early document that interdisciplinary training is framed as affording an epistemic virtue: it presents an opportunity to "broaden the research training and equipment of promising young social scientists" ('Research Projects', 1937, p. 251).

From these relatively modest beginnings, the word 'interdisciplinary' and its derived forms are now everywhere. Not only do they occupy a central place in the vocabularies of universities—they attract "considerable hype", to quote a humorously (though perhaps not intentionally) deadpan report from the

Amsterdam Young Academy (Douw et al., 2022, p. 4)—'interdisciplinary' teaching and research is also cited as an object of desire by governments and large corporate entities. Students and workers are told that they need to be interdisciplinary in order to adequately prepare for life and work in the 21st century.

While this development might feel new, it's actually a consequence of a much older change in the way knowledge is produced. The 1937 use of 'interdisciplinary' is a consequence of the explosion of disciplinary knowledge that typifies post-18th-century academic research. Thanks to grand advances in scientific methods and technologies during the Scientific Revolution and the Age of Enlightenment, the last two hundred years have witnessed a spectacular multiplication in the number of academic disciplines: a glittering explosion of narrow intellectual taxa, each with their own methods, vocabularies, conceptual frameworks, research infrastructures, funding instruments, and sacred cows. Philosophy, the queen of the sciences, calved into countless subordinate fields, both experimental and theoretical. New disciplines appeared as if overnight, monstrous and hyper-specialised: chromed thoroughbreds of knowledge production.

This process of speciation and specialisation, however, came at a cost. As different disciplines specialised and deepened, they also by necessity became more siloed. Consequently communication between disciplines grew more and more difficult. No longer was it possible for a clever person with enough time and capital on their hands to have deep disciplinary expertise in multiple domains, as might have been the case until even the late 19th century; the price of expertise simply became too high.

The cost associated with disciplinary speciation and specialisation soon became too big to ignore. In the 20th century—and in particular the post-Second World War period—scholars began to identify an ever-increasing number of what we now call 'complex' or 'wicked' problems: problems such as climate change, social injustice, nuclear weapons policy, drug trafficking, pandemic responses, the Cold War, and so on. Because complex problems are so massive and diffuse, scholars realised, it's simply not possible for complex problems to be solved, or resolved, via the methods and knowledge of a single discipline. Tasked with needing to actually solve these issues, it became increasingly clear that specialist scholars would need to (re)learn how to communicate not only within disciplinary silos, but between them. It is only by becoming *interdisciplinary* that these big problems could be

adequately addressed—and it is this need of which the 1937 notice is the first attested articulation.

As the academy became more obviously siloed and our problems more obviously wicked, use of the word 'interdisciplinary' and its derived terms exploded from the mid-20th century. Perhaps the most influential use of the word can be found in a 1972 report issued by the OECD. In that document, the authors argue that the disciplinary siloing of the contemporary university had caused undeniable social damage; interdisciplinary teaching and research was the only way out. "The guiding principle is not the need to demolish the disciplines, but to teach them in the context of their dynamic relationships with other disciplines and with the problems of society", they write. "This is justified if only because of the increasing social costs of the over-specialisations of knowledge. Indeed, it may be argued that one of the reasons for the tarnished image of science is public reaction to its power to produce specialised applications of knowledge [...]" (1972, p. 9). Strong sentiments indeed.

Also to be found in this report is a typology of interdisciplinarity: a typology that, due to the importance and influence of this report, quickly became conventional amongst teachers and researchers interested in different kinds of cross-disciplinary collaborations. It is worth quoting this typology at length:

> **Discipline:** A specific body of teachable knowledge with its own background of education, training, procedures, methods and content areas.
>
> **Multidisciplinary:** Juxtaposition of various disciplines, sometimes with no apparent connection between them, e.g.; music + mathematics + history.
>
> **Pluridisciplinary:** Juxtaposition of disciplines assumed to be more or less related, e.g.: mathematics + physics, or French + Latin + Greek: "classical humanities" in France.
>
> **Interdisciplinary:** An adjective describing the interaction among two or more different disciplines. This interaction may range from simple communication of ideas to the mutual integration of organising concepts, methodology, procedures, epistemology, terminology, data,

> and organisation of research and education in a fairly large field. An interdisciplinary group consists of persons trained in different fields of knowledge (disciplines) with different concepts, methods, and data and terms organised into a common effort on a common problem with continuous intercommunication among the participants from the different disciplines.
>
> **Transdisciplinary:** Establishing a common system of axioms for a set of disciplines (e.g., anthropology considered as "the science of man and his accomplishments", according to Linton's definition). (OECD, 1972, 23-24)

Not all of these remain in common use: 'pluridisciplinary' in particular, while to our eyes a useful distinction, has largely been devolved into a subordinate kind of interdisciplinarity rather than being a kind of disciplinarity in its own right. Nonetheless, most contemporary work on interdisciplinary teaching and research relies on some version of this typology, whether explicitly or otherwise.

...and in Practice...

These are all very fine sentiments, motivated by a justified concern that monodisciplinary teaching and research is simply inadequate for dealing with the problems of the modern world. But this well-stated need is only the first step. We still need to know how interdisciplinarity actually works in practice. What does it look like in the classroom, or in the research laboratory, or in the dusty, wood-panelled chambers of an Oxford don? How should we recognise it? What constitutes the set of best practices for interdisciplinary teaching and research?

We know that to be interdisciplinary is to work at the site of overlap between two or more different disciplines, and that these disciplines should be of sufficient distance before you begin. (Otherwise you would be merely 'pluridisciplinary'; a much less impressive feat.) Unfortunately, however, this doesn't give us very much with which to work. Even ignoring the conceptual problem of measuring the distance between disciplines (it is not clear, for instance, whether that distance should be measured morphologically or cladistically, let alone how those differences could be adequately justified),

there's little in the definition to suggest how exactly we should begin this enterprise. Moreover, the little that is offered—the comment on the composition of interdisciplinary groups—strikes us as insufficient.

We take this insufficiency to rest upon a basic assumption—common to much of the material on interdisciplinary and transdisciplinary teaching and research—that all scientific truths are basically and blandly reconcilable: that is, that a truth isolated in one domain will be compatible with all other true claims. This attitude is one that has its origins in the whiggish optimism of Enlightenment science. Per Isaiah Berlin, this optimism is underwritten by three interlocking propositions: first, that questions only have one correct answer; second, that methods exist to discover those answers; and third, that answers cannot be incompatible. As he describes the phenomenon:

> The first proposition is this: to all genuine questions there can only be one correct answer, all the other answers being incorrect. If there is no correct answer to it, then the question cannot be a genuine one. [...] The second assumption is that a method exists for the discovery of these correct answers. Whether any man knows or can, in fact, know it, is another question; but it must, at least in principle, be knowable, provided that the right procedure for establishing it is used. The third assumption [...] is that all the correct answers must, at the very least, be compatible with one another. That follows from a simple, logical truth: that one truth cannot be incompatible with another truth. [...] At best, these truths will logically entail one another in a single, systematic, interconnected whole; at the very least, they will be consistent with one another. (Berlin, 2013, p. 25-26)

Of course—and as Berlin himself argues—we now have good reason to be suspicious of these assumptions. There exist any number of apt descriptions of phenomena within given disciplinary domains that may not be portable outside of that domain.

Consider, for instance, perhaps one of the most famous examples from 20th century science. Einsteinian relativity and quantum physics are equally proficient at furnishing good descriptions and explanations within their particular domains. General relativity is useful for describing and predicting the causal behaviour of larger entities, while quantum physics is useful for describing and predicting the probabilistic behaviour of particles. These

theories are fundamentally incompatible with one another (cf. Maxwell, 1985). Relativity is premised upon the assumption that gravitational fields are continuous entities that represent the geometric properties of 4-dimensional spacetime. Quantum physics is premised upon the assumption that fields are *discontinuous*, being composed of well-defined quanta. This means that there can be no analogue for gravitational fields in quantum physics, and it is this lack of analogue that renders the theories incompatible. We will not weigh in on whether or not this incompatibility is evidence of some deeper epistemic disagreement; we happily leave answering that question to those with the relevant interests and training. What *is* worth noting though, is that this compatibility issue (a violation of Berlin's third proposition) is a direct consequence of the fact that there exist two equally apt but non-reconcilable correct ways of describing the world (a violation of the first proposition).

The potential irreconcilability of knowledge claims is not the only problem facing interdisciplinary collaboration. Interdisciplinary collaborations also face stumbling blocks when it comes to establishing methodological or definitional norms. What constitutes convention and/or good practice in one domain may not be apt in another. To share a personal anecdote: some years ago, one of the editors of this volume collaborated with a psychologist, a biologist, and a fellow philosopher on an interdisciplinary paper exploring the different ways in which a person could love their country (cf. Ioannou et al., 2021). As part of that process, the four contributors spent more than one agonising—though, it must be admitted, ultimately fruitful—afternoon in a local café just establishing what we mean when we talk about something being a 'fact'. While we appreciate that this sounds trivial (and, rest assured Dear Reader, it *felt* trivial), it ultimately proved very important to the eventual success of the paper. Had we not gone to the effort of performing that foundational conceptual work, we strongly suspect the paper would never have been published at all.

These kinds of agonising yet fruitful negotiations take place constantly at the University College Groningen (UCG): the faculty at the University of Groningen with whom all the contributors to this volume are affiliated in one form or another. UCG, like all Dutch university colleges, is an interdisciplinary institution premised upon the idea that interdisciplinary collaborations offer all kinds of distinct epistemic and other benefits that are hard to achieve in order environments: benefits like, for instance, being able to speak across the aforementioned disciplinary silos.

And yet, in spite of that grand vision, our students and faculty are constantly confounded by the lack of appropriate rules, guidelines, or best practices when it comes to making interdisciplinary collaborations work. Contrary to the whiggish optimism of most literature on interdisciplinarity, and thanks to the blunt lessons offered by experience, we have learned that interdisciplinary collaboration is, to put it frankly, *really bloody difficult*. We have also become keenly aware just how much of the success of interdisciplinary collaborations is due to the heroic efforts and grit of collaborators. Success cannot simply be assumed. Instead, it is only with hard conceptual labour that the norms, concepts, and practices of different disciplines can be brought into (even momentary) alignment.

...Together

That is where this book comes in. This volume—a collaboration between UCG students, internal faculty, and external staff—is the distillation of years of insight about how to do interdisciplinarity properly. It deals with the methods, approaches, experiments, and challenges that we've encountered, and how we've succeeded (and failed!) in overcoming those challenges.

Crucially, we've encountered and negotiated these challenges together. While disciplines come with sets of shared knowledge of procedures, methods and content areas, little shared knowledge exists for interdisciplinary spaces. We establish these procedures, methods, and conceptual grounding as we go. Sometimes this process begins with an instructor who wants to broaden their pedagogical toolkit within the classroom, sometimes it begins with a student who questions a disciplinary norm. When it comes to interdisciplinary work in practice, we find that co-constructing these spaces with students is inevitable and valuable.

This volume is an experiment that tests the principle of co-constructing knowledge with students. In doing so, we test the boundaries between education and research. We do so by explicitly treating our student contributors not as students, but as researchers. Loosely guided by faculty members in a supervisory role (either during the writing of the chapter, or beforehand in the context of project work), students were given the opportunity to experience first-hand what it means to develop their own research question or proposal, how to select and engage in research methodology, how to communicate what they did in an academic chapter, and perhaps most uniquely,

what it means to contribute to an edited volume. As editors, we—Naomi de Ruiter, Ryan Wittingslow, and Roland Chiu—interacted with the student authors as if they were professional researchers; offering reviews of their work and communicating decisions regarding minor or major revisions that were needed, up until acceptance of their chapters. None of this work was done for credits or grades; it was done out of curiosity and ambition.

With the following chapters, the reader is invited into the process and the outcomes of student-driven education; where students were given the opportunity to pursue their own curiosity, and to take charge of their own acquisition of knowledge. For some of the students, this involved exploring and unpacking their own experiences of learning (Chapters 5 and 6), where they adopted the role of researcher and participant, knower and that which is known. For others, students adopted the role of researcher, engaging in empirical and/or conceptual scholarship. In all cases, students inquired into interdisciplinarity in some way or another. What this meant ranged from how interdisciplinarity research can be done (Chapters 1 and 2), to how innovative research methods can reveal interdisciplinary understanding (Chapter 6), to how non-traditional domains of knowledge construction (i.e., art) can contribute to either philosophical knowledge itself (Chapter 3) or to learning about philosophical knowledge and debates (Chapter 5).

In all cases, students learned what it means to be a researcher, and they engaged deeply with interdisciplinarity. Their reflections on this process can be found in Part 3 of this volume. The knowledge that was constructed regarding interdisciplinary in both broad and rich, as evidenced by the chapters in this volume. Below, we outline what the contributions are to our understanding and practice of interdisciplinarity.

Part I: Foundations and Conceptualizations

In Chapter 1, Daniel MacRae and Hubert Matuszewski lay the foundation for this book, with an all-encompassing framework for engaging in and understanding the collaborative interdisciplinary research process: from selecting an appropriate topic to publishing results. The framework is descriptive, rather than prescriptive, drawing from literature as well as extensive survey research from interdisciplinary researchers working across a wide range of disciplines and from all over the globe. The large-scale data is complemented by in-depth interviews, offering nuance for the framework. With their frame-

work, they offer general descriptions, considerations and recommendations for interdisciplinary researchers.

Chapter 2 builds on Chapter 1, as it draws from a unique portion of the data collection from Chapter 1. MacRae and Matuszewski shift their focus to a consideration of the factors that propel or hinder collaboration in the context of interdisciplinary research. They build on the current literature regarding the practical and unique elements of collaboration in interdisciplinary settings by examining the experiences of researchers via large-scale survey results and in-depth interviews. The chapter provides considerations and suggestions regarding aspects of collaborative work in interdisciplinary settings, including team size, collaboration experience, team-member roles, unique skills, and the influence of disciplines. Together, Chapter 1 and 2 thus provide a critical and useful guide for engaging in research that involves a team of researchers from various disciplines.

In Chapter 3, Patrik Wintergerst and Dr. Benjamin Bewersdorf argue for a specific set of strange bedfellows: art and philosophy. Specifically, they suggest that engagement with artwork can bring about experiences which can function as evidence in philosophical arguments. They illustrate this idea with two specific examples, the duck-rabbit drawing in Wittgenstein's *Philosophical Investigations*, and the use of sculpture and related methods in the context of Buddhist practices. With their chapter, Wintergerst and Bewersdorf show that art offers a valid way of knowing, and thus bridges what may otherwise be seen as a non-academic domain with an academic domain. This chapter also pushes Western scholars to look beyond their own academic culture, and to embrace non-western philosophical traditions which rely more heavily on the aesthetic transmission of ideas.

Part II: Case Studies: Interdisciplinary Education

With Chapter 4, Catherine Lange, Elena Laviolette Di Carpegna, Mosele Jansen, Stela Gkika, and Dr. Marline Lisette Wilders explore the opinions and expectations about interdisciplinary education by examining the University College Groningen as a case study. Specifically, they describe the viewpoint of students, lecturers, and management that attend and work at UCG, and they explore the limitations and strengths of the interdisciplinary educational approach as conducted at UCG. They do so with an interview study, showing that students, lecturers, and management expressed similar ideas about what interdisciplinarity is, that an interdisciplinary education requires

a sufficiently strong disciplinary foundation, and that an interdisciplinary education benefits students by helping them to think outside of the box and to improve their communication skills—two skills that are expected to increase job opportunities after graduation. The student sample and the faculty sample had different ideas about the more specific goal of interdisciplinarity, where students described the contribution to solving complex problems, whereas faculty emphasised the usefulness for gaining a unique understanding of more concrete concepts or topics. The results draw attention to the need to make the goals of interdisciplinarity more explicit within the educational program, as well as the need for strong disciplinary foundations.

In Chapter 5, Twan Tromp, Kerstin Baureis, and Dr. Benjamin Bewersdorf argue that art-making projects should be considered as an additional, and highly useful, educational practice for active learning. Drawing on first-hand experiences of this active-learning method, they show how art-making provides a context in which students themselves are responsible for the generation of knowledge. As such, this method used similar principles as techniques such as flipped classrooms or project-based learning assignments. Engaging in art-making is described as unique as it challenges students to translate a philosophical debate into an artwork. In doing so, students are encouraged to gain a deeper understanding of the philosophical debate, to be open to new opinions within this debate, and to make these philosophical debates their own. While the authors focus their proposal on philosophy education, they suggest that art-making can be used in all domains of education as a useful way of activating students and engaging them in deep learning. As such, this chapter echoes the main thesis in Chapter 3, namely that art should be taken more seriously within the academic domain; but this chapter outlines how it can be used in education itself.

In Chapter 6 Julius Bischof, Alison Cronin, Nikolai Levin, Omer Levy, Mira Singh, and Dr. Ferdinand Lewis describe an innovative method that can be used for gaining new perspectives. The chapter provides an illustration of how autobiographical reflective writing can contribute to the interdisciplinary understanding of well-being, understood as human flourishing across multiple dimensions. In the chapter, the student authors describe their own process of delving into this method, which took place within an educational setting. They demonstrate how the open-ended nature of this kind of reflec-

tive writing is uniquely capable of eliciting a wide range of information about what well-being means, and as such, that well-being is an interdisciplinary concept. This reflexively-written chapter simultaneously demonstrates the process of learning how to engage in research from the student perspective, and demonstrates a way of engaging students with the concept of interdisciplinarity through experiential learning.

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PART I
Foundations and Conceptualizations

CHAPTER 1

A Framework for Interdisciplinary Research

Daniel MacRae & Hubert Matuszewski

Introduction

Interdisciplinary research (IDR) has gained traction in recent decades. It is widely seen as an emerging solution to complex problems that lie beyond any one academic discipline, such as climate change or world hunger. As Myburgh and Tammaro (2013) put it:

> The need for interdisciplinarity arises from developments in knowledge and culture that are characterised by complexity, hybridity, non-linearity, reflexivity, and heterogeneity. Many complex or practical

> problems can be understood only by pulling together insights and methodologies from a variety of disciplines; many problems require holistic approaches. (p. 124)

However, there are a myriad of interpretations and definitions of the term "interdisciplinary research." One of the major obstacles to developing a better understanding or a single coherent definition of IDR lies in the lack of an all-encompassing framework; there is little understanding of the different forms and processes of IDR. In this chapter, we propose a framework that makes room for nuances in the processes and methodologies of IDR. Before presenting the framework itself, we describe our methodology, which makes use of a variety of research methods, namely; a literature review of IDR and interdisciplinarity in general, a survey, and interviews. We then rationalise our understanding and definition of IDR as a collaborative process wherein researchers integrate their respective (disciplinary) knowledge. This view serves as a platform for our framework, which is then discussed for the remainder of this chapter.

Methodology

Our research began with a literature review of papers and chapters covering the subjects of interdisciplinarity, the theory and process of IDR, how to assess the quality of IDR, case studies of IDR, various disciplinary research methods, as well as the processes of obtaining funding for and publication of IDR. While we were able to develop a solid theoretical framework, ambiguities surrounding certain stages of IDR, some of the motivations of researchers, and methodologies of certain fields (especially those that were neither qualitative nor quantitative), remained. As such, we opted to supplement our literature review with the experiences of interdisciplinary researchers through the use of multiple interviews and a survey. These methods serve as a litmus test for literature-based assumptions and understandings of IDR and its process; yielding more nuanced positions on IDR, and further enriching our framework. As this framework was developed and refined using both the literature review and our empirical studies, their results will be reported together, following this methodology section, to rationalise the design of our descriptive framework for IDR.

These methods also contain questions surrounding the topic of collabora-

tion and team-building in IDR—as we believe that this subject is inherently linked to our view and definition of IDR—as well as to the IDR framework we will put forward in this chapter. While these topics were included within the survey and interviews described here, the results of these parts of the survey and interview are not discussed in this chapter as they pertain more to the (practical) matters of interdisciplinary collaboration, rather than the research process itself. Instead, the results regarding the subject of teamwork and collaboration are discussed in Chapter 2.

Sample

In order to accommodate the myriad of research practices and forms of IDR, our survey and interview samples called for a diverse set of researchers. Thus, the samples represent a wide variety of disciplines across the natural sciences, social sciences and humanities. To ensure further diversity (of research and cultural norms) within the sample, we include researchers based in Europe, Asia, Africa, Oceania, and North and South America. The samples also included multiple levels of seniority in academia; ranging from PhD students to experienced postdoc researchers.

In total, 264 researchers completed the survey. This sample (N=264) represents a wide variety of academic disciplines and research practices. The survey respondents were spread across 14 different countries, specifically; Argentina, Australia, Canada, Chile, France, Germany, Guatemala, Italy, the Netherlands, Portugal, South Africa, Sweden, the United Kingdom, and the United States.

Ten interviews were conducted with 10 researchers based in the Netherlands, the United Kingdom, and the United States. Within this sample (N=10, of whom 5 were male and 5 female) we cover a range of levels of academic seniority, from PhD researchers to more seasoned researchers, as well as an assortment of academic backgrounds, including computer science, biochemistry, physics, dentistry, speech recognition, artificial intelligence, the arts, geography, geology and political philosophy.

Procedure

Potential interviewees and survey participants were identified through the websites of academic research institutions which indicated the interdisciplinary nature of their research. The emails of interdisciplinary researchers were obtained from their profiles on these websites, and these were used to

contact them. In the case of the survey, potential participants received an email in which we provide a brief explanation of our research project and a link to fill out the survey online (via Qualtrics). As we aimed to use the survey as a method to access a wide range, as well as a large number, of researchers, we contacted 2,712 potential survey respondents through this method, 264 of whom completed the survey. The consent of researchers filling out the survey was collected on the first page of said survey; if they did not give their consent, the survey would immediately end. If they did express consent, they could go on to fill in the self-administered survey. On top of this, the survey included the option to express interest in a potential interview. Out of the 54 researchers that indicated their interest, we were only able to arrange two further interviews through this method due to scheduling and availability constraints.

The interviewees were contacted in a similar way; an email that explained the purpose of our research, with a request for their potential interest and availability to be interviewed. We identified our sample of 10 interviewees by seeking to create a balanced sample between disciplines (i.e., natural sciences, social sciences and humanities), academic seniority and gender. If a potential interviewee accepted our request, a suitable date and time was arranged over email. Participants were then asked to fill out an online informed consent form before the date of the interview itself (also via Qualtrics). At the start of the online interview[1] the purpose of our research project was reiterated, and the interviewees were asked for their consent to record the interview. These recordings were for internal use only, and the identities of the interviewees, as well as the survey, remain anonymous. Each of the ten interviews lasted between twenty and fifty minutes.

Survey

The survey was divided into two sections, the first of which relates to the process and definitions of IDR. The first questions of the survey were open questions that dealt with IDR in a broad sense; the perception and process of interdisciplinary research. The participants were first asked to provide a short written answer about their definition of "interdisciplinarity," so as to

1 The interviews were conducted online through video conferences software such as Google Meets as a result of COVID-19 restrictions imposed at the time of when the interviews were being conducted.

provide a reference point for our understanding of the definition of IDR. On the next page, participants were then asked to select one of four definitions of IDR, with the possible options relating to broad groupings identified in our literature review. This question was designed to evaluate what the participants associated with or valued most in IDR. More specifically, each of the definitions emphasised one of the following: the borrowing of research methods, the process of solving a broad/complex problem, an explorative approach in defining a complex problem, or a collaborative process where various skills are synthesised. In the following question, participants were asked to fill out a six-part Likert scale, where each part pertained to their research process or how IDR is evaluated (in relation to disciplinary research). The following two multiple choice ("select all that apply") questions had participants select the research methods and research deliverable formats that they had used in their experience of IDR. In the case where "journal article" was selected, another multiple choice question asked participants if the article was published in a disciplinary or interdisciplinary journal. The final question in this section was a written answer question, where participants were asked to point out the most difficult phase or aspect of IDR.

The second section of the survey consists of questions surrounding the subject of collaboration and team-building within IDR. As stated at the beginning of this section, the results of this latter half of the survey are not part of the discussion within this chapter, but are instead discussed in Chapter 2. So too is a more detailed description of the questions contained within this latter part of the survey. On the final page of the survey, participants were able to write remarks about the survey (or IDR in general), indicate their interest in hearing the results of this study, and indicate if they were open to being interviewed as part of this study at a later date.

Interviews

As the interviews were semi-structured, the order of the questions and topics differed depending upon the nature of the conversation and answers of the participant. This allowed for a more in-depth discussion, as well as a more comfortable environment for the participants to divulge any thoughts or reflections on their experiences of IDR. At the beginning of the interview, participants were asked to describe how they perceived or defined "interdisciplinarity." Much like the survey, this provided a frame of reference for how

they approach IDR, and how our definition compares to theirs. Then, participants were asked to describe the nature of their work, oftentimes offering a description of a past IDR project. From this point onwards, the interview became more flexible, depending upon the content of their answers, we probed them to elaborate on notable ideas they mentioned, while also maintaining the direction of the interview towards the remaining questions. Similarly to the survey, the remaining interview questions could be divided into two parts; one pertaining more to our framework and their research processes, while the other focused on the subject of their experiences of collaborating in IDR contexts. The latter is described in Chapter 2, as these results are not included within this chapter. Regarding the former, participants were asked to describe the nature of their work and research methods, the format of their research deliverables and their experiences of obtaining funding for their IDR projects.

Data Analysis Strategy

As the survey consisted of a variety of question formats, there was a need for both qualitative and quantitative exploration of its results. The written answer questions offered insights into the personal views of researchers on the definitions of interdisciplinarity, the challenging aspects of IDR, and the personal traits they identified as being valuable in the context of IDR. We sought to identify commonalities, as well as nuances, in the answers to these questions, so as to pinpoint factors that were significant across the broad spectrum of academic disciplines and methods that were encompassed by the survey. Meanwhile, the Likert scale and multiple choice questions offered insights into the more procedural aspects of the researcher's research process, and offered quantitative data on the range and quantity of different research methods and formats of presenting findings. These also offered a (quantitative) view into the general trends of preferred working group sizes, and rankings of which individual traits were most important in IDR.

The results obtained from the interviews were collated, and general themes and trends, as well as the differences between different (disciplinary) research norms, were identified. We use the interviews throughout the designing of our IDR framework to put the proposals discussed throughout the rest of this chapter to the test; resulting in slight iterations and improvements to both the framework itself as well as increasing the robustness of our discussion and the view of IDR and interdisciplinarity we put forth in this chapter.

It is important to reiterate the role of the survey and interviews in our study. Our analysis is primarily a conceptual one—one that is, in this chapter, centred around the research process of IDR. We therefore aim to identify and discuss key trends in the results of these processes and research methods, so as to provide a litmus test for our findings in the literature review and inform our general understanding of IDR practices, rather than to find causal relationships between variables by performing statistical tests on the results of the survey. The responses to the survey and the discussions contained within the interviews would ultimately shape the definition of IDR that we used to design the framework, as well as improve iterations of the framework by making it more inclusive of a wide range of research methods. As such, our findings from both the literature review as well as the empirical methods are discussed together throughout the rest of this chapter.

Interdisciplinarity & the Disciplines

Before we put forward our framework, we will first discuss our understanding of interdisciplinary research stemming from the methods described earlier, as there is a great debate in academia surrounding what interdisciplinarity actually is and how it should be defined. The definitions of "academic disciplines" and "interdisciplinarity" form the groundwork for how different areas of academic knowledge interact and converge in the context of IDR. As such, the definition of interdisciplinarity is preceded by discussing the definition of a discipline. This is something of a grey area. Where one person might speak of "subdisciplines" and "interdisciplines," whereas others may point to multidisciplinary/interdisciplinary endeavours. This grey area of trying to devise a clear nomenclature is not one that is tackled by this chapter. To circumvent this challenging nomenclature discussion, we include the three aforementioned terms of multi-, inter- and transdisciplinary research under the umbrella term "interdisciplinary research" throughout this chapter, as well as in Chapter 2. The contents of either chapter apply broadly to each of these three terms. Regardless of the different opinions surrounding how the terms ought to be used in which circumstances, we feel that the general framework proposed thereafter is still broadly applicable. As mentioned, the framework attempts to cater for multiple nuances of IDR, and indeed this very issue of defining disciplinarity and interdisciplinarity is one such nuance.

Understanding Disciplines

IDR is generally understood to be "a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline or profession … [that] draws on disciplinary perspectives and integrates their insights through construction of a more comprehensive perspective" (Klein & Newell, 1996, pp. 393-394). As crossing the boundaries of disciplines appears to be a prerequisite for interdisciplinarity, it is helpful to understand what a discipline is. After all, "in order to be able to cross a boundary there need to be boundaries in the first place and one needs to know where these boundaries are" (Krishnan, 2009, p. 6).

Here, however, we are already met with some ambiguity. As Aram (2004) explains, "recognizing ambiguities in the concept of 'discipline' foreshadows the challenge of defining interdisciplinarity" (p. 381). It may seem like a simple concept at first, we can start with something like chemistry as an example of a discipline. And perhaps, then, fields such as organic chemistry can be labelled as "sub-disciplines." But when we get to fields with more complicated relationships, our taxonomy begins to fall apart. Biochemistry, for example, may be seen as a sub-discipline of both biology and chemistry, yet the combination of those fields could arguably warrant it an interdisciplinary field, rather than just a sub-discipline of one or the other. It also can just be seen as a normal discipline in its own right. Bioinformatics combines biology, computer science, information engineering, mathematics and statistics, while molecular biology brings together chemists, geneticists, zoologists, bacteriologists and botanists. Are those disciplines, multidisciplines, multidisciplinary research, or something else altogether?

This debate leads us to the concept of "interdisciplines," "developed interdisciplinary fields […] characterized by a communication system that is very similar to the patterns of disciplinary fields" (van den Besselaar & Heimeriks, 2001, p. 8). Cognitive neuroscience is a branch of neuroscience and psychology and overlaps with "sub-disciplines" such as physiological, affective, and behavioural neuroscience. Perhaps they are inter-multi-sub-disciplinary fields? A close look will render the distinctions between "disciplines," "sub-disciplines," and "interdisciplines" as abstruse; there is not much consensus on how disciplinarity should be understood. There are, however, a few notable approaches.

A good starting point is Kuhn's paradigms. Kuhn (1996) viewed science as being grouped into paradigms which operated on different subject matters,

question sets and methodological traditions. Initially, this was only meant for the natural sciences, which had more clearly defined boundaries between subject matters. Storer (1963) coined two dimensions to classify disciplines: "hard" vs "soft" paradigms. Fields with a hard core were those with established and clearly defined theories and methods (these tended to be the natural sciences). In contrast, those with a soft core had a greater plurality in theories and methods (such as the social sciences). Storer also distinguished between disciplines considered to be pure and theoretical (such as physics) from those more concerned with applying knowledge (such as engineering).

While Storer proposed these dimensions, they are often attributed to Biglan, who effectively raised the study of disciplinarity to a coherent practice by publishing a statistical analysis of the disciplines. Biglan (1973) noted that any given field of specialisation had its own university department, and each department was usually then tied to one discipline. As such, it was inferred that each discipline had its own system of research organisation, teaching and administrative activities. He posited a new dimension: whether or not the discipline was concerned with life systems (e.g., biology) or non-living systems (e.g., history). There are some issues with these classifications, however. For instance, Biglan collected his data from disciplinary specialists. When Stoecker (1993) applied these dimensions to eight new disciplines just 20 years later, Biglan's model struggled to classify them; it failed to account for new information and any provision for crossing between disciplinary boundaries. As Piaget (1972) argued, truly "new" and isolated disciplines have never existed, they are always offshoots or combinations of previous disciplines and have overlapping methodologies and concepts, and no clear predictions can be made by purely epistemological definitions.

In 1989, Becher expanded upon Biglan's idea of using dimensions to classify paradigms by bringing a qualitative approach to the model, forming a topology informed by the related theory of "academic tribes." Becher's new qualitative approach focused on social theory and historical analysis, replacing the statistical analysis centred on classification. Becher also replaced the life/non-life dimension with two further dimensions. A rural/urban dimension, differentiated between urban disciplines, which were characterised by intense interaction and a high people-to-problem ratio, and rural disciplines, which have less interaction and a lower ratio, as well as a convergent/divergent dimension, where convergent disciplines were uniform in

research practice standards, and divergent fields sustained more intellectual deviance and attempts to shift research standards. Becher's work showed similarities between disciplines such as physics and history, where researchers professed strong senses of disciplinary unity to their peers and associated disciplines by international recognition and the use of shared norms. Again, however, there are problems with this model.

Viewing disciplines as social or pedagogical organisations offers another insight into how to understand disciplinarity. This view holds that disciplines should be understood as self-regulating organisms that aim to maintain themselves by passing down knowledge and positions of power through a degree-granting process. Lenoir (1997) asserted that "disciplines are the institutional mechanisms for regulating the market relations between consumers and producers of knowledge" (p. 47) and Bernstein (2000) recontextualised fields as a space in which the undifferentiated world was translated into teachable and learnable formats. However, the characteristics described by Lenoir and Bernstein could also be applied to smaller specialities or other socio-cultural organisations. To differentiate disciplines from other socio-cognitive structures, Turner (2000) focused on how disciplines reproduce themselves by regulating how rewards and positions are allocated. Turner saw disciplines as "kinds of collectivities that include a large proportion of persons holding degrees with the same differentiating specialization name, which are organized in part into degree-granting units that in part give degree-granting positions and powers to persons holding these degrees" (p. 47). An issue with the approach of understanding disciples as sociocultural organisations is that it "frequently lean[s] towards describing disciplinarity as a social action more than defining it in a predictive or proscriptive way, under the notion that a definition is too objective or that disciplinarity is inherently too 'messy' to be generically defined" (Morrison, 2015, p. 98).

The approaches described above each examine different aspects of disciplines. The ongoing discussions surrounding the disciplinarity of various fields, such as social and economic history, women's studies, and medieval studies, are examples of this. Definitions that work for existing disciplines fail to classify subsequent ones. As Morrison (2015) discusses, the concept of a discipline seems to be a historically situated and constantly shifting instrumental social construction. With the number of fields that universities teach rising from just a handful before 1850, to as many as 149 by the end of the twentieth century (Braxton & Hargens, 1996), this is a significant issue for our

definitions; they should accommodate any discipline that develops in the future.

Without consensus on a precise definition, perhaps we would be better served with a list of characteristics to understand disciplinarity. Recognising the epistemic overlaps between disciplines and the approaches discussed above, Morrison (2015) offers the following elements to paint a complete picture of a discipline:

1 A discipline is a space wherein the combination of epistemic qualities of subject matter and the focus of inquiry about these become translated into a teachable and learnable format.
2 A discipline is a structure around which expertise can be developed, by means of which expertise can be located, and through which stewardship of trustworthy standards can be maintained.
3 The same discipline serves different purposes and has different apparent properties based on the level of subject expertise and the relative perspective of the observer.
4 A discipline need not be mutually exclusive of other disciplines and can intersect with aspects of other disciplines and in any number of directions. (p. 197)

These characteristics include the social, pedagogic and organisational structures of disciplines, relating them to their subject matters and methods while recognising that disciplines can't be defined solely by a single subject matter or methodology. On this issue, Morrison argues that disciplines should be seen as "custodians" or "stewards" that uphold the standards of methods, theories, processes and tools, rather than having exclusive ownership of them. This notion of stewardship ensures the responsibility of qualified and recognised standards both within disciplines and later in IDR. Lyutov et al. (2020) explore the reasons behind failures and classification problems in scientometrics and point towards the inter-relatedness of academic disciplines. They find that misclassified disciplines can be understood as either "method lenders," which are methods-orientated, or "content explorers," which use methods from a variety of other disciplines to explore well-defined content. Big data techniques reflect the challenges of philosophical debates surrounding disciplinarity; they have been unable to find clear boundaries or divisions between disciplines.

Ultimately, disciplinarity does not appear to be best served by a single short definition; there would simply be too many aspects left open to confusion and debate. Instead, we use Morrison's characteristics to guide our understanding of what a discipline is, how they may relate to other disciplines, and how they are responsible for their theories and methods. With Morrison's description as a frame of reference, we can move on to the debate surrounding interdisciplinarity.

Defining Interdisciplinarity

A large part of the literature surrounding interdisciplinarity describes the level of integration between disciplines. This leads to the use of the terms "multidisciplinary," "interdisciplinary," and "transdisciplinary." Multidisciplinary research entails researchers from different disciplines working in parallel or sequentially to address related problems; they do not necessarily integrate their disciplinary insights and may work on separate questions (Aboelela et al., 2007). Interdisciplinary research also addresses a common problem, but languages or models from different disciplines are integrated or "borrowed" to form a more holistic understanding of the problem (Aboelela et al., 2007). Transdisciplinary research is widely considered to have the highest degree of synthesis; it is conducted by researchers from different disciplines collaborating to develop conceptual, theoretical or methodological innovations that integrate and go beyond academic disciplines (Aboelela et al., 2007). However, it can prove difficult to define criteria that differentiate these three levels of interdisciplinarity. For instance, how much integration is needed before multidisciplinary research becomes interdisciplinary? Or how should we quantify or measure this integration?

Many definitions of interdisciplinarity describe it as the crossing of disciplinary boundaries and structures. However, this assumes that there is a clear definition of disciplines that discerns these boundaries. As discussed above, the notion of a discipline is simply not concrete enough to base the definition of interdisciplinarity on. While we cannot escape disciplinarity completely, we aim to reframe interdisciplinarity as a matter of professional collaboration and teamwork. Rather than seeing interdisciplinarity as approaching subjects beyond the capacity of a single discipline, we put forward that it should be seen as occurring when the capacity of a single disciplinarian is exceeded. IDR is the synthesis of individuals' skills and knowledge; researchers bring insights to interdisciplinary projects, not the disciplines

themselves. It is not chemistry that generates new insights, but rather the chemist applying their chemistry knowledge and integrating it with the insights of other researchers.

It is perhaps possible to conduct IDR alone, thereby sidestepping the collaborative aspect of interdisciplinarity. However, in order to maintain the quality and depth of research, we argue interdisciplinarity should be primarily a team-based or collaborative affair. A distinction between polymaths and interdisciplinarity needs to be made. Polymaths, who have a degree of proficiency in multiple fields, will not have the same level of expertise as a team of equivalently trained experts in each of those fields. If an individual does interdisciplinary work alone, it is either done without the same level of expertise as experts in those fields would do, or it would take substantially longer. Klein's (1990) account of solitary interdisciplinary researchers shows the importance of relying on consultation with others, and slowly developing an interdisciplinary portfolio over the course of 10-30 years. However, they also had to narrow the scope of what they learned from some disciplines and had to take leave from some disciplinary activities to renew or gain other expertise. The polymath's process of interdisciplinary integration is happening within their mind and with only one point of view, missing out on additional viewpoints used by research teams to negotiate an intersubjective consensus. As Morrison (2015) puts it, "via transactive memory systems, interdisciplinarity can create a level and type of expertise not possible in a single person" (p. 201). Even if researchers decide to approach an interdisciplinary project alone, they must collaborate with other experts to gain relevant insights and information.

While we can focus on the collaborative aspect of interdisciplinarity, we cannot completely detach ourselves from academic disciplinarity. They are simply such stable social realities that we cannot undo or avoid them.[2] We recognise that they are a major facet of academia, and we cannot understand interdisciplinarity without at least some connection to it. "The challenge of interdisciplinarity [...] is one of strategic positioning. All interdisciplinary fields, by extension, need to establish relations to their objects of study, define relations to other disciplines, assert their own boundaries and mission, and question the self-understanding of disciplines as coherent and unified entities" (Jassanoff, 2010, in Klein, 2010, p. 160). To ensure quality

2 This is also known as disciplinary essentialism.

methods and adequate depth of theoretical understanding, IDR must have access to disciplinary expertise.

Instead of defining interdisciplinarity directly through disciplinarity, we can instead think of it as researchers bringing disciplinarian knowledge and using their expertise to wield said knowledge in a useful way to others. If we're to imagine research as a picnic, we can say that each person brings one meal that they're very proficient in preparing for others to enjoy, whilst also indulging in the meals of others. This understanding of interdisciplinarity circumvents issues clouding the definition of disciplines and their boundaries. As this expertise is developed through disciplinary institutions, we will continue referencing the notion of a "discipline" throughout this chapter. Furthermore, they can serve as a frame of reference for identifying relevant or specific theories and methods. Moving forward, it would be beneficial to have a brief definition of IDR to reference. In this regard, a slight adaptation to Aboelela et al.'s (2007) definition fits quite well:[3]

> Interdisciplinary research is any study or group of studies undertaken by scholars from two or more [...] disciplines. Such research is based upon a conceptual model that links or integrates Theoretical Frameworks from those disciplines, uses study design and methodology that is not limited to any one field, and requires the use of perspectives and skills of the involved disciplines throughout multiple phases of the research process. (p. 341)

This definition proves useful as it emphasises the role of scholars and the importance of their disciplinary skills and perspectives. In the survey we conducted, the most prominent understanding of interdisciplinarity was one of "a collaborative process wherein the different knowledge and skills of individual researchers are synthesised to approach complex subjects," followed by "a process of creating a solution to a problem that is too broad or complex to be dealt with adequately by a single discipline or profession." While these are by no means exclusive of each other, when pressed for a single interpretation, the stressing of a collaborative approach seems to be most popular

3 We removed the words 'distinct scientific' before the first mention of disciplines, as Aboelela et al.'s study was more focused on IDR in the life sciences and we aim for a broader understanding of IDR.

with people whom themselves conduct IDR. Furthermore, all of the literature regarding the definition of IDR acknowledged a continuum of collaboration, communication, and sharing (Aboelela et al., 2007). One example describing this process read; "interaction may range from simple communication of ideas to the mutual integration of organising concepts, methodology, procedures, epistemology, terminology, data, and organisation of research and education in a fairly large field" (OECD, 1998, as cited in de Boer et al. 2006, p. 12). The view of IDR as a collaborative affair also serves as a basis for identifying the necessary competencies for individual researchers to succeed in interdisciplinary endeavours (see Chapter 2). The recognition and increased awareness of these competencies can contribute to a better understanding of what high-quality IDR is, and how to execute it.

From their literature review and interviews with interdisciplinary researchers, Aboelela et al. (2007) also concludes that the mere act of bringing together more than one discipline is insufficient in making a research project interdisciplinary. Rather, analyses of the conceptual framework, study design, execution and conclusion can also reveal the true degree of interdisciplinarity. These factors, as well as the collaborative and skills-based dimension of IDR, are key features of our framework for IDR.

Introducing our Framework

As IDR is more frequently demanded by research institutions, many attempts to formulate a framework for IDR have already been made. However, these frameworks may not reflect the reality of the myriad of different forms of IDR and can be restrictive or suggest a relatively narrow selection of research methods. Two notable frameworks that appeared in our research were the Institute for Interdisciplinary Studies (IIS) model and the Methodology for Interdisciplinary Research (MIR) framework. The IIS model (Keestra et al., 2016) is a practical manual for IDR. However, its scope is limited, encompassing merely European students, and it uses case studies from just the social and natural sciences. This limitation manifests itself in the description of only two methods, qualitative and quantitative research methods. The MIR framework (Tobi & Kampen, 2018) similarly focuses on the technical design of data collection through research methods primarily in the social and natural sciences, leaving out methods from fields based in areas such as the humanities.

Furthermore, the aforementioned frameworks are built on a process-based approach. The hypothesis and research questions are regarded as pivotal to all decisions in various stages of research. The IIS and MIR frameworks "put the common goal of the researchers at the center, instead of the diversity of their respective backgrounds" (Tobi & Kampen, 2018, p. 1211). However, the common goal of the researchers may not be well-defined at all, seceding importance to exploration and engagement with new ideas and approaches. While there may be an overarching goal, topic, or direction, the flexibility and variability of IDR render the goal insufficient in being an all-encompassing guide to the project.

Another generalisation of IDR surrounds its purpose. While it is often framed as a primarily problem-solving process (instrumental interdisciplinarity), there are also exploratory forms of IDR with less clearly defined "steps" of research. Critical interdisciplinarity interrogates dominant knowledge structures and raises epistemological questions that unsettle established epistemological assumptions (Cairns et al., 2020). Recent literature, such as that by Cairns et al. (2020), supports the view that IDR is a "research praxis whose finality is more experimental, less absolute, less definitive and less objectifiably conclusive" (Buller, 2009, p. 402), and may lead to more questions being asked than being answered. IDR distinguishes itself from a rigid (disciplinary) strategy through an iteration that allows for a dynamic research design, evolving through additional insights and learning. Krimsky (2000) outlines the necessity of frequent communication, critique, evaluation, and reporting. Pohl and Hadorn (2007), meanwhile, explain that a recursive design "is a meaningful pragmatic way of working with intermediary results and further developing them with the help of critical assessment" (p. 86). In our survey, over 67% of the respondents at least partially agreed that "I/we often have to edit or adjust our research question(s) or research objective throughout the research project," showing that there is indeed an explorative or iterative element to IDR, which can be missed by existing frameworks for IDR.

For the reasons described above, existing frameworks for IDR are generally narrow in scope, limiting their applicability to specific research methods or fields. Perhaps it is for these reasons that they don't appear to have broken ground amongst the interdisciplinary researchers we surveyed. When asked whether they agree or disagree with the statement "there is a clear framework (or step-by-step process) to follow when doing interdisciplinary research,"

68.4% of interdisciplinary researchers strongly or somewhat disagreed, indicating that either interdisciplinary researchers aren't aware of the existence of these frameworks, or that they aren't helpful as a guide on how to do IDR. By trying to limit the scope in favour of having a linear and obvious process, from start to finish, these frameworks fail to capture the essence of complexity inherent to IDR; the elements that will necessarily have to be created for that specific IDR project.

Having said that, IDR isn't necessarily a completely random process either, and does indeed have, and perhaps needs, some grounding in the disciplines and institutions involved. This conundrum is addressed succinctly by Buller (2009):

> Although interdisciplinarity is increasingly required, even imposed as a prerequisite for research funding, it cannot be preordained or preconstructed. Neither can it float free of strong prerequisite disciplinarity groundings. Rather it is discovered, performed and enacted through researchers and scientists voluntarily. (p. 401)

Given this problem of striking a balance between making structured recommendations and a need to recognise the fluidity of IDR, we come to the distinguishing feature of our framework. The framework we propose in this is descriptive rather than normative.

Many of the shortcomings of existing frameworks surround their often-limited scope to fields in the natural and social sciences and qualitative or quantitative methods. Rather than follow this trend by simply including more methods, we aim to account for individual context and nuances as much as possible, especially in developing the IDR project's Conceptual Framework. As such, we do not delve too deeply into the specifics or nuances of different research methods, nor do we lay out explicit criteria or steps for "good" interdisciplinary research at any stage of the research process. Doing so would risk making generalisations and excluding specific forms of interdisciplinary research. Instead, we offer general descriptions, considerations and recommendations with which to understand the collaborative interdisciplinary research process.

Our framework is more accommodating to methods in the humanities; not limiting itself to qualitative and quantitative methods, but also incorporating exploratory research and conceptual analysis, among others. It also accom-

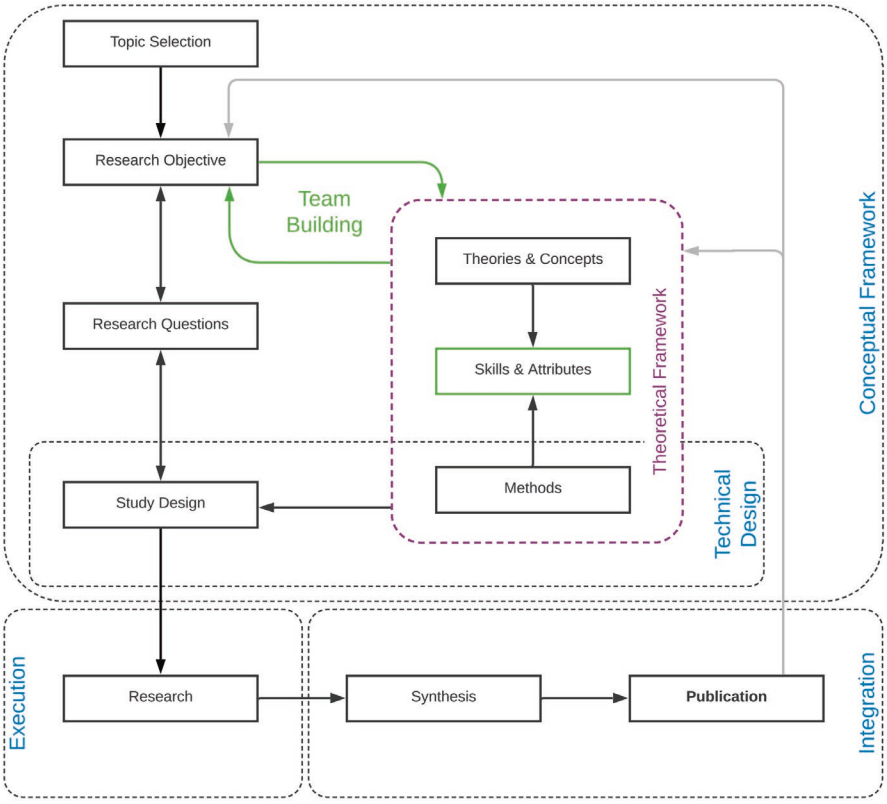

Figure 1: A visual representation of the interdisciplinary framework proposed in this chapter. The framework is divided into 4 main entities, the Conceptual Framework, Technical Design, Execution and Integration. The Conceptual Framework, and the Technical Design within, aim to operationalise an idea into a workable and executable research project by means of defining various parameters such as the Research Objectives, Methods, and so forth. Research is conducted, and subsequently synthesised into various desired deliverables which can go for publication, and/or back into the research process of future projects.

modates research that focuses on synergising pre-existing knowledge. The need for this inclusion is highlighted by the fact that in our survey, there were at least seven other methods mentioned, some of which (such as computational, experimental and applied methods) were shared by around half of the responses, with others, such as case studies, hermeneutic methods and conceptual analysis being used by at least 15% of respondents.

Rather than focus on the process–based or problem-solving approaches described above, our framework entails a more holistic approach to research design. As opposed to a linear system, our IDR framework includes periods

of cycling back, re-testing or re-questioning and adjusting the research design when new insights arise. This is denoted in Figure 1 by the double-headed arrows and the cyclical nature of the Team Building process. As such, IDR is not bound to a fixed methodology; indeed, it thrives from a flexible and iterative process. When conducting our interviews and survey, some researchers were resistant to the idea of a framework for IDR, as they felt a formulaic guidance or structure for it would undermine its creative and non-linear nature. As such, we sought to include as much flexibility and freedom in the research process as possible. There is ample room for such an explorative phase early in the timeline of any IDR project in our framework. Regardless of whether the Research Objective is explorative or solution-oriented, developing the Conceptual and Theoretical Frameworks represents a key, and often lengthy, part of our IDR framework.

On top of this, we again note the discussion surrounding the level of interdisciplinarity of a research project, with projects being differentiated as either multidisciplinary, interdisciplinary, or transdisciplinary. Because of the wide range of methods used by IDR projects and the nuances of their topics or research aims, the degree of integration of academic disciplines also varies between research projects. Our framework enables the different levels of (inter)disciplinarity to be used at various stages of IDR; there can be stages where a transdisciplinary approach is necessary, while other stages could be more suited to inter- or multidisciplinarity practices. This capacity is referenced throughout the next sections, which describe each "phase" of our framework in more detail.

On the whole, our framework for IDR presents a comprehensive approach towards understanding the process and methodology of IDR. Rather than limit our framework to a handful of research methods, fields, or even "levels" of interdisciplinarity, we try to accommodate the wide variety of shapes and sizes that IDR comes in. In the following sections, we describe each of the phases of our IDR framework, make recommendations, point out considerations, and explain how the stages are intertwined.

Conceptual Framework

The early stages of an IDR project can be a laborious and time-consuming process; it is the project's backbone, after all. As described by one of our interview subjects; in order to step up to the problem, and not limit the

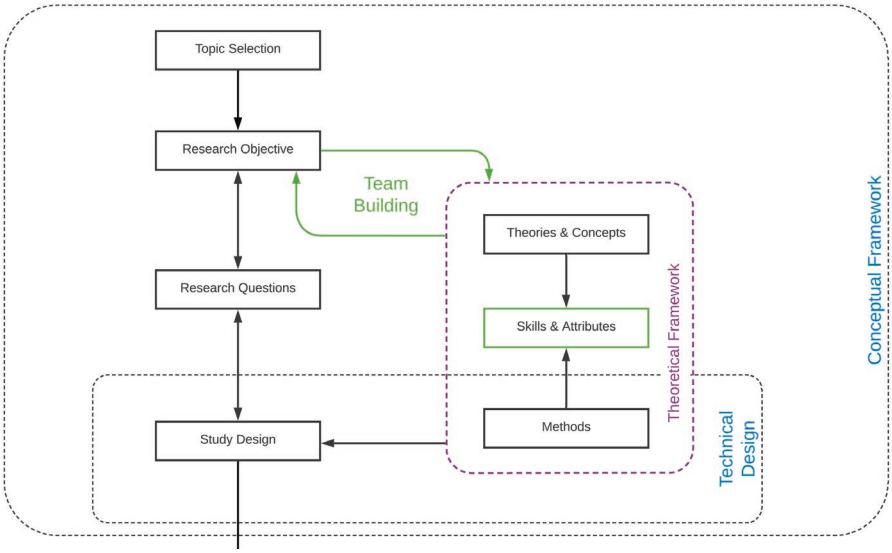

Figure 2: Zoomed in image of the Conceptual Framework section of Figure 1. In tandem with the familiar stages of Topic Selection, Research Objective and Research Questions, there are two other groups of stages: the Theoretical Framework and the Technical Design. The Theoretical Framework seeks to establish the scholarly foundation, research concepts, available skills & expertise, and disciplinary methods available to a given research project. The Technical Design then operationalises the means by which a Research Topic can be investigated.

understanding of said problem to just the skills and expertise available, it takes time and effort to understand and include all of the relevant disciplinary insights. A large amount of communication is required between different researchers, alongside potential consultation with stakeholders (where necessary), as outlined in Chapter 2. As one is made aware of their constraints and has to deal with including/excluding additional insights or ideas or a shifting project scope, this is an area under continuous revision. It takes time to understand which disciplinary perspectives are relevant and to understand them in the first place. As another interview subject stated, "in order to be interdisciplinary, you need to spend a lot of time with people to truly be interested in each other, and each other's competence, and yet you still don't know what you get out of it." In our survey, most interdisciplinary researchers resonated with the struggle of the early stages of IDR. When asked if "the initial stages of interdisciplinary research are rather abstract, fuzzy, and perhaps difficult to navigate," nearly 60% of respondents agreed to some extent.

In our framework, the Conceptual Framework encompasses the total, logical master plan for the entire research project. Within it are more specific steps such as Topic Selection, Research Objective, Research Questions, the development of the Theoretical Framework and the assembly of the research team. These steps, and any decisions made within them, are predominantly disciplinary (for example, what theories or methods to use), but on the whole, they form an interdisciplinary process. With the Conceptual Framework, the research team develops an understanding of how the disciplines relate, their strengths and weaknesses, and what perspectives or scopes they offer. In the following subsections, we will go through and examine each step in more depth and discuss how they are relevant to the broader research project.

Topic Selection

Generally, there seems to be two forms of identifying a topic suggested in both literature and our own research methods; either the researcher works within a topic that a university, research institute or a non-academic organisation or initiative sets, or the researcher(s) picks a topic out of personal interest. The process of choosing a topic is an opportunity to negotiate with stakeholders outside of academia, and as such, can potentially be seen as a transdisciplinary stage. IDR often begins with complex problems, and, in practice, this means understanding all of the relevant perspectives, whether or not they are academic. Defining the research focus may need societal input to formulate accurate and appropriate Research Objectives and questions (for instance, to understand the challenges a community faces in regard to climate change, immigration policy, etc.). From that point, the research may return to being interdisciplinary to analyse the problem further, identify relevant disciplinary insights and bring them together.

Regardless of how a topic is chosen, it is important to be genuinely interested in the subject. As we'll discuss in Chapter 2, this will help motivate the researcher to overcome obstacles and challenges that they'll likely face in subsequent phases of the project, such as the commitment of considerable amounts of time to understand unfamiliar disciplines or ideas.

Research Objective

The Research Objective is the general goal or purpose of your research and has a significant impact on the Conceptual Framework. It identifies the

problem that requires an interdisciplinary approach. This entails four main considerations.

1. The complexity of the problem (Newell, 2007). If the problem falls within just one or two disciplines, then the problem may not be complex enough to warrant an interdisciplinary approach. If the problem crosses boundaries between areas traditionally studied by different disciplines, it is a complex problem and an interdisciplinary approach is justified. Should aspects of the problem also fall *outside* of academic disciplines, a transdisciplinary approach is required to accommodate non-academic insights.
2. The scope of the problem (Newell, 2007). A research team should focus on the predominant linkages, and then decide whether weaker subsystems are also worth pursuing.
3. The focus of the problem (Newell, 2007). Going beyond disciplinary tools allows the team to properly identify the scope of the problem.
4. Ethical appropriateness. The researchers must identify the relevant stakeholders and set an ethical standard for deriving the research subject (Newell, 2007). Researchers will be concerned with ethical issues related to humans, animal welfare, ecology, legislation, data and information sharing, funding agencies or research practices (Fox, 1990). As different researchers are more sensitive to different issues, it requires explicit discussion among all of the stakeholders in the project.

The Research Objective also includes other considerations that shape the Conceptual Framework and the direction of the research process. These include knowing what is already understood about the research subject, which aspects or dimensions of the problem are important to consider, and which perspectives are needed to look at the problem (Keestra et al., 2016). The Research Objective is thus linked to the development of the theoretic framework, which we will examine in the following section. The Research Objective determines the relevant disciplines (their theories and approaches more specifically). Using journals or articles, one can find relevant researchers from the disciplines that are required for the project (Keestra et al., 2016). The selection of disciplines requires metadisciplinary knowledge; knowing what the disciplines study and what ideological predispositions they may have (Newell, 2007). As disciplinarians do not necessarily carry a metadisciplinary capacity, the

responsibility of connecting other disciplines may fall on the shoulders of a non-research role (see Chapter 2 for a discussion on team roles).

The Research Objective is subject to change as a result of developments in the research team's expertise, resources and interest. One of the most significant considerations is the scope of the research project. Having too narrow of a scope brings the project closer to disciplinary research, while having too broad a scope comes with the risk of losing depth (and perhaps rigour) in the relevant disciplines. In our interviews, interdisciplinary researchers stressed the importance of identifying a suitable scope, and noted that this scope is entirely dependent on the researchers and what subjects they wish to pursue. Overly broad scopes may prove challenging for researchers more familiar with "narrower" disciplinary research, and may also fall victim to evaluators of research proposals, a common obstacle for interdisciplinary researchers. However, it is with those broader scopes that interdisciplinary research can find new and innovative ideas, a risk that our interviewees were generally willing to take, even if it demands considerable time and effort to step up to the problem's true scope.

Theoretical Framework

The Theoretical Framework represents the scholarly foundation upon which the research project is based. As illustrated in Figures 1 and 2, the Theoretical Framework is a subset of the Conceptual Framework. It is the toolbox of theories, concepts, skills, and methods drawn from the various affiliated academic fields to investigate the Research Objective. As Swanson (2013) asserts, "the Theoretical Framework is the structure that can hold or support a theory of a research study" (p. 122). It is a synthesis of the thoughts of leaders in the respective disciplines about the research subject (Kivunja, 2018). In that sense, it can be said that disciplines each contribute a frame to a greater framework.

The three main parts of the Theoretical Framework are: (1) Theories and Concepts; (2) Methods; and (3) Skills and Attributes. These are all drawn from disciplinary "frames." Theories and Concepts refers to explanations of the phenomena that each discipline studies (Abend, 2008), and Methods covers the various research approaches that disciplines use (qualitative, quantitative, or other). Some disciplines are more reliant on certain theories and methods than others; disciplines vary in the levels of consensus they exhibit on theoretical or

methodological orientations (Braxton & Hargens, 1996). Fields like chemistry or physics show consensus around well-defined methods of inquiry (they have a "high paradigmatic development"), while fields such as education use a wider range of methods that are not as univocal (and may be considered as having "low paradigmatic development") (Alise, 2008, p.4).

For researchers, theoretical knowledge, skills and methodologies are gained from disciplinary education and previous research experience. This being the Skills and Attributes box in Figures 1 and 2. As Morrison (2015) explains, "no discipline 'owns' a method, theory, process, or tool" (p. 194). Rather, disciplines are "custodians" of the theories and methods. By understanding IDR as the synthesis of a diversity of researcher's skills, it is the researcher, not the discipline, that enables the methods, theories, processes or tools to be used in an IDR project.

For fields that approach similar problems or use the same terms differently, some degree of integration is needed to find common ground. To address these differences, Newell (2007) identified four integration techniques:

1. Redefinition: can reveal communities in key terms or assumptions obscured by discipline-specific terminology through reformulating the definition in more "accessible" language.
2. Extension: addresses differences or oppositions by extending the meaning of an idea beyond one domain and into another.
3. Organisation: finds commonalities using the above techniques, and arranges redefined insights or assumptions to bring out the relationships and patterns among them.
4. Transformation: (for concepts and assumptions that are not just different, but opposite, e.g., economic rationality vs sociologic irrationality) transforms opposing assumptions into (continuous) variables, expanding the scope of the theory by examining what contributes to changes in those variables.

By reducing conflict between disciplinary concepts and achieving a clear and agreed-upon definition, the Theoretical Framework becomes more comprehensive and accessible to each of the researchers. Furthermore, the Theoretical Framework will better reflect the commonalities and relationships between disciplines and sub-systems relevant to the research problem.

Building an effective and robust Theoretical Framework will also include

developing an awareness of what assumptions the Theoretical Framework makes. Within disciplinary paradigms, rigorous training conditions a scientist's reactions, expectations and beliefs; they learn how to apply concepts to solve exemplary problems (Kuhn, 1969). Researchers develop complex mental representations with which they can solve and understand problems efficiently and effectively (Keestra, 2017). However, these mental representations are limited to problems and approaches that fall within their field, which proves cumbersome for IDR: "Experts might find [events or problems] so familiar that they overlook the event's deviation, responding automatically in a habituated fashion" (Keestra, 2017, p. 136). The habitualisation of research practices and procedures risks limiting the scope of their research, which circumvents the whole point of IDR in the first place. In IDR, it is not at all unusual or worrisome that an element of the problem at stake is unknown or missed out by the broader team (Keestra, 2017), but it is important to be aware of any missing insights.

Both the individual researcher and the team should employ metacognition to monitor and regulate their own cognitive processes and representations (Keestra, 2017). On an individual level, metacognition entails the reflection on epistemological, philosophical, metaphysical and normative assumptions. It is the amount of this reflection that explains the development of expertise, more than biological or social factors (Ericsson et al., 1993). For the collective team, metacognition develops understandings of task-related, team-related, process-related and goal-related information, although this pertains more to the Conceptual Framework, than the theoretical one. Through critical thinking and drawing on individual metacognitions, the team metacognition can identify theoretical assumptions,[4] missing insights, unexplained phenomena, skills, or disciplines that are required to approach the research subject. It is also important to note that this metacognition should occur throughout the research project. As Oughton and Bracken (2009) explain:

> Successful projects are able to identify and support the processes that allow the communication and negotiation that is necessary not just for the initial framing of a research funding proposal but to be able to

4 These can be ontological, epistemological, anthropological, cultural and social, ethical or methodological.

> maintain negotiation. Self-awareness and continual reflexivity and a willingness to be questioned by others are essential to this process. (p. 392)

Neuroscience and gerontology provide two of many examples of theoretical assumptions. Cognitive neuroscience is dominated by WEIRD countries;[5] over 90% of publications come from these countries, which represent just 12% of the human population, and cultural generalisability of findings based on this population is often assumed (Henrich et al., 2010). Generalisations made about reasoning, fairness, visual perception and moral decision-making are undone through differences in socio-cultural norms and individual contexts. For instance, individuals from western countries tend to use analytical reasoning, while eastern societies may be more inclined to use holistic reasoning. Yet many long-standing theories about human perception emphasise analytical thought (Henrich et al., 2010). Meanwhile, Gomez and Curcio (2012) identified three distinct approaches to interdisciplinary collaboration in the field of gerontology. In Europe, a "logical-rational approach" is common, in North America a "logical-instrumental approach" was developed, and a "logical-subjective approach" was developed in South America. Metacognition can be used to identify these theoretical assumptions, and differences in methodologies. The team may then proceed to seek out additional researchers from different disciplines. They may also choose to challenge a theoretical assumption made by an already included discipline by inviting researchers who are based in the same field, but have an antithetical perspective or approach to provide more balance and depth of understanding (this is discussed in more detail in Chapter 2).

By bringing together all of the attributes and approaches described above, the Theoretical Framework draws similarities to transactive memory systems (TMS). A TMS is defined as "the shared division of cognitive labour for encoding, storing, and retrieving information based on a collective awareness of where specialized knowledge resides in the team" (Liao et al., 2015, p. 2). TMS's have been shown to improve team learning (Lewis et al., 2005) and team performance (Chiang et al., 2014), as researchers can "draw on, and harness, the specialized knowledge domains located in professional subgroups" (Liao et al., 2015, p. 23). Each researcher contributes theories,

5 Western, Educated, Industrial, Rich and Democratic.

concepts, skills and methods to the Theoretical Framework. The team's Theoretical Framework structures and summarises these resources, providing an understanding of what they are and which ones are relevant to the Research Objective.

Co-Creative Iteration & Team Building

In our diagram, the green arrows represent the iterative nature of IDR. Here, the Research Objective and Theoretical Framework develop in tandem. The Research Objective identifies relevant knowledge or skills and then adds the necessary theoretical "frames" to the framework by inviting additional researchers to the team. The Research Objective shapes what is and is not included in the Theoretical Framework. In the opposite direction, the research team draws expertise and insights from the Theoretical Framework to understand the Research Objective.

A large amount of development in the Conceptual Framework occurs here, in what can be an ambiguous and lengthy phase of the research project. The Research Topic is clarified into a Research Objective (and by extension, the Research Questions). The problem is investigated, theories are applied and evaluated and appropriate research methods are identified (Ravitch & Riggan, 2016). As you evaluate which of your disciplines you will use to answer these questions, you cross-check what each of them is saying as to gauge which ones will help you answer your question (Kivunja, 2018).

This iterative process is best described with an approach known as "double-loop learning." Double-loop learning is a "process whereby participants deliberately reconsider governing variables in order to generate radically new strategies for achieving business goals,[6] and assess their potential impact" (Pennington, 2011a, p. 63). In IDR, the Research Objective and questions are constantly altered in light of new (disciplinary) insights, which, in turn, calls for further insights, more alterations and so on. This requires "a combination of group divergent thinking activities across multiple domains of expertise that make task-level assessments of potential joint research activities, and tentative evaluation (convergent thinking) of potential outcomes from those activities" (Pennington, 2011a, p. 63). This process is outlined in Figure 3.

This double-learning loop entails significant amounts of co-creative interaction and communication across the research team. With each of the

6 We do not imply that this strategy is limited to business goals exclusively.

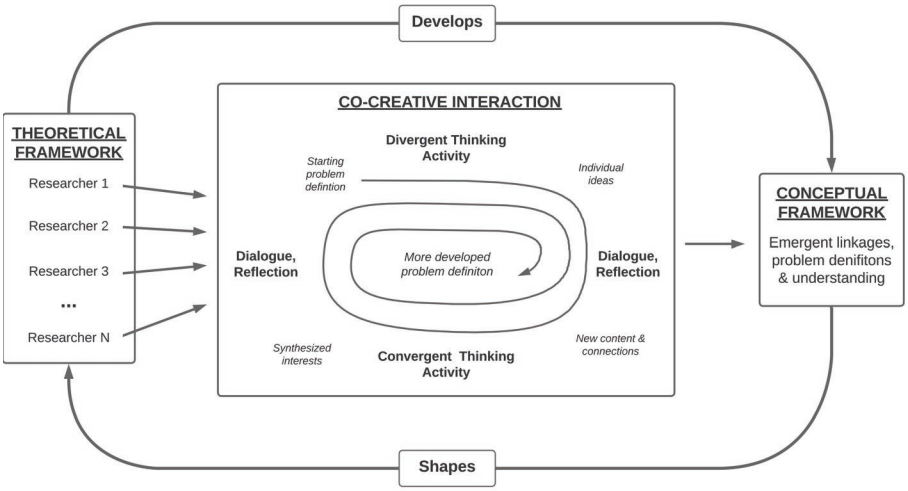

Figure 3: Logic model of double-loop learning in IDR (adapted from Pennington, 2011b).

researcher's inputs, the team collaborates to understand and define the research subject. Divergent and convergent thinking processes are key processes for this interaction, alongside learning via dialogue and reflection. Divergent thinking is "the ability to generate a variety of solutions to a problem" (Pennington, 2011b, p. 189), where researchers utilise their and others' insights to suggest definitions, theories, linkages and approaches. This is commonly referred to as "brainstorming", however, common brainstorming procedures aim to produce as many ideas as possible without discussing those ideas. In IDR, divergent thinking is followed by dialogue and reflection that encourages the transformation of disciplinary ideas into aligned and well-supported research ideas (Pennington, 2011b). Discussion and reflection are, in this sense, learning activities that enable a better understanding of research approaches from other disciplines. This is followed by convergent thinking, which is "the ability to deduce a single solution to a problem" (Pennington, 2011b, p. 189). By critically evaluating the exploratory ideas and connections developed in the previous step, the team arrives at a selection of ideas that have the most potential for providing a path forward, upon which further dialogue and reflection occur.

With furthered understanding and a greater equipment of resources, the research team may decide to alter, add or remove elements to their Theoretical Framework. As often as possible, the research team should identify relevant sources of disciplinary knowledge or insights. Otherwise, they will

struggle with the consequences of a "missing voice." In a study of the interdisciplinary teams evaluating children for developmental disabilities, McClelland and Sands (1993) describe a research team that is missing a discipline. Other researchers attempted to speak for this missing voice, which contributed to a series of ambiguous findings and uncertainty across the team and which would have been addressed had the missing member been consulted. In these cases, the research team may decide to bring in further researchers who can provide new theoretical knowledge, methods, or insights. Factors to consider when identifying potential collaborators in IDR contexts are discussed in Chapter 2.

Through the integration of insights, the Theoretical Framework remains entangled with the Research Objectives and the broader Conceptual Framework. The Theoretical Framework provides a theoretical backing for the definitions and the approaches that the Conceptual Framework uses, while the Conceptual Framework decides which insights are necessary to address all of the relevant research questions and problems. In short, the Theoretical Framework informs the Research Objective, which, in turn, shapes the Theoretical Framework.

Research Questions

With an adequately developed Research Objective and Theoretical Framework, the research team can develop the Research Questions. As Bergmann and Jahn (2008) argue, these questions must emerge through a team effort; not only are they motivated by the same topic or problem, but they also possess the theoretical knowledge to craft well-defined Research Questions.

As IDR studies complex problems, the primary research question will likely be multi-faceted (Tobi & Kampen, 2017). This question should draw on the disciplinary perspectives and insights brought together by the Theoretical Framework. In transdisciplinary research, this also includes non-academic knowledge drawn from social contexts (Bergman et al., 2012).

The primary research question typically concerns a complex and cross-disciplinary question that cannot be easily answered. As such, more "answerable" sub-questions also need to be formulated. These sub-questions break down the various aspects and dimensions of the primary research question into more answerable subparts. These sub-questions will resemble questions researchers are familiar with answering within their own disciplines, as they will have a narrower scope and are approachable with the available research

methods. Each sub-question should then contribute to answering the primary research question.

Of course, IDR questions will vary in scope according to the project, but there are some general criteria or guidelines for these questions. For sub-questions, criteria can be drawn from disciplinary standards, but for both these and the primary research question, Keestra et al. (2016) describe four criteria. The Research Questions should be:

- **Relevant** to the broader problem, and clear why it is worthwhile to answer the (sub-)question.
- **Anchored** in the Theoretical Framework.
- **Researchable**; researchers should be able to conceive research methods to approach the question.[7]
- **Precise** with a clear and specific focus.

Technical & Study Design

With Research Questions established, the "last" step within the Conceptual Framework is the Study Design. This encompasses the research methods that will be used to address the research question. In our diagram, Study Design sits within the Technical Design region, alongside Methods from the Theoretical Framework. This is because the Study Design makes use of methods that the researchers have drawn from their disciplinary education and background. Hence, we can say that the Theoretical Framework aids the achievement of the criteria for good research by improving the validity, credibility, transferability, confirmability, and dependability of research findings (Kivunja, 2018). A variety of methods to choose from comes down to negotiating which method is appropriate. This is not always straightforward given different specialisations.

In the IIS framework for IDR, Keestra et al. (2016) outline three general considerations for deciding the most appropriate research method. First, determine the type of information which best answers the research question. While the main research question is interdisciplinary, the sub-questions can vary in the scope of disciplinarity. This will help decide what type of informa-

7 Applies especially to the sub-questions, the primary research question may be approached by bringing together the sub-questions, rather than one research method answering the primary question.

tion is necessary to answer the question, as you are developing ways to translate relevant concepts into researchable items. Secondly, determine the optimal approach. The way you operationalise concepts and theories is approach dependent. Finally, consider which methods will produce the data needed. The availability of methods is contingent on the researchers and their respective inclinations. Depending on the selected research method, you also commit to an approach to process that data. Ensuing steps, such as data cleaning, categorising or analysing, will depend on that method. As described in the Theoretical Framework, a substantial degree of epistemological self-reflexivity is needed when choosing a research method.

As IDR draws its methods from disciplinary backgrounds, this is also where the rigour and validity of research methods are drawn from. As discussed in earlier sections, disciplines are "custodians" of research methods, and are responsible for upholding research standards. Because research methods vary greatly between research projects, we cannot prescribe a universal set of points that would assure a high standard of research; this is very much at the discretion of the researchers, their respective disciplines and the resources available to them.

As research methods are derived in a monodisciplinary context, adjustments may need to be made for them to fit in an inter- or transdisciplinary environment. "Methodological creativity and innovation are, therefore, essential prerequisites for the success of integrative research" (Bergman et al., 2012, p. 80). In IDR, simply mixing established, discipline-specific methods may suffice (i.e., mixed-methods approach). For example, in sociology, it is common practice to combine interviews with document analyses. This process includes understanding methodological overlaps, strengths and weaknesses (Bergmann & Jahn, 2008), as well as the considerations described in the previous paragraph. Then, the best-suited methods can be used in tandem to supplement each other and answer the research question. The process of using different methods to approach the same problem is a form of triangulation. With the idea that all methods are framed in a specific way, evaluating readings from other methods will develop a more comprehensive understanding of phenomena (Patton, 1999).

As will be mentioned in Chapter 2, it may also prove practical for researchers to split up and work in sub-groups, each using the research methods they are familiar with. This is a common occurrence, especially in large IDR projects, where specialists are trusted to conduct their research away from the larger

group before all of the parts are brought back together towards the end of the project. This process is perhaps not as interdisciplinary as previous stages, as the disciplines are working in isolation from each other, but can be considered to be multidisciplinary, as they are working in parallel to address similar topics.

In transdisciplinary research, a new methodological framework that includes non-scientific actors and social contexts may be necessary (Bergmann et al., 2012). For instance, the relation of power in societies can present an obstacle to the collection of evidence and would require the development of a different research approach. Power, the ability of an individual or group to constrain the options of another, can suppress or distort evidence (Rolin, 2009). The difference in social standing between researchers and informants can intimidate informants by invoking uncomfortable emotions (such as guilt or shame) in what Fricker (2006) calls a "hermeneutic injustice." It can undermine the relationship of trust between the researcher and the informant. One of the participants describes an example of this. Crasnow (2007) describes an example of this; an anthropologist conducting research in Brazil was confronted by informants who stated that they would only cooperate with her participatory research method if she joined them in their political struggles to improve their quality of life. The unequal positions of the anthropologist and the informants could have undermined their relationship of trust, were it not for the anthropologist adjusting her approach; becoming more involved in their political engagement enabled her to gain access to otherwise inaccessible information. Some other examples could be job insecurity or social ostracization on account of sharing personal thoughts. Because of the importance of a relationship of trust in investigating aspects outside of academic knowledge, transdisciplinary research questions require deliberation over how to perform research in a more humanities-based context.

It may also transpire that the research question cannot be answered using any of the available methods, and it may be necessary to modify the research question. As IDR is a flexible and dynamic process, taking a step back to make adjustments is possible and, to an extent, is to be expected.

Conceptual Framework

All of the steps and linkages described above contribute to the formation of the broader Conceptual Framework. While we have discussed them in separate sections for clarity, they are often undertaken in different orders and even simultaneously. Our framework for IDR (Figure 1) recognizes this

fluidity by having multidirectional arrows that allow for both forwards and backwards steps. Furthermore, we build upon existing frameworks by emphasising iterative and recursive processes, such as the assembling of the research team and the development of the broader Conceptual Framework.

The aforementioned steps cover the research process. However, as the Conceptual Framework is also a "logical master plan" (Kivunja, 2018), there are also other, more practical, considerations. As described earlier in the discussion of the Theoretical Framework, team metacognition is employed to understand task-related, team-related, process-related and goal-related information, which includes more specific considerations such as:

- What tasks need to be done?
- Who does what?
- What deadlines are there and when are they?
- Who writes reports or makes presentations?
- Who makes personnel decisions and how?
- Who manages and has access to data?
- Who is responsible for maintaining or procuring research materials or instruments?
- How will publication credit be assigned?
- Who files patents?
- How can funding be procured?
- How will the team communicate?
- Are there conflicts of interest?

The Conceptual Framework also covers broader considerations, such as:

- What are the goals of the research project?
- When is the research project considered completed?
- What is a successful research outcome?
- Are changes in direction needed?
- In what context does the research project operate, and should further research be done later?

The Conceptual Framework is the culmination of all of the above steps: it is the research team's thinking about the study. It can be a confusing phase of the research project with no clear direction or structure; this calls for perse-

verance and an ability to deal with uncertainty and complexity on the part of the researcher. Developing the Conceptual Framework is a dynamic and iterative process, and often draws from the Theoretical Framework to develop understandings, pick out relevant perspectives, and decide the steps ahead.

Research & Outcomes

Because research methods vary so widely between different IDR projects, it is difficult to make concrete recommendations as to how those methods should be carried out, and how any results should be analysed. Rather, this task is best left to the researchers that are more familiar with whichever research method is being used, which was often the case in the experiences of the researchers we interviewed. In that regard, there is a degree of trust to be had across the team that the individual researchers, or sub-groups of researchers, perform said methods with adequate rigour.

Following the conclusion of their research, the team will have to come together to discuss their findings. While research methods and approaches differ between IDR projects, there are a few considerations that apply to all research projects when it comes to interpreting and presenting their results, that being the synthesis and communication of findings.

Synthesis of Findings & Conclusions

After the research process is completed, and relevant information collected, the research team can turn their focus towards drawing conclusions. How the research team processes their data or findings is entirely dependent on the research methods they used. However, there is likely a need for different researchers or sub-groups to come together to discuss and integrate their findings, as pointed out in Chapter 2. Different research methods will have addressed different sub-questions, and it is important for the findings for each sub-question to be brought together to formulate a holistic understanding, such is the nature of (and reason for) an interdisciplinary approach.

In the discussions surrounding their conclusions, the research team, as a whole, should strive to view their findings even-handedly from all of the relevant perspectives, they will then be able to appreciate the different insights provided by the disciplines involved. The importance of this was brought up throughout the interviews and responses to the survey, no perspective should be cast aside just because it is problematic or carries less

clout than any other. Considering each relevant insight can contribute to a more accurate and holistic understanding of the research subject as opposed to having multiple framings of the subject confined within the languages of the individual disciplines involved.

Communicating Findings

It is the norm for researchers to publish their results as articles in academic journals. This was corroborated by our survey, with around 90% of respondents stating that journal articles were one of the methods they used to present their research findings. However, journals are far from the only format in which interdisciplinary researchers present their results. In the survey responses, there were many mentions of policy recommendations, white papers, TEDTalks, webinars/videos, websites, and arts-based outputs such as a theatrical show, among many others. Within our interviews, we heard of outputs in the field of setting up rural art-based communities and starting a knowledge platform with a multitude of other output methods used to make the research available to a wider audience. One example of a particular note was asking a set of journalists to discuss a research finding and publish it with their affiliated media. Interviewees expressed a desire to connect or present their research to the wider public when using a variety of methods to present their findings.

We cannot go about explaining every conceivable form of output, but what we can say is that a larger amount of outputs is more likely to make your research more impactful. Another point of notice is that you may tailor your outputs toward a specific research goal or target audience; if you aim to aid a regional community with agriculture, a research finding may be better implemented by starting an organisation which informs rural workers of your findings and helps them improve in some facet.

In general, it is important to consider the target audience when writing or creating the desired output format(s). For instance, using complex terminology to describe intricacies from one discipline won't lend well to trying to publish an article in a journal associated with a different discipline. Equally, highfalutin writing will be less understandable to the general public, who will be less likely to read feverishly long academic papers.[8] If the basis of the IDR project is to tackle an interdisciplinary, or even transdisciplinary problem,

8 The irony of this recommendation is not lost upon the authors.

then you not only have to deal with the communication of your findings but also explaining the complexity of the issue tackled, which itself will be composed of multiple perspectives and stakeholders. If the medium of communication of findings is through writing, then it is important to keep it both digestible and succinct, it should be understandable to a broad audience (in particular, stakeholder entities which may come from under-educated backgrounds which would benefit from being informed of your findings), and shouldn't generally require hours of laborious reading and attention in order to understand the message. Given the vastness of IDR, there will of course be instances wherein a long explanation of the situation is unavoidable, but in general, it is good practice to limit length and text complexity as much as possible.

Discussion

Having read the title of an interdisciplinary framework, it is perhaps forgivable to have thought that this chapter would be an A-Z explanation of every stage of IDR from start to finish, giving a clear set of do's and don'ts. In our approach, we felt that such an approach isn't all that useful, as exceptions would be waiting to happen. Given the vastness of complex problems and different research methods, it would be unreasonable for this chapter to assume that it can account for all combinations of methods, disciplines and backgrounds.

It is more worthwhile to discuss how IDR should be perceived, and how standard literature may be somewhat short-sighted. IDR relies heavily on the researcher to craft their own methodologies and strategies; especially if the IDR conducted is combining perspectives which were previously never jointly considered.

When considering co-researchers for an IDR project, skillset and approach matter more so than the discipline from which they originate. This view was raised throughout our interviews with interdisciplinary researchers, who stated the importance of spending time and energy to understand and appreciate all of the perspectives relevant to the research subject. How the researchers approach the challenges of IDR is paramount to the success of an IDR project. If, for example, an IDR project needed a physics perspective, and cared merely for just that disciplinary perspective, then surely any odd physicist would do, as long as they had the necessary expertise. But this, of course, isn't the case. Their skillset, their ability to work in a team, and their

openness to other perspectives, among other factors, are also just as important to an IDR team as their disciplinary background, and as such defining IDR by the integration of disciplines alone is limiting (see Chapter 2). The epitome of IDR lies in the amalgamation of "interdisciplinarians," those with "expertise on the integration of disciplines in a range of contexts and the management of other researchers from different disciplines working together" (Bruce et al., 2004, p. 460). In that regard, our model of interdisciplinarity itself can be regarded more as "interdisciplinarianism," as we strive to detach IDR from being tied to disciplinary institutions, alongside all of the ambiguity and limitations contained therein.

It does seem that interdisciplinarity, particularly collaborative IDR, will continue to be on the rise. As pointed out by Spring et al. (2012):

> [...] a meta-trend, observable over the past several decades, is that work is being conducted increasingly by teams. The proportion of scientific publications authored by groups rather than solo authors has more than doubled in the past 50 years. As the volume of scientific knowledge has expanded over time, it has become increasingly difficult for a single individual to have deep expertise in multiple disciplines. (p. 411)

However, just because it is gaining traction doesn't mean it is correct. We also acknowledge the limitation of the depth vs. breadth problem:

> No interdisciplinary study can approach source material with the in-depth approach of a specialist. It is therefore tempting to accept without question the interpretation of specialist reports [...] however, much more value can be gained from specialist reports by acquiring enough expertise to understand the primary data. (Holas-Clark, 2009, p. 25)

When conducting IDR, researchers have to strike a balance between depth in one discipline, thus making the research more academically rigorous in one area, and breadth, which will utilise more relevant insights, and is where the value in IDR is found. Having too much breadth can lead to a loss in depth. However, this can be remedied by incorporating experts from relevant disciplines into the project, and/or expending time and effort to understand the entirety of the research subject. The dilemma between going into depth vs. incorporating more perspectives is one that researchers will have to face

almost certainly when doing IDR, and there isn't necessarily a right or wrong answer in that regard. Much like many parts of our framework, this is dependent on the research project and its scope.

In addition, this chapter leaves a few questions unanswered. While we lay out a framework that we believe can guide a researcher in increasing the quality of their IDR, we do not mention any metric by which we can evaluate how well the IDR was executed. The lack of such clear metrics has long been to the detriment of IDR. At present, the review processes of academic research are structured in such a way that it prefers disciplinary research. One interview subject expressed their view that journals advertise themselves as being interdisciplinary, but that she felt this was very much not the case in their review processes. It is therefore no surprise that in our interviews and survey, interdisciplinary researchers pointed out difficulties in obtaining funding and finding journals to publish their research in, both of those review processes don't seem suited for interdisciplinary research, as it is somewhat unclear what "good" IDR is, and evaluators have not been trained to recognise its value. Thus, many interdisciplinary endeavours are taken at personal expense. It is for this reason (as well as no clear phase or time at which this happens) that applications for financial grants aren't included in our framework; this isn't consistent across all forms of IDR. Because of this, we have no way to accommodate for any specific constraint, whether it be financial or time-based.

Likewise, our discussion surrounding how the findings of IDR are presented remains purposefully ambiguous. There is a wide variety of formats that researchers wish to present their results in, ranging from journal articles to websites and from speeches to art-based formats. While the majority of IDR is published as journal articles, this remains an area where peer review and journal submission processes remain an obstacle. Again, these processes seem to favour disciplinary approaches that fall within the scope of the journal. Interdisciplinary researchers often have to submit to multiple journals before they find one that's willing to accept their work.

The current configuration of research grant processes, peer review, and university faculties as a whole pose significant obstacles to interdisciplinary research. Funding is much more likely to be granted to disciplinary research as it is more apparent how it will lead to tangible results, whereas in the early stages of interdisciplinary research, it may be unclear what the outcomes will be. Both here, and in peer review of publications, interdisciplinary research is scrutinised by each of the involved disciplines. Rather than recognising the

added value of bridging said disciplines, each one poses another chance for the research to be shot down by any shortcoming surrounding depth or rigour within the confines of one discipline. Similarly, interdisciplinary researchers find it difficult to operate within the time constraints imposed upon them by universities and funding bodies. The expectation of results before a particular deadline doesn't suit IDR, which requires significant amounts of time and energy on the researchers' part, a subject that was raised by nearly all of our interviewees when asked what the most difficult part or phase of IDR was.

While there is ample literature discussing these problems and proposing solutions, it remains to be seen how universities and governing bodies translate their statements of enthusiasm for interdisciplinarity into tangible and conducive policies to aid researchers in their interdisciplinary endeavours. As one researcher told us, interdisciplinarity "is praised left, right and centre, but when it comes to getting funding, that eagerness is hard to find."

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CHAPTER 2

Forming Effective Interdisciplinary Research Teams

Daniel MacRae & Hubert Matuszewski

Introduction

When we think of researchers, we may be drawn to think of individual researchers making large breakthroughs in their respective fields; whether it be Newton in physics, Euler in mathematics, or Lavoisier in chemistry. However, such a portrayal no longer reflects the norm. Research is increasingly being conducted both in teams, rather than lone individuals, and through multiple disciplinary perspectives, rather than inherently being tied to a single discipline. Simply put, the way we do research is changing.

This change is happening on two fronts: disciplinarity and researcher count. While disciplinary research is still rather popular, societal problems are increasing in complexity (Stokols et al., 2008), requiring more perspectives, hence, the growing presence of interdisciplinary research (IDR) (Disis

& Slattery, 2010; Wuchtey et al., 2007). While it is understood as the epistemic overlap of multiple disciplines (Klein & Newell, 1996), as outlined in Chapter 1, we look at it from the perspective of the disciplinarian; the integration of knowledge through the collaboration of (often disciplinary) researchers. As each IDR project is tailored to the problem it tackles, these researchers require not only their disciplinary training, but also a level of adaptiveness and an openness to the new perspectives offered by different disciplines.

In tandem with an emerging interdisciplinarity comes a greater requirement of multiple collaborators on a given project, who are needed to supply enough relevant expertise in each of the involved disciplines. As research subjects both across and within disciplines become increasingly complex and surpass the capacities of individuals (Hackett & Rhoten, 2009; Khagram et al., 2010; Cooke & Hilton, 2015), it is no surprise that research collaborations are in vogue across academia. The growth of research teams in the social sciences and natural sciences (Guimerà et al., 2005; Wuchty et al., 2007; Hunter & Leahey, 2008) is a near-universal trend. Wuchty et al. (2007) found an increase in co-authorship in 99.4% of the subfields of science and engineering journals[1] over the last five decades, and a 100% increase in the subfields of social science journals. As well as the frequency of collaborations, the size of collaborative teams has also increased. In the science and engineering articles, team size had grown steadily between 1945 and 2000, nearly doubling from an average of 1.9 authors per paper to 3.5 (Wuchty et al., 2007). Over the same period, collaborations between social scientists writing papers increased from 17.5% of published papers to 51.5% (Wuchty et al., 2007). While the humanities don't follow this trend as closely, there was still a 85.3% increase in collaborations in its 27 subfields (Wuchty et al., 2007).

With this increase in collaborations come increased difficulties in finding common grounds across disciplinary traditions and languages, especially in the context of IDR. Each researcher brings their own knowledge, skills, methods and even language from their respective (often disciplinary) back-

1 Wuchty et al. (2007) divide scientific publication data on 19.9 million articles, into three main branches (aligning with the ISI classification system): science and engineering (with 171 subfields), social sciences (54 subfields), and arts and humanities (27 subfields).

grounds, which contributes to many of the challenges of IDR. As MacLeod (2018) explains, these differences "make it difficult to see how another cognitive domain operates" (p. 716) and can lead to uncertainty or disrupt methodological practices upon which the researchers' ability to solve problems depends. As these epistemic and methodological differences may lead to tensions or conflicts in collaborative settings, effective and cohesive collaboration in IDR teams has been found to be of paramount importance to conducting high-quality research (Fiore, 2008).

In this chapter, we explore the factors that propel or hinder collaboration in the context of IDR. We begin by describing current literature surrounding both the practical aspects of research teams, such as team size and team roles; as well as the potential sources of tensions or breakdowns of collaboration in interdisciplinary settings. Using a combination of a survey and interviews, we compare and contrast this literature against the self-reported experiences of interdisciplinary researchers, so as to develop a conceptual analysis of factors that contribute to effective IDR teams. Lastly, we discuss various different approaches and frameworks which may contribute to a more refined method of conducting IDR.

Research Team Composition

Research teams are chosen in such a way so as to best be able to achieve the research objective. As such, these teams will vary significantly, and these variations will provide different nuances and forces on the inter and intra levels of teamwork. From our literature review, we identified three frequently-mentioned practical concerns; team size, team roles, and familiarity; of which varying levels and configurations generate their own unique collaborative environments.

Team Size

The number of researchers on an IDR project is context dependent; different team sizes offer different benefits, but also come with different drawbacks. There is no consensus in existing literature on the "ideal" team size, nor what roles each team needs, and this remains an area of active research in the science of team science (Liu et al., 2020). While IDR teams are typically between three and 50 members (Halvorsen et al., 2015), it is unlikely that

there will ever be an agreed-upon ideal in this regard, as projects vary in scope and size.

As research teams increase in size, they benefit from increased role differentiation, a plurality of ideas and approaches, and access to a greater set of resources (Witte & Davis, 1996). With an expanded member count comes an opportunity for increased diversity[2] within the team, which has been found to improve the quality of "end products" (Nemeth, 1995; McLeod et al., 1996; Guimera et al., 2005; Leung et al., 2008), which bodes particularly well for IDR given the importance of being flexible in, and sometimes requiring, multiple final deliverables. Larger research teams also accrue more citations than smaller teams (Wuchty et al., 2007).

The trade-off here is one of coordination, especially if the researchers are from disparate or even potentially incommensurable fields, backgrounds or locations (Witte & Davis, 1996). Miscommunication and confusion about task assignments and scheduling can reduce effectiveness and efficiency, something that grows in prevalence as the size of the team increases. This can then be further exacerbated through personal or language conflicts. Smaller research teams (of two to around seven researchers) have the opposite problems; they are easier to coordinate and are less likely to suffer from communication problems, but they have access to fewer resources (Witte & Davis).

In most of the literature that we cite throughout this chapter, success is defined purely by the number of citations that a research project's work accrues after publication. However, this does not paint the full picture; there are more dimensions to be looked at. Wu et al. (2019) argue that rather than relying just on citation figures, the "disruptiveness" of the research should also be considered; in other words, how well it introduces "something new that eclipses attention to previous work upon which it has built" (p. 378). An example of this can be found in the difference between two well-known articles: the BTW-model of self-organised criticality[3] and Wolfgang Ketterle's article on Bose-Einstein condensation.[4] Both articles have received a similar

2 A multidimensional factor that includes not only disciplinary background, skills and methodologies but also ethnicity, religious beliefs, gender, career stage, socioeconomic class, life experiences and viewpoints (Uriarte et al., 2007).

3 Put forward by Bak, Tang and Wiesenfeld in 1987.

4 For which he received the 2001 Nobel Prize in Physics.

number of citations, however, subsequent research on the BTW-model cited the article without also citing its references, while Ketterle's work was almost always cited alongside Bose, Einstein, and other antecedent works. The BTW-model can be cited alone, whereas Ketterle's article usually has to be backed up by references to Einstein and Bose; and would thus be concluded to have a lesser impact. The difference here is that one article suggested new ideas and disrupted previous theories, while the other built upon existing scientific ideas. In this regard, citation figures don't tell the full story of the impact or significance of a research piece.

On this issue, the size of the research team can have a significant impact on the novelty of the research team's work. In their quantitative analysis of 65 million papers, patents and software products,[5] Wu et al. (2019) found that smaller teams had a higher tendency to disrupt science and technology with new ideas, while larger teams tended to build upon recent and more popular developments. They found that solo authors and smaller teams were more likely to develop older or less popular ideas, while larger teams hedged their bets on developing recent and high-impact work, making them more likely to score high-impact (more citations) papers.

Familiarity

Previous collaboration experience between researchers contributes positively to the productivity of research teams. Brozek and Keys (1944) pointed out that:

> Cooperative work is a social art and has to be practiced with patience. A team of research workers representing various disciplines can be welded into a fully integrated unit only on the basis of extensive experience of working and thinking together. (p. 512)

5 Over 42 million Web of Science research articles (published between 1954 and 2014, 5 million US patents assigned between 2002 and 2014 and 16 million pieces of software from GitHub repositories uploaded between 2011 and 2014.

A study of grant proposals submitted to National Science Foundation interdisciplinary initiatives found that research teams where members have co-authored in the past are more likely to have successful grant applications than teams where members have not worked together previously (Lungeanu et al., 2014). The productivity of scientific collaborations has been found to increase due to prior collaboration (Abbasi et al., 2011), and can sustain a supply of co-created ideas (Pennington, 2011).

However, other studies suggest that long-lived teams suffer from decreased creativity over time (Porac et al., 2004), as team members' perspectives become increasingly homogenised as they collaborate more often (Pennington, 2011). Furthermore, researchers who have cited each other in the past are less likely to have successful grant applications (Lungeanu et al., 2014). This is because their arguments, theories, or methods are too similar and "at best represents an incremental advancement" on previous work (Lungeanu et al., 2014, p. 63). Teams consisting only of individuals who have worked together are less likely to have innovative ideas (Guimera et al., 2005), though this hindrance may manifest itself to a lesser degree if said individuals come from different research areas (Lungeanu et al., 2014). While previous collaborations will aid the cohesion of the team, care should be taken to avoid a certain staleness or repetitiveness to the research. A mix of freshness, with new researchers injecting fresh ideas, appears to lead to better outcomes. Using publication and citation rates from across four scientific fields, Whitfield (2008) found that teams made up of 50-60% of repeated collaborations reach a "bliss point" between individuals with experience and proven track records and newcomers with lots of time and energy to devote to the project.

Team Roles

Another thing to consider when structuring a research team are the roles that are needed for the team to succeed. Existing literature on IDR offers a variety of suggestions for the roles and individual characteristics that are needed for an effective research team. The roles discussed by said literature are broadly grouped together and summarised in Table 1. There are general characteristics that apply to all individuals that would make them effective team members. These, however, will be discussed in a later section.

A Principal Investigator, in addition to being a regular researcher, also

Table 1: Roles within an IDR project (Cheruvelil et al., 2014; Garwood & Poole, 2018; Griffin et al., 2006; Lakhani et al., 2012; Pennington, 2011; Stember, 1991).

Role	Description
Researcher	● Conducts research ● Contributes knowledge (often based in disciplines), skills and expertise on research methods ● Tries to find connections between their own disciplines and the research subject/other disciplines ● Answers research (sub-)questions
Leader/ Principal Investigator	● Organises the team (facilitates meetings, establishes goals and ground rules, assigns tasks, sets deadlines, etc.) ● Develops a process-oriented activity ● Identifies the scope of the project ● Maintains professional and intellectual integrity ● Builds bridges between disciplines and researchers ● Resolves conflicts ● Identifies and resolves epistemological and methodological differences ● Empowers team members by giving feedback and coaching of team members and subgroups ● Builds and maintains team cohesion and motivation ● Fosters mutual respect among team members
Interlinker/ Project Manager	● Gathers resources for the team (e.g., funding or facilities) ● Connects the team to researchers that may be useful for the project (often using social networks/social capital) ● Connects the team to any relevant external bodies or organisations

bears the responsibility of steering a team towards its goals; ensuring that the efforts of each of the researchers within the team are synchronised (Stember, 1991). They also render a team of researchers more effective when they are broad-minded, and motivate members of the team (Griffin et al., 2006). Especially in an interdisciplinary context, they also bear the task of balancing the exploration of new scientific avenues with the performance of routine work that will be of benefit to future teams (Liu et al., 2020).

While the Researcher and Leader roles are fairly straightforward, the role of the Interlinker (sometimes referred to as the "project manager" [Garwood &

Poole, 2018]) is a little less so. The responsibilities of the Interlinker are to connect the research team with experts in other disciplines/faculties and to provide resources to the team. This role is often not clearly defined and is usually grouped together with the responsibilities of the Leader, but its importance cannot be underestimated. Researchers' social networks are often limited to within their respective disciplines or faculties, a factor that can inhibit access to insights from other disciplines. As one interdisciplinary researcher in Cooke et al.'s (2020) study described, "it is more difficult to 'size up' a potential collaborator who is outside your field. You won't know them by reputation" (p. 153). Having at least one member of the team who is outwardly engaging and has access to more resources can connect the team to more disciplines, increasing the opportunities for new team membership and the cross-fertilization of ideas (Pentland, 2012).

Effective Team Members

As the collaborative nature of IDR relies on the contributions of individual researchers, it is important to understand what makes for a "good" interdisciplinary researcher. There is a great deal of literature indicating various skills, motivations and traits that interdisciplinary researchers should have in order to overcome epistemic and methodological differences. We have compiled and grouped these traits in Table 2.

The first category, individual skills, covers both (perhaps disciplinary) academic skills as well as general characteristics that allow individuals to cope with and motivate themselves through the more challenging or unclear phases of IDR. This grouping focuses primarily on (disciplinary) research skill, and are generally applicable to all forms of academic research, whether it be disciplinary or interdisciplinary. This prerequisite for researchers partaking in IDR is nothing new. Blackwell (1955) explains that each researcher in IDR should have a recognised competence in at least one discipline. With these skills, researchers will be more proficient in bringing the knowledge and methods housed in their respective disciplines to the team, aiding their attempts to dissect or understand the interdisciplinary research topic.

Then we have interpersonal skills. As we view IDR as a collaborative enterprise of knowledge generation and sharing (see Chapter 1), this is fairly self-explanatory. Researchers should have good collaboration skills in order to work effectively with their peers, as this will facilitate a better (group)

Table 2: Useful characteristics of IDR (Blackwell, 1955; Carey & Smith, 2007; Cheruvelil et al., 2014; Cooke et al., 2020; Datta, 2018; Kessel et al., 2008; Lakhani et al., 2012; Lyall & Meagher, 2007; MacLeod et al., 2015; Vogel et al., 2014).

Category	Characteristics
Individual Skills	● Familiar with (disciplinary) research methods and knowledge (e.g., theories and concepts) ● Has a certain level of experience (linked with career stage) ● Posses a degree of incumbency or familiarity with the rest of the team ● Expression of viewpoints/opinions ● Is flexible and adaptable ● Is willing to deal with uncertainty and complexity ● Is creative ● Able to bridge the gap between theory and practice ● Perseverant ● Shows an interest in a wide range of subjects ● Is emotionally mature
Interpersonal Skills	● Committed to a common interest ● Communicative ● Good listener ● Values collaboration ● Proficient in time and information management skills ● Proactive in team-building ● Proactive in engaging with other partners (both researchers and other stakeholders)
Approach to Information	● Broad in perspective ● Flexible and versatile in semantics, theoretical orientation and modes of inquiry ● Interest in other disciplines, willingness to learn from them ● Open-minded attitude towards ideas from other disciplines and experiences ● Willingness to devote lots of time to learning what others know ● Open to new methods ● Intellectual curious ● Respectful of other disciplines ● Willing to promote the success of other disciplines ● Able to reflect on theoretical assumptions ● Intellectually tenacious in branching out and creating new areas of knowledge or practice

understanding of different disciplinary insights and contribute to more effective discussions surrounding the research subject. The quality of these interactions has also been shown to be critical to translating team heterogeneity into innovative outcomes (Drach-Zahavy & Somech, 2001). As Pennington (2011) explains, "group innovation is highly dependent on the quality of interactions between participants. Designing ways to more effectively engage in creative group learning and interdisciplinary problem formulation is a necessary precursor to effective interdisciplinary collaborative action" (p. 58). With a variety of different disciplinary theories floating around, tensions may be unavoidable in intragroup dynamics (Liu et al., 2020). In this regard, team members, especially team leaders, should be educated in training methods specifically developed to tackle the interpersonal, communication, and coordination issues that have been identified in the study of teams (Asai, 2019; Fiore, 2008). These skills will also aid the team on an organisational level; clear communication helps facilitate clear deadlines and expectations and, on the whole, results in a more efficient and productive team.

The final category is how each researcher approaches the information, methods and languages of different disciplines. Much of the literature examined in Table 2 indicated the importance of flexible approaches of researchers within IDR teams. As IDR can consist of a wide range of disciplines engaging with one another, it is key that researchers are able to effectively and respectfully navigate an environment wherein many different disciplinary ideas or norms are floating around. In the following section, we discuss the potential consequences of failing to address these disciplinary divides nor establishing a cohesive collaborative environment after instituting the organisational concerns of the team described in this section.

Difficulty of Teamwork

While the more practical concerns described above help facilitate effective working patterns within the team, IDR comes with the inescapable obstacle of bridging disciplines, which in itself comes with a variety of additional challenges. In this section, we describe the tensions and conflicts between disciplinary norms that may encumber the research team's collaborative process.

The Territories of Disciplines

A significant benefit of IDR is the synthesis of knowledge sourced from multiple disciplines. However, this comes with the additional challenge of integrating researchers from disciplines of differing practices and norms. IDR teams consist of members who are from disciplines of (perceived) unequal status, are junior or senior faculty members, are from departments with different levels of prestige, and have different salaries, teaching loads or access to different resources (Stember, 1991). It is difficult for academics to embody open-minded approaches to research, as each of them have varying "mental models, cognitive maps or frameworks, or paradigms" (Davies & Devlin, 2007, p. 5). As Wissoker et al. (2000) write:

> There is something about academic training that makes people insistent that one disciplinary approach must be right and others wrong, or, at best, misguided.... Scholars treat interlopers from other disciplines as if they were engaged in a war for territory, as if interdisciplinarity were a zero-sum game. (p. 7)

One researcher in Cooke et al.'s (2020) study wrote that "working with colleagues in other disciplines sets up tensions around issues of rigour and currency. That is, which field has more or less currency and which field offers more or less rigour" (p. 151). The sociologist Burton Clark once quipped that "men of the sociological tribe rarely visit the lands of the physicists and have little idea of what they do over there. If the sociologists were to step into the building occupied by the English department, they would encounter the cold stares if not the slingshots of the hostile natives" (1963, as cited in Becher, 1989).

Groupthink

To groupthink means to subordinate critical thinking within a group in favour of seeking group conformity and unison (Janis, 1982). Within a board meeting in a company, an employer may not be so willing to challenge a claim made by a higher-up for fear of their job security or social standing among their co-workers. Within a social group, an entire group may follow the idea of one person in fear of being the dissenting mood killer, even if everyone else within the group also equally disagrees with the proposition of said person. In IDR, you may have epistemic barriers between different

groups, and a threat may arise if one of the disciplines becomes overbearing and forces compliance from other collaborating disciplines, which may threaten intellectual pluralism (Moran, 2002).

In the context of IDR, this group dynamic breakdown is an imminent threat. For example, teamwork breakdown in interdisciplinary medicinal projects can lead to serious errors (Institute of Medicine, 2004). Getting everyone on the same page, and making sure everyone is heard, is pivotal to avoiding growing concerns and potential teamwork breakdown. For instance, collaborations between researchers from the natural sciences may dominate proceedings with social scientists or humanities researchers, as their fields are seen more as "hard science" or "pure" (Machlup, 1961). Such a project could succumb to groupthink, as a faction of researchers seeks to assert the dominance of their field over others, for the sake of practicality and pursuing approachable solutions to complex problems. The particular symptoms of groupthink to be avoided here are mindguarding, stereotyping, and self-censorship (Janis, 1982), which are described below:

- *Mindguarding* (Janis, 1982) refers to an entity or activity which limits information flow within a team for better or for worse. In the normal context, this may refer to overlooking certain doubts or disregarding sources that may seem unreputable or banal. In the context of a team, such a mentality may present itself from a slightly different perspective; that being one's own disciplinary background. Since disciplinary education is still mostly based on disciplinary approaches (Klaassen, 2018) there are certain benefits of interdisciplinarity which are not sufficiently exploited such as psychosocial development (Clark & Clark, 1997), where a lack thereof may lead to a tendency to cast doubts on the legitimacy of points raised by different disciplines. In IDR such skills are tested on topics where no such aptitude could have been developed, and perhaps a given insight/publication/piece of evidence will be seen with different levels of importance, which can stir conflict. As described above, one may feel a particular level of attachment to their discipline, and be unwilling to compromise it for a more well-rounded view of a problem or react harshly to criticism from other perspectives from other disciplinarians. In light of the aforementioned roles, such a case could present itself where a specialist-heavy individual may struggle with assessing the bigger picture of an IDR project.

- *Stereotyping* (Janis, 1982) is coined as a mindset wherein one ignores or proactively demonises members of an out-group or ones who challenge a certain group premise. Given the disparities between disciplinarians, we may suspect a certain level of this to happen on the intra-team level. By not being aware of what other fields and disciplines do, one may succumb to the risk of being overly reductionist and stereotyping group members and their habits from different methodological backgrounds. Someone in the natural sciences could perceive someone from the humanities as not being objective enough, and vice versa. Particularly, gender stereotypes can play a role (Olmos-Peñuela et al., 2013).
- *Self-censorship* (Janis, 1982) stems from a fear of breaking consensus and giving into the notion that the group knows best. While we mentioned the limitations of a disciplinarian leading them to perhaps act overzealously, it can also work in the opposite way, wherein one is insufficiently confident in the knowledge and observations that they legitimately have. If there is a legitimate query to be had, or a dissatisfaction within the team, even if said dissatisfaction is not really related to your area of expertise, one may be tempted to—but probably shouldn't—just keep their mouth shut and hope for the best. Open communication is of utmost priority; this relies on a mutual trust that the person to whom one may wish to raise concerns isn't a mindguard of their own discipline, and they themselves do not engage in self-censorship.

If these symptoms are not circumvented, then there is a large risk of artificially reducing the scope of an interdisciplinary team, and failing in its vision to be more insightful from the typical mono-disciplinary approach. In an explicit reference to the graph of Figure 1 (from Chapter 1), groupthink would be a force that slows down and hinders the interaction between the Research Objective and the Theoretical Framework. Slowing this interaction down is thus a hindrance to the foundational iterative process of interdisciplinarity, resulting in sub-optimal research output; with perhaps the mere compensation of the illusion of group harmony.

The Fuzzy Front End

A pivotal point in any research project is the procurement of financial or material backing, which tends to occur quite early in the project's lifespan. While this is true for many forms of research, it is particularly unfortunate

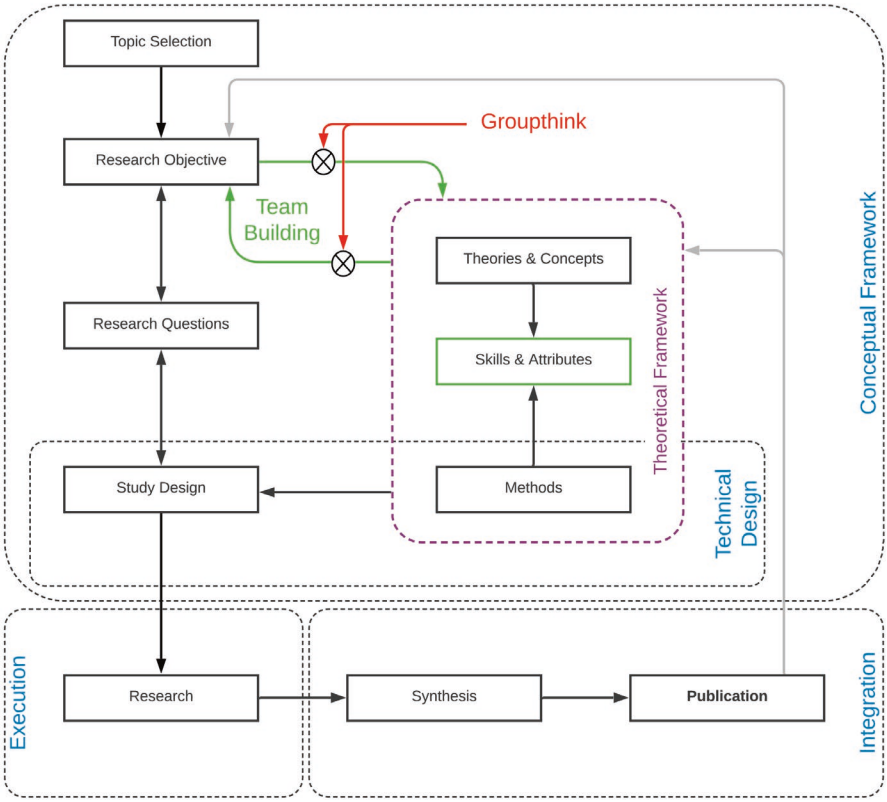

Figure 1: A descriptive framework for IDR (adapted from Chapter 1). The red arrows indicate the influence of groupthink on the research group's team building processes. More specifically: on the left-to-right green arrow, the Research Objective is hindered against the Theoretical Framework by means of having limited scope. While on the right-to-left green arrow, poor theoretical exploration (and the closing off of other disciplines) may limit the ability of the team to evaluate their Research Objective by means of something like mindguarding.

for IDR. The demand for ideas is highest early on in the project, as the research team must formulate compelling and tractable ideas in order to obtain funding (Darch et al., 2010). This is in spite of the fact that many IDR teams require substantial amounts of time to learn how to effectively collaborate with each other (Jeffrey, 2003) before they can supply a steady stream of high-quality ideas (Pennington, 2011). On top of the more practical issues, such as assembling the team and clarifying roles, there is also the time needed to learn one another's jargon and terminology (Liu et al., 2020).

The result of having to make research design decisions early on is that they

become locked in, and the material and intellectual cost of changes increases over time (Pennington, 2011). Because of this, "the potential for new ideas to influence current project outcomes decreases with time. Novel ideas may still emerge, but these are more likely to become fodder for the next proposal" (Pennington, 2011, p.58). It remains to be seen how much of an impact external constraints (from universities, funding bodies or other institutions) on the project's timeline[6] have on the research team's effectiveness. One factor that has frequently been shown to contribute to effective IDR projects is the duration and frequency of the research team's interactions. As Kessel et al. (2008) point out, "the investment of time and interpersonal space for acquiring at least a well-informed understanding of alternative conceptual and methodological languages is a prime requirement for successful inter-disciplinary initiatives" (p. 437-8).

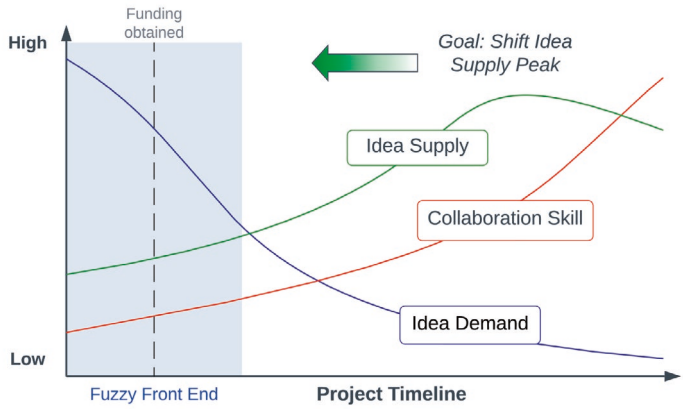

Figure 2: Demand and supply graph over the life of a research project (adapted from Pennington, 2011). For new teams, there is a slow development of collaborative skills, which leads to a peak of idea supply that is later than the "fuzzy front end" where research proposals often need to be made.

Returning to the issue of research proposals; in the often ambiguous "fuzzy front end" (Reid & de Brentani, 2004) stages of exploration and research topic development, the research team may not have hit its stride in generating new ideas yet, as seen in Figure 2. They may still be establishing the research question or topic, navigating disciplinary norms and boundaries, identifying

6 Such as having to produce a research proposal early on in a project timeline, or a deadline for the entire project's completion.

relevant research areas, or even just getting to know one another (Pennington, 2011). It is here that research teams often have to invest the substantial time needed to learn how to effectively collaborate with new members (Pennington, 2011). Despite this, it is at this early stage that they are expected to submit research proposals. As Pennington explains, this can be understood as "a lack of synchronization between supply and demand of interdisciplinary research ideas" (2011, p. 57). This disconnect can have significant ramifications for the research team: ideas articulated in research proposals may not successfully identify or make linkages between disciplines (Spencer et al., 2008), or the project may not reflect the interests of all the involved parties, causing researchers' alignment with the project to go awry and participation to dwindle (Pennington, 2011). In order to get the establishment and proposal of the research project "right" the first time, it then becomes the onus of the research team to swiftly address the nature of their collaboration, on a personal and epistemological level, and establish clear team structures or responsibilities, so as to facilitate effective interdisciplinary collaboration.

Methodology

The literature may not exactly represent what is going on within interdisciplinary research. For example, it could be the case that the size of teams is not a large concern for active researchers, or there may be disagreements regarding the pros and cons thereof. Thus in order to evaluate the ideas raised by the literature in the previous sections, it was deemed necessary to consult and talk to active researchers from the field. To achieve this, a combination of interviews and a survey was used. The interviews primarily aimed at procuring in-depth experiences and views of researchers on their experiences with the process of IDR and collaboration, while the survey offered a viable method for collecting a wide range of experiences and opinions from a diverse set of researchers on particular issues raised in the literature review. Both methods subsequently offered a platform with which to develop our conceptual analysis of the above-described literature and best enabled us to interact with researchers and their insights.

The empirical results discussed in this chapter are obtained from the same survey and interviews used in Chapter 1. The procedure and samples included in these two methods are best described in that chapter, and more details

should be found there. For the purposes of brevity, we summarise the samples as consisting of, for the survey, 264 interdisciplinary researchers of varying disciplines, seniority and nationality, and, for the interviews, 10 researchers of equally varying backgrounds. Again, a more detailed breakdown is offered in Chapter 1. Here, we describe the questions contained within our empirical methods that pertain to the subject of this chapter.

While the first dealt with the definition and research methods of IDR, the second half of the survey contained questions pertaining to the nature of collaboration, (research) team roles and individual (researcher) characteristics. Two multiple choice questions asked participants about their preferred working group size, and which traits they most valued in interdisciplinary researchers. These multiple choice questions were made with the intention of testing the assertions made within the "Research Team Composition" of the chapter. On team size, there were many implied benefits of having a larger team, such as a higher quality of end products (Guimera et al., 2005; Leung et al., 2008; McLeod et al., 1996; Nemeth, 1995) and more citations accrued (Wuchty et al., 2007) among others. This would suggest a tendency, or at least a favourability towards larger teams since we assume that researchers desire both higher-quality deliverables and more citations. The question on researcher traits consisted of seven options, which were a condensed version of the traits described in Table 2. This literature didn't hint at any hierarchy, and as such we expected a somewhat balanced distribution between the various answers, but it remained possible that researchers valued some characteristics more than others. The final question was a written answer question which asked participants to describe traits they felt would contribute to a good IDR leader/supervisor/coordinator. This question was meant to compare and contrast the viewpoints of the researchers we surveyed against what was presented in Table 1, specifically the Leader/Principle Investigator. We assumed that a good Leader would at least already be competent as a researcher, and we thus asked the interviewees to point out additional traits to the ones given in the questions.

Participants were asked how many researchers they would prefer to collaborate with on a team, if their collaborators were more specialised in one discipline or if they possessed broader knowledge/skills, how responsibility and leadership were (or should be) allocated, and what traits they felt contributed to effective interdisciplinary researchers. The interviews were flexible in nature, and, as we aimed to incorporate the practical experiences and views

of our interview participants, the discussion surrounding collaboration and preferences in identifying other researchers to collaborate with was somewhat dependent on the answers given to the above-described questions, with participants being asked to elaborate on the specifics and reasoning behind their responses.

The survey and the interviews served as a test of the content found throughout the literature review and furthered our understanding of the interdisciplinary research process by accessing the practical experiences of a diverse set of interdisciplinary researchers. We identify key commonalities and differences across the various responses to the survey and interviews, as well as the nuances of the assortment of IDR projects and academic disciplines involved. As the empirical results and literature review are intertwined in our research process and development of the conceptual analysis within this chapter, the findings of both the literature review and empirical methods will be discussed together throughout the rest of this chapter.

Results & Discussion—Practical Affairs of Collaboration

Team Composition

Discussions throughout our interviews surrounding the number of collaborators on a research team reflected findings in the literature review. Several participants indicated a preference to work in smaller groups, as it allows them to develop better personal relationships and the working familiarity that they felt was key to IDR. It is therefore unsurprising that the majority of respondents to our survey preferred working in groups of two to four (Table 3). That is not to say that the research team is limited to interacting with just four people, expertise can also be sourced externally. As one survey respondent explained, "I think there should only be a couple researchers on [the] project, who can discuss and ask for advice from experts from certain disciplines."

Small teams disrupt research fields by exploring promising and novel ideas in depth, whereas large teams amplify recent successes by solving acknowledged problems and refining approaches. Large teams need to consider some degree of bet-hedging as they need a reliable stream of funding and recognition to "pay the bills" (Kuhn, 1961). They may need to protect themselves from the losses that come with failures (Collins, 1998),

Table 3: Responses to Question 8 (What is your preferred working group size when engaging in interdisciplinary research?) The numbers pertain to the number of individuals working in a team. The question was multiple choice with one selectable.

Preferred team size *(possible multiple choice question options)*	**Respondents**
1 (working alone)	11
2–4	143
5–8	62
9–14	7
15–30	0
30+	0
No preference	21
Total	**244**

which can have greater (financial or reputational) consequences for larger teams. Smaller teams, which have more to gain and less to lose, can afford to explore opportunities and take risks. Reflecting this trend, Wu et al. (2019) "consistently observe that… larger teams produce articles, patents and software with a disruption score that markedly and monotonically declines with each additional team member" (p. 379). As such, the amount of researchers to be taken aboard a project is an essential consideration for interdisciplinary research projects. The ideal team size will depend on the aim of the research project. When investigating a new, obscure or unorthodox idea or approach, the team may benefit from having fewer researchers. Meanwhile, projects aimed at proposing a solution to a complex problem may find more advantages in using existing ideas and pooling together resources in order to develop in-depth understandings or to devise solutions to said problems.

One potential remedy for larger teams is to break them apart into smaller sub-groups, which are tasked with different aspects or sub-questions of the research project. Rhoten (2003) found that research centres that worked in groups of less than 50 investigators were more productive than centres that had over 50 investigators on a research team. However, engaging with more researchers (>10) was also found to be central to successful collaborations (Rhoten, 2003). Smaller working groups may benefit the productivity of those groups, while still allowing them to engage with the resources that the broader

research project may offer. However, it should also be noted that the coordination of the sub-groups will still require a fair amount of time and energy.

Familiarity with more practical matters is also a factor to consider. One interdisciplinary researcher we interviewed pointed out that when looking for potential collaborators, they often looked for individuals who worked in a mechanically similar fashion to themselves. In the contexts of computer science-related projects, researchers would seek individuals who are familiar with similar programming languages or software such as GitHub or Jupyter. In other cases, this may relate to programmes or methods used to analyse data, or the use of software systems for document preparation such as LaTeX. An individual's ability to acclimatise to the team's workflow or practices can speed up the early stages of their integration into the team, and can allow the team to move onto their work sooner. When asked what skills or characteristics they look for in potential collaborators, many of our interview subjects stated that they look for someone they simply enjoy working with, while all stressed the importance of these relations and developing a mutual understanding and appreciation for one another's fields and ideas. This view reflects research by Riedl et al. (2021), which suggests that collective intelligence[7] (CI) is most strongly predicted by group collaboration processes and ability to work together, finding that this was more important in predicting CI than the skill of the individual members. The importance of interpersonal relations in IDR is such that one interviewee suggested that the presence of these relations is what differentiates interdisciplinary research from multidisciplinary research.

An obstacle to accessing these benefits is the time needed to build up familiarity between researchers. Oftentimes the time pressure of submitting research proposals, or being expected to do so, can become quite problematic for building working relationships. In one of our interviews, an interdisciplinary researcher described networking events where they were given just five minutes to get to know another researcher, or having to go through academic "sandpits" where one is thrown into a group and expected to come up with research proposals over the course of a week. They felt unable to make a strong enough assessment of the others, their work or their values within this timeframe to be able to make a decision on whether or not to collaborate

7 A group's ability to perform a diverse set of problem-solving tasks (Woolley et al., 2010).

with them. As described throughout this chapter, it takes time for researchers working on IDR projects to develop personal and working relations. While networking events do offer opportunities for researchers to make connections outside of their own fields, universities and other organisations must be careful not to rush this process.

Team Roles & The Interlocker

While the earlier discussion of the team roles (as summarised in Table 1) describes the necessary skills and responsibilities for IDR, it is not to be understood that one person must fit completely within the parameters of one role alone; an overlap is more than possible. Discussions during the interviews indicated that the roles within IDR teams can be very flexible. For instance, leadership responsibilities can be shared across collaborators. This may especially be the case in smaller research teams of 2-4 people. Furthermore, a team member in the vein of the Leader or Interlinker would benefit from having a familiarity with funding application processes as not all disciplines have identical grant application processes. In one of our interviews, an interdisciplinary researcher pointed out that data scientists and programmers were more likely to struggle in interviews or answering questions before a panel as the nature of their work means they ponder questions and problems over a long period of time, rather than providing answers instantly, as would be the case in an interview. Thus, the research team may find it beneficial to incorporate researchers who are accomplished or accustomed to these processes.

An additional role, that appears to be under-defined in existing literature, could be added to Table 1: that of the Interlocker. In the past, it was argued that each member ought to be well-versed in at least one discipline. For example, the OECD (1998) stated that "highly competent proficiency in a single discipline is the only acceptable basis for interdisciplinary success" (p. 18), Blackwell (1955) argues that each researcher must have recognized competence in at least one discipline, and Stember (1991) states that IDR efforts "seldom work when members are not fully competent in their own field" (p. 6). This viewpoint, however, neglects other useful skills in interdisciplinarity, such as the ability to communicate effectively between, or to integrate, different disciplines. In this regard, Carey and Smith (2007) propose the role of an Interlocker; a researcher who has a breadth of knowledge in theories, approaches and discourse across multiple disciplines, rather than a

depth of knowledge in a single discipline. The role of the Interlocker is one of a translator: they facilitate the breakdown of disciplinary boundaries, negotiate tensions, and bring together perspectives from different disciplines. Perhaps as a consequence of an interdisciplinary education or background, their skills lie in integrating different disciplines with an adequate, but perhaps not highly proficient, understanding of those disciplines. Similarly, Anbar (1973), suggests the concept of a "bridge scientist," one that plays an identical role to our Interlocker. Their responsibilities are to translate perspectives and languages between disciplines, as well as resolve paradigmatic conflicts. Anbar suggests that there are four types of individuals who become bridge scientists, these are listed below:

1. "Professionals who are strongly grounded in a particular discipline, and, having satisfaction in terms of scientific curiosity and recognition by their peers, have become adventurers.
2. Professionals who are strongly grounded in a particular discipline and might like to stay in it, but who feel forced to get involved in other disciplines because their own discipline is becoming obsolete and non-marketable.
3. People who had some rather superficial training in one or more disciplines, who now find that they can get work and consequent recognition as generalists.
4. People who have moved into managerial, sales or other essentially bridge positions, but have not been prepared to fulfil a bridge role." (Chettiparamb, 2007, p. 29)

Anbar concludes that the first category will likely be the most active and creative in IDR, while Category 2 will be less so. The other two categories should be less involved in the team's actual research process. Category 3 is best used in organisation or marketing but preferably shouldn't interfere in project management or research, while Category 4 risks becoming a serious obstacle to the effectiveness of the team in any role. In the next section, we will discuss skills that researchers should have in order to be prepared for IDR, it is perhaps these skills that Category 4 lacks.

Nonetheless, the role of such an Interlocker (or any researcher that may not be highly trained or proficient in at least one particular discipline) in IDR remains unclear. There is very little literature that legitimises this role, and

further research on these individuals is needed. Their skill in integration, however, is one that should be found throughout the research team, and is often emphasised in our literature review, as well as our own interviews and survey. While there should still be a high level of disciplinary competence in various fields across the team, in order to maintain the validity of the theoretical and conceptual frameworks,[8] at least some team members should have broader collaborative capacities. Bridging skills enhance collaboration and help remedy tensions that arise as a result of incongruent disciplinary methods or theories.

Team Roles in Practice

While all IDR researchers have certain skills that would benefit the output of research, not every researcher is the same, nor works in the same fashion. For these reasons, the team roles we've described in Table 1, as well as the Interlocker, are not necessarily roles that exist within IDR teams exactly as we've described them. They may exist in a wide variety of forms, and responsibilities may be shared between individuals. For example, a handful of our interview subjects described how they had experience of working in smaller teams where there was no clearly-defined Leader, nor a specific individual that would carry out only the responsibilities we've assigned to the Interlocker or Interlinker in our earlier discussions. Team members are likely to have different aptitudes. Some may be better at researching and finding resources, or be better at contacting external agents, while others may be better at managing a team, handling inner team dynamics/team morale, finding practical solutions, among other things. Having a team that covers a wide variety of aptitudes may be beneficial to a research project. For example, we may find a researcher who is highly skilled in disciplinary methods or writing, but not quite as proficient in integrating between other disciplines, and vice versa. Thus, the question of having a well-rounded team not only pertains to covering a wide range of aptitudes, but also to ensuring that for any weaknesses identified within the team, there is someone who can compensate for it.

One already well-researched way of dividing these different aptitudes is through the Belbin team roles. Research conducted by Belbin (2010) devised nine clusters of individuals' behaviour that a team should have access to in

8 Chapter 1 contains a detailed definition of these two frameworks.

Table 4: The nine Belbin team roles (from Belbin, 2010, p. 22).

Role	Description & Team Contribution	Allowable Weaknesses
Plant	Creative, imaginative, unorthodox. Solves difficult problems.	Ignores details. Too preoccupied to communicate effectively.
Resource Investigator	Extrovert, enthusiastic, communicative. Explores opportunities. Develops contacts.	Overoptimistic. Loses interest once initial enthusiasm has passed.
Coordinator	Mature, confident, a good chairperson. Clarifies goals, promotes decision-making, delegates well.	Can be seen as manipulative. Delegates personal work.
Shaper	Challenging, dynamic, thrives on pressure. Has the drive and courage to overcome obstacles. Can provoke others.	Hurts people's feelings.
Monitor Evaluator	Sober, strategic, discerning. Sees all options. Judges accurately.	Lacks drive and ability to inspire others. Overly critical.
Teamworker	Co-operative, mild, perceptive, diplomatic. Listens, builds, averts friction, calms the waters.	Indecisive in crunch situations. Can be easily influenced.
Implementer	Disciplined, reliable, conservative, efficient. Turns ideas into practical actions.	Somewhat inflexible. Slow to respond to new possibilities.
Completer Finisher	Painstaking, conscientious, anxious. Searches out errors and omissions. Delivers on time.	Inclined to worry unduly. Reluctant to delegate. Can be a nit-picker.
Specialist	Single-minded, self-starting, dedicated. Provides knowledge and skills in rare supply.	Contributes on only a narrow front. Dwells on technicalities. Overlooks the "big picture".

order to be successful. These roles are summarised in Table 4, and are often used to inform management consulting practices; they may inform IDR project management as well. It should again be noted that one person is not limited to just one role.

Applying the roles to the context of IDR, the Specialist can be seen as the standard disciplinarian, with a proficiency in the methods from their specialisation. Their contribution is strong, but narrow. There is a danger that the specialist will apply said expertise to problems outside of their discipline. The Coordinator is the work delegator, and as such instils norms within the group. However, the Coordinator is not as confined to a discipline as the Specialist, and can be flexible in different interdisciplinary arrangements. In trying to reach the objective, both of the aforementioned roles could succumb to an overly-narrow perspective. An Implementer is similar in that regard, but since their implementation may not always be confined to one discipline, they can be more flexible towards exploration.

The Shaper values project momentum, striving for both exploration of new horizons and a deep understanding of disciplines to progress the research. The Monitor Evaluator also works on the mechanics of progress; they would require a broadness of disciplinary knowledge. They are known to be impartial and thus explore improvements even at the risk of hurting feelings. The Completer Finisher is similar in that regard, but in a steadfastness to complete the task, they can overlook potential alternatives, unlike the monitor evaluator.

The Teamworker is one that supports whatever the team is doing; they are versatile and help the team as much as possible. However, they play an equally exploratory and problem-solving role. They are perhaps not the most highly skilled in a single discipline as they take a more Latourian approach to science; they are not too interested in what the subject matter is, but rather what components there are, how they are related and how to best help make them work as a coherent entity. The Resource Investigator is similar to the Interlinker described earlier; they are outgoing and will seek opportunities or individuals on behalf of the research team, although they may not offer as much technical expertise as the Specialist.

The final Belbin role is the Plant. They are clever, imaginative, and good at coming up with unorthodox combinations or solutions to solve complex problems. In doing so they risk losing some degree of disciplinary rigour. Because of this, they may be suited to collaborating with individuals who fall

into the Specialist mould, as they would provide more specific expertise to either reinforce ideas, or keep them in check. The Plant may provide an idea of the role of the Interlocker that Carey and Smith (2007) propose, as they are good at finding and understanding interrelatedness and using unconventional approaches. But, like the Interlocker, this role may lack disciplinary skills or understanding.

All of these roles, with their respective attributes, contribute to the formation of effective IDR teams. The considerations and necessary skills for a team raised by these Belbin roles are analogous to those described in earlier sections (e.g. Table 1), and, in future, the Belbin roles may offer more practical insights on collaboration sourced from teamwork research outside of the academic sphere. Nonetheless, we argue that individuals who are highly specialised but low in exploration should be balanced with individuals who may be less specialised, but willing to explore how the expertise of those specialised researchers relates to other researchers or ideas.

Disentangling Discrepant Disciplines

Much of the value of IDR can be found in combining of a myriad of fields, ideas and methods in diverse research teams. Be it a diversity of disciplines, career stages or opinions, the amalgamation of different individual skills builds up to a diversity at a team-level that encourages critical thinking across multiple theories and approaches, the uncovering of disciplinary assumptions and the creation of novel ideas or approaches. However, this diversity brings with it additional challenges for IDR teams. With a mixed bag of disciplinarians comes a mixed set of norms (even within the same discipline there may be a mixed set of norms on account of them being different people), which may take time to resolve before establishing a common set of group norms. Failure to harmonise a research team can contribute to suboptimal research output, or sometimes a complete lack thereof in extreme situations.

As discussed earlier, the territorial attitude of researchers can result in a hierarchy of disciplines, an occurrence that was described by some researchers in our sample. As one survey respondent explained; “someone only trained in one discipline can be hard to convince to change perspective and to understand other disciplines.” This occurrence is also observed in our literature review. Fanelli and Glänzel (2013) describe an example where researchers from the natural sciences may see themselves as “above”

researchers from other fields, as they believe their field is more rigorous, serious or "pure." These attitudes are an obstacle to the collaborative nature of IDR and, as Moser (2016) points out; dismantling these hierarchies is perhaps the most difficult, but transformational, work in IDR. In this section, we suggest strategies and explore considerations for overcoming these obstacles, based on the findings of our research, existing literature on the issue, as well as concepts present in related literature.

Safety and Ontological Security

With the aforementioned importance of having multiple/outside perspectives, it may be daunting to consider that the act of collaboration may in itself discourage the incorporation of outside perspectives. This is due to an assurance of quality from merely having conducted collaboration, in other words, collaborating could result in having a heightened sense of ability by virtue of being in a team (Minson & Mueller, 2012). We may think of mantras such as "teamwork makes the dream work" in context to having perhaps a blind confidence in research merely on account of being aware that one has gone beyond what they alone would be capable of within a given topic. While you may be incorporating more viewpoints through the acquisition of collaborators, you are also enclosing yourself to those viewpoints alone, and any development on a topic will be enclosed within this environment.

Decision-making capacity is increased through the integration of different perspectives into the decision-making process; to either challenge their own prejudices/bias, or to cross-examine a set of information found. On a grander scale, this is rather impractical on account of the sheer amount of material each individual brings to the team. Having a thorough examination on a team-wide basis, alongside a long discussion regarding each point, would be unreasonably time-consuming given the necessity of teams to reach a consensus. What may arise is a lackadaisical approach to information, where you may trust that your peers have a similar if not better decision-making capability compared to your own; have adequate or greater prior knowledge. Or, you merely trust opinions on account of not challenging previously held preconceptions. Such an attitude, paired with a desire—or pressure even—for consensus by which academic progress can be made, may inevitably lead to an impaired incorporation of external viewpoints, and thus a diminished ability for proper decision-making. Another force that similarly works against collaboration is collaborative inhibition

briefly summarised as "two heads apart are better than two heads together" (Barber et al., 2015).

To overcome the territoriality of disciplines, it is important to understand where it comes from. The concept of ontological security can provide an answer. "Security is concerned with maintaining the relationship with the environment as it is. Inadequate agents are not equipped with skills to understand or deal with the unknown outside of in-group controlled environments" (Denham & Andringa, 2021, p. 10). Diversity and out-groups are perceived as threats, and attempts to achieve ontological security "frequently involves forms of exclusion and othering which may be both violent and counter-productive" (Rossdale, 2015, p. 369), and is "likely to decrease security for those not included" (Kinnvall, 2004, p. 763). In IDR "territoriality is often redoubled when interdisciplinary spaces are at stake … such spaces are new, with boundaries less clear and less ritualized than in traditional disciplines" (Wissoker et al., 2000, p. 7). Relying on and protecting disciplinary norms and routines can distract from real-world threats, making the group less effective at what IDR strives to do: understanding complex real-world problems that extend beyond the bounds of disciplinary norms. The habitualisation, or consolidation, of routines sustains in-group identities, and thus disciplinary boundaries. This becomes a major obstacle for IDR, as "best interdisciplinary projects involve a lively process of interaction in order to explore commonalities and differences and establish relationships between disciplinary partners" (Lyall & Meagher, 2007, p. 1). This view was regularly expressed by our interview subjects, almost all of whom emphasised the importance of close collaboration between their peers.

Effective Leadership

The role of the team Leader(s) is perhaps one of the most important roles in the team in facilitating effective communication and collaboration within the research team. As discussed above, IDR teams face many challenges in navigating different disciplinary norms and languages, and these interactions can lead to a certain territorialism between researchers of different disciplinary backgrounds.

So then, how does a research team overcome the disciplinary divides that contribute to a hierarchy of disciplines within the research team? Kessel et al. (2008) propose applying Crumley's (1995, as cited in Kessel et al., 2008) notion of a heterarchy: "the relation of elements to one another when they

are unranked or when they possess the potential for being ranked in a number of different ways" (p. 2). The idea of a heterarchy stems from biological and social structures that are not arranged hierarchically, different elements all contribute to patterns that make up complex systems where no part is seen as better or more important than any other. This systematic thinking can be used to bring different disciplines together to work in tandem, rather than in opposition, to understand the relatedness of every aspect of an IDR subject.

Establishing a heterarchy is a responsibility that tends to fall on the shoulders of the team's Leader(s). Hüttermann and Boerner (2011) established the importance of transformational and collaborative leadership in diverse teams at both a team and an individual level. Many studies of IDR outline the importance of the Leader performing the responsibilities outlined in Table 2. The conditions for cohesion and inclusion that the Leader establishes serve as a counter to the perceived need for ontological security, replacing it with psychological safety. As Clark (2020) explains, "psychological safety is a condition in which you feel (1) included, (2) safe to learn, (3) safe to contribute, and (4) safe to challenge the status quo—all without fear of being embarrassed, marginalised, or punished in some way" (p. 2). Furthermore, psychological safety "promotes interpersonal risk-taking and signifies a change from a defensive and self-protective team role … to being a fully collaborating member" (Denham & Andringa, 2021, p. 11).

Clark (2020) outlines four steps (or levels) to achieve psychological safety, which are outlined in Figure 3. As regular and effective communication is key to IDR, the Leader should make each research team member feel included in the group, feel safe to participate and learn in the group, contribute to the group, and use skills to challenge norms and improve the whole group's knowledge. In IDR, one's ability to collaborate with others is equally important as one's expertise (Datta, 2018). This can prevent researchers from returning to disciplinary habitualisation and the symptoms of groupthink described earlier, enabling them to explore and interact with novel ideas by developing an atmosphere suitable for conjuring up and suggesting new ideas. With psychological safety achieved, researchers can "fold into and expand a matrix that is developing around a particular question" (Callard & Fitzgerald, 2015, p. 88).

In literature surrounding teamwork and collaboration (often in a business sphere), there are many strategies for achieving psychological safety within

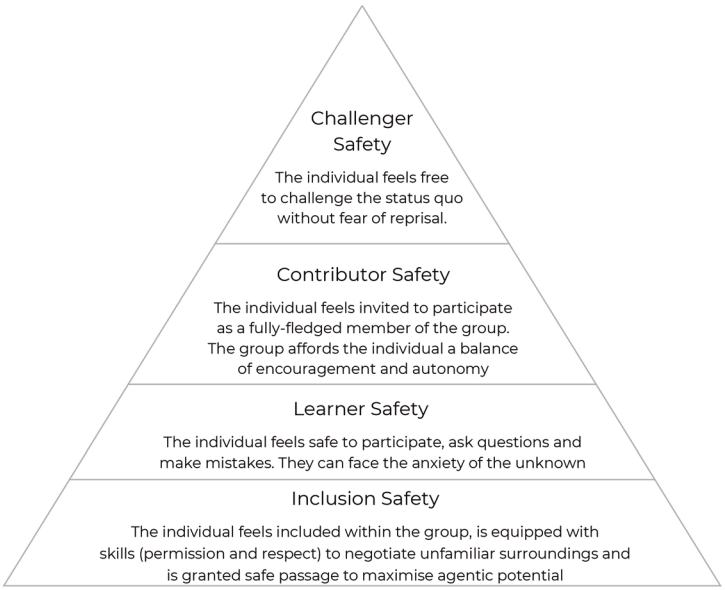

Figure 3: Levels of psychological safety (adapted from Clark, 2020 and Denham & Andringa, 2021)

teams. Research often points towards regular and effective communication, empowering leadership styles and the clear delegation of goals, roles and tasks as drivers of effective teams. Stokols et al. (2008) find that this carries over to multi-disciplinary teams as well, on top of the need for the intra- and interpersonal skills in Table 3. Opportunities for informal interactions can also benefit collaboration by developing better interpersonal relationships and establishing common grounds. Further factors that contribute to effective collaboration include organisational/institutional, physical/environmental (such as meeting facilities, labs or offices), technological and sociopolitical factors (Stokols et al., 2008).[9]

With a heterarchy and a healthy working environment, the group as a whole can feel safe to engage with each other and question their own and others' norms in the pursuit of developing a higher-quality and holistic understanding of the research subject. Heterarchies are vital in the context of IDR, as discussions often involve a myriad of different, and perhaps

9 These factors, however important they may be, lie outside the scope of this chapter, and due to the diversity of IDR projects, are too context-dependent for us to make generalizable recommendations.

conflicting, disciplines. Establishing one, however, adds additional pressure and responsibility to the Leader(s) of interdisciplinary research teams, of whom so much is often expected that it led one survey respondent to remark that they were analogous to "a sheep with five legs": highly sought-after; the jack-of-all-trades; a perfect candidate—who is often searched for in vain.

Skills for Interdisciplinary Researchers

While they are helpful for any research collaboration, social dimensions may have an even greater bearing in an interdisciplinary context as there are even greater abrasive forces in teamwork than usual. Such forces may consist of fundamentally different paradigms stemming from having gone through different disciplinary educations; different academic vocabularies resulting in language barriers; and different approaches to conducting research/writing papers/looking for publications, among other factors. To combat such abrasive forces, the team working on a problem should be tolerant and amicable with one another on a personal level, alongside the standard requirement of professionalism and research etiquette. Overcoming differences in disciplinary practices and languages requires effective interpersonal skills, as well as a collaborative (rather than individualistic) approach to knowledge generation and sharing (Cheruvelil et al., 2014). With the potential for implicit disciplinary hierarchies, and the politics of knowledge to cause tensions, we may stress the importance of interpersonal relations within IDR.

Researchers' approaches to external information is a significant factor in determining the success of the research team; they must be prepared to adopt and understand unfamiliar theories and methods. Throughout our interviews, interdisciplinary researchers stated the importance of either personal dedication or an intrinsic motivation in conducting IDR. This was also reflected in the survey results. While each of the characteristics in Figure 4 are valuable and not to be discarded, our survey of interdisciplinary researchers aggrandise a particular few. It suggests that having a broad perspective and being respectful towards other disciplines is of utmost importance. This helps them navigate diversity within the research team, which is an important trait for IDR teams, and calls for an interest and willingness to devote time to respectfully learning about other disciplines and peers. "Interdisciplinary study represents, above all, a denaturalization of knowledge: it means that people working within established modes of thought have to be permanently aware of the intellectual and institutional

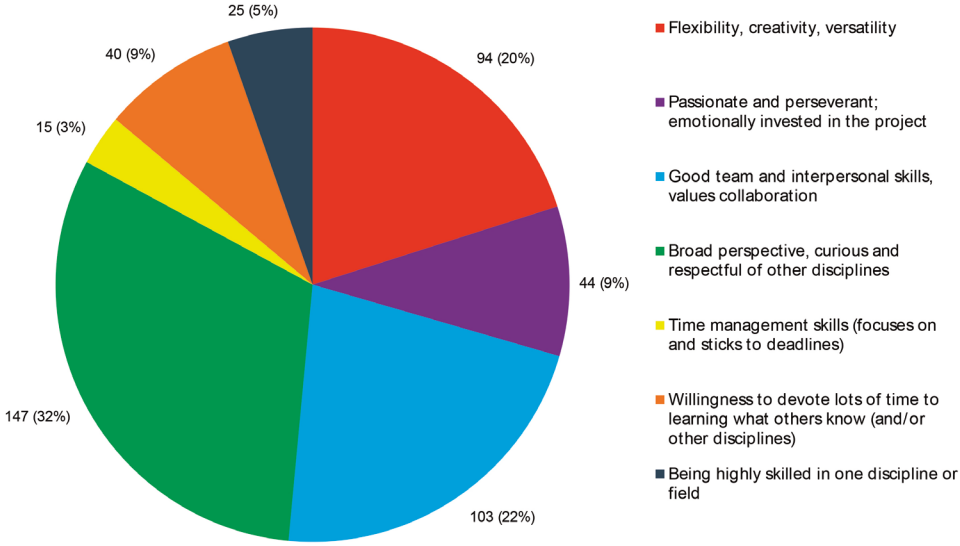

Figure 4: Results for survey question 9: "*In your opinion, which of the following traits are the most important for interdisciplinary researchers to have?*" (Respondents were asked to pick up to three traits. 243 researchers responded to this question.)

constraints within which they are working, and open to different ways of structuring and representing their knowledge of the world." (Moran, 2002, p. 181).

Breadth or Depth?

At multiple points in this chapter, we have touched on the idea of striking a balance between single discipline-based skills or knowledge and the ability to bridge across different disciplines. This dilemma is not new to IDR; we refer to it as the "breadth vs. depth" dilemma here, and IDR teams must consider how to balance these. Both are necessary but are unlikely to yield desirable results without the other. Without breadth, their research may not be considered "interdisciplinary," but without sufficient (disciplinary) depth, the team's research loses rigour and is at greater risk of being rejected by journals and universities alike. We find that this predicament is not limited to just the subject of their research, but also to how the research team incorporates individuals. For instance, when assembling a research team, would one rather have a researcher that is very highly skilled in just a single discipline, who offers a wonderful depth of knowledge but may not easily or often work outside their own discipline, or someone who brings an opposite

skillset and is highly proficient in crossing disciplinary boundaries, but may not offer as much technical expertise as the monodisciplinarian? The outcomes of this dilemma are best summed up by Stember (1991):

> The right combination of commitment to the common interest, disciplinary competence, broad interests, and personal attributes may be difficult to determine, but no one of these is sufficient. Without a sufficient inclination for adventure, a competent disciplinarian may retreat from the group project. Similarly, someone with insufficient expertise in one discipline is likely to struggle even more in an multidisciplinary environment, treating important matters superficially at best. (p. 6)

How to strike a balance between researcher's characteristics (e.g. Belbin's Specialists and Plants) is, as always with IDR, dependent on the research project. There is no universal or ideal ratio between the attributes or skills discussed in this chapter, but projects may lean more towards one or the other depending upon the project's objectives and context. We suggest that negotiating a harmony between these two is at the discretion of the team Leader(s), or indeed the team as a whole. Projects aimed at coming up with solutions to problems may benefit from incorporating more researchers who are highly skilled in their disciplines and problem-solving skills. Meanwhile, projects that are more exploration-oriented may opt to incorporate more researchers with broader (or more creative) skills who seek to develop new concepts and ask better questions, rather than answer existing ones.[10] A mix of both is needed to supply sufficient disciplinary expertise while developing ideas that lie beyond the boundaries of said disciplines; the very objective of interdisciplinary research.

Conclusion

It is clear that there are many factors that contribute to effective collaboration within an IDR team. The conversation surrounding the subject of collaboration itself spans multiple disciplines. However, there are a few key consider-

10 As discussed earlier, this role remains under-defined, and more research is needed to understand the function of such researchers in the context of interdisciplinary research teams.

ations that remain constant throughout these discussions in both the literature review and empirical results. We summarise these below:

1. **Team Size**: The number of researchers can have a significant impact on the scale and scope of the project; more people can supply more resources and problem-solving power, but may find that their research is less disruptive or "groundbreaking" than that of projects done by just a handful of researchers.
2. **Collaboration Experience**: Research teams with members that have worked together before may be more effective or efficient in collaborating, but their ideas may become stale or repetitive. New researchers with fresh perspectives can (re)invigorate a research project.
3. **Team Roles**: Delegation of responsibilities can improve effectiveness, but team roles needn't be black and white. Leadership and responsibility can be shared and researchers can occupy different team roles simultaneously; how any of this is assigned depends entirely on the scale of the project and what workflow structure suits the context.
4. **Skills & Expertise**: A variety of skills and motivations are needed to carry out a collaborative project. Not every researcher needs to be highly proficient in just one discipline, but expertise must be found somewhere across the team. Equally, not every researcher needs to be skilled in integration or synergizing disciplines, but these skills are desirable somewhere within the research team.
5. **Influence of Disciplines**: Academic disciplines can be a territorial affair, but interdisciplinarity is not a zero-sum game. A diversity of disciplines is needed to challenge assumptions, improve outcomes and prevent the project from falling back on normative solutions. Achieving this calls for an openness and flexibility to new ideas and approaches on the part of the researchers themselves. A heterarchy of researchers and disciplines can promote a healthy environment for discussions by levelling the playing field between disciplines.

While considerations such as "how many researchers (or disciplines) are needed?", "who should I work with?", and "how should responsibility be delegated?" are all key to the success of an IDR project, there is no one-size-fits-all answer to what makes an IDR team effective. Decisions surrounding the

points above will be made on a case-by-case basis, and are highly dependent on the particular situation of each project.

The final consideration on our list is perhaps the most important. In any context, a team member that feels insubordinate to another member will affect the effectiveness of the team as a whole; in IDR, this is true for disciplines as well. Across the literature we examined and our interviews, the importance of not dismissing outside or "lesser" disciplines was vital to the successful collaboration and fruitful output of IDR teams. The integration of perspectives and researchers from the natural sciences, social sciences and humanities serves to paint a complete picture of a problem or phenomenon, even if this proves to be difficult or time-consuming. Much like Falk-Krzesinski et al. (2011), we favour a systems view of disciplines, "where an interdependent and iterative set of clusters can be: viewed as a coherent whole, while the relationships among the components are also recognized and seen as critical to the system" (p. 154).

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Appendix A: Qualtrics Survey

Thank you for participating in our research survey. We are collecting information as part of a research project on interdisciplinarity, more specifically the interdisciplinary research process. To do this, we would like to hear from people who are familiar with interdisciplinary research. We anticipate that this survey will take around 10-15 minutes to complete.

We will be asking you a series of questions related to your views on interdisciplinary research, specifically regarding your general opinion on interdisciplinarity, the methodology used in your interdisciplinary research experience(s) and some questions about your collaboration experiences, what makes for 'good' researchers and research teams. (For the purposes of this study, the terms 'multidisciplinary', 'interdisciplinary' and 'transdisciplinary' all fall under the term 'interdisciplinary')

Your responses will be anonymous, only the researchers involved in this study will have access to the answers you provide. If there are any questions that you do not wish to answer or are unsure about, you do not have to answer them.

Questions: If you have any questions about this study, you may contact the investigators, Daniel MacRae and Hubert Matuszewski at d.macrae@student.rug.nl or h.matuszewski@student.rug.nl (there will also be a text box at the end where you can leave any comments).

Do you consent to participate in this survey?

☐ I consent

☐ I do not consent

Q1 How would you define "interdisciplinarity"?

Q2 Which of the following statements **best** describes your understanding of "interdisciplinary research"?

☐ The 'borrowing' of research methods from other disciplines to answer research questions raised within one's own discipline

- ☐ A process of creating a solution to a problem that is too broad or complex to be dealt with adequately by a single discipline or profession
- ☐ A fundamentally explorative process that aims to develop a broader or more comprehensive understanding of a topic
- ☐ A collaborative process wherein the different knowledge and skills of individual researchers are synthesised to approach complex subjects

Q3 To what extent do you agree/disagree with the following statements?

	Strongly Disagree	Some-what Disagree	Neutral/ Unsure	Some-what Agree	Strongly Agree
"The initial stages of interdisciplinary research are rather abstract, fuzzy, and perhaps difficult to navigate"	☐	☐	☐	☐	☐
"I/we often have to edit or adjust our research question(s) or research objective throughout the research project"	☐	☐	☐	☐	☐
"It is clear to me what & high-quality interdisciplinary research is (as opposed to low-quality or "bad" interdisciplinary research)"	☐	☐	☐	☐	☐
"The interdisciplinary research process is not at all the same as disciplinary research"	☐	☐	☐	☐	☐
"The standards for rigorous disciplinary research apply to interdisciplinary research as well"	☐	☐	☐	☐	☐
"There is a clear framework (or step-by-step process) to follow when doing interdisciplinary research"	☐	☐	☐	☐	☐

Q4 Which research (or data collection) methods do you use in your interdisciplinary research? Select all that apply. (If you use "mixed methods," select both quantitative or qualitative)

☐ Qualitative
☐ Quantitative
☐ Computational Methods
☐ Experimental Methods
☐ Conceptual Analysis
☐ Hermeneutic Methods
☐ Applied Research
☐ Case Studies
☐ Other (please specify):

Q5 Which of the following deliverable formats have you (or your project) used in your interdisciplinary research experience to publish/present research findings? (select all that apply)

☐ Journal article
☐ Policy recommendation
☐ White paper
☐ Conference paper
☐ Convention speech, lecture (eg. Ted Talks)
☐ Arts-based outputs (eg. theatrical performance or artwork)
☐ Other (please specify):

** Skip To: Q7 If Q5 != Journal article **

Q6 You indicated that you have presented your interdisciplinary research findings as a journal article, where was this article(s) published? (select all that apply)

☐ A journal that is commonly (or strongly) associated with one discipline or field
☐ An interdisciplinary journal
☐ Other (please specify)

Q7 In your opinion, what is the most difficult part, phase or aspect of interdisciplinary research?

Q8 What is your preferred working group size when engaging in interdisciplinary research?

☐ 1 (working alone)
☐ 2-4
☐ 5-8
☐ 9-14
☐ 15-30
☐ 30+
☐ No preference

Q9 In your opinion, which of the following traits are the most important for interdisciplinary researchers to have? (please pick no more than 3)

- ☐ Flexibility, creativity, versatility
- ☐ Passionate and perseverant (especially through uncertainty and lack of clarity); emotionally invested in the project
- ☐ Good team and interpersonal skills, values collaboration
- ☐ Broad perspective, curious and respectful of other disciplines
- ☐ Time management skills (focuses on and sticks to deadlines)
- ☐ Willingness to devote lots of time to learning what others know (and/or other disciplines)
- ☐ Being highly skilled in one discipline or field

Q10 What traits would someone need in order to be a good interdisciplinary research **leader, supervisor or coordinator**? (Aside from those in the previous question)

Q11 Do you have any additional remarks about this survey, or interdisciplinary research in general? (If not, leave blank)

Q12 If you would like to hear about the results of our study, please write your email in the box below. (If not, leave blank)

Q13 If you are open to being interviewed by us to further discuss your experiences in interdisciplinary research, please leave your email in the box below (If not, leave blank).

Appendix B: Interview Consent Form

I, _____, hereby consent to be a participant in the current research performed by Daniel MacRae and Hubert Matuszewski.

I have agreed to take part in the study entitled "A Study of Interdisciplinary Research" and I understand that my participation is entirely voluntary. I understand that my responses will be kept strictly confidential and anonymous. I have the option to withdraw from this study at any time, without penalty, and I also have the right to request that my responses will not be used.

The following points have been explained to me:

- The goal of this study is to understand interdisciplinary research. This includes the process and methodology of such research, as well as how researchers from different disciplines collaborate.
- My participation in this study should help advance our understanding of how interdisciplinary research is conducted and what factors contribute to effective collaboration within interdisciplinary research teams.
- The study will last approximately 30-40 minutes.
- My responses will be treated confidentially and my anonymity will be ensured. Hence, my responses cannot be identifiable and linked back to me as an individual.
- For the researchers' purposes of reviewing interview responses, the interviewers will ask for my permission to record the interview shortly before the interview begins (this recording will not be accessible to anyone other than the researchers, and will not be distributed in any form)
- The researcher will answer any questions I might have regarding this research, now or later in the course of the study.

By clicking the button below, I acknowledge the points above and agree to participate in the survey

☐ I consent

☐ I do not consent, I do not wish to participate

CHAPTER 3

Experiencing Art as Evidence: Examples from Western and Eastern Philosophy

Patrik Wintergerst & Benjamin Bewersdorf

1. Introduction

The goal of science and philosophy is to generate knowledge and understanding of the world. While this goal might not always be reached, scientific and philosophical research can both still be understood as cognitive pursuits. Art is often taken to fundamentally differ from science and philosophy in this respect. Art is assumed to be ill-suited to teach us about the world; engagement with art is viewed not as a cognitive but a purely aesthetic pursuit (Gibson, 2008, p. 573-4).

We believe that such a fundamental difference between science and philosophy on the one hand and art on the other is misconceived. We believe that

art can be an effective tool to generate knowledge about the world, as well. It is our impression that using art to generate knowledge is heavily underutilised as a result of this misconception.

In the following, we will focus on philosophical knowledge in particular and argue that engagement with art can generate knowledge within the domain of philosophy. We will start by examining the standard objections against the idea that art can generate knowledge and briefly examine an influential reply to these objections by Carroll (2002). While Carroll's response might show how some artworks—such as works of literature—can generate some philosophical knowledge—such as knowledge about virtues and vices—we believe that Carroll's response is unable to account for many other instances in which an engagement with art can generate philosophical knowledge. We will then propose an alternative explanation of how art can contribute to philosophical knowledge. We believe that the engagement with artworks can bring about experiences which can function as evidence in philosophical arguments. We will illustrate this idea by two examples from very different philosophical traditions, the duck-rabbit drawing in Wittgenstein's *Philosophical Investigations*, and the use of sculpture and related methods in the context of Buddhist Practices.

The definition of art is extremely controversial and we will not be able to comment extensively on this debate here. For the purpose of this chapter we will work with an extremely broad definition of art: We will count any outcome of a creative enterprise as an artwork. This definition notably includes entities into the class of artworks which many scholars would be hesitant to call art, such as the drawing of a child, which might lack the right aesthetic properties or the right relation to an art historical context (Adaijan, 2022). The same might be said about our two examples; one might object that while they are outcomes of creative enterprises, they do not constitute art proper. Even if that were the case, however, it would not take away from the main point of this chapter: engagement with the outcomes of creative enterprises—be they artworks or not—can lead to philosophical knowledge. They should therefore become part of philosophical discourse.

2. Plato's Objection

One of the best known critics of art providing knowledge from the history of philosophy is Plato, who is considered to be the first to briefly discuss the

epistemic properties of art. Plato discusses this topic in the context of his considerations on what the best possible society would look like. In Chapter 10 of the *Republic* (Republic X, 595a-608c), he writes that the ideal state should reject imitative art, as "all poetical imitations are ruinous to the understanding of the hearers" (Republic X, 595b).

This claim is justified through appeal to Plato's theory of forms. For Plato, forms (such as the form of a bed), are the only real objects of knowledge. They are prior to any instantiations of the thing in the perceptible world (such as the bed itself). Since artists, according to Plato, do not base their works on the forms themselves, but rather on their instantiations, their works are twice removed from the objects of genuine knowledge. Even worse, since many artworks are based on other art (such as a painting depicting scenes from the Homeric epics) they are thrice removed from the original forms. Due to this derivative nature of art, it is harmful to understanding and should be discouraged, if not prohibited.

While Plato's argument rests on a metaphysical view which has fallen out of fashion, we can still find his scepticism reflected in modern objections against the idea that artworks can generate knowledge. Plato's scepticism is, like the modern objections we are about to discuss, grounded in the idea that art is in some way a degree removed from genuine truth and reasoning. Plato's notion that artistic representation is not valid data of the real world relates in particular to what Carroll (2002) calls the no-evidence argument, which we will now turn to.

3. Modern Objections

More recently, Carroll (2002) discusses what he takes to be the three main objections to the idea that art is useful for the generation of knowledge and education: the banality argument, the no-evidence argument, and the no-argument argument.

According to the banality argument, any knowledge that might be generated through art is trivial. So while art might produce some very general understanding—think of claims like "killing is bad"—nothing really useful can be learned from art.

The no-evidence argument rejects the ability of artworks to generate knowledge on the grounds of them providing insufficient epistemic justification. Since fictional depictions are not real events, and even supposedly

realistic paintings are not the same as seeing the represented thing, one does not gain justification for believing certain things about the real world by reading a book of fiction, looking at a painting, or watching a drama. While artworks might represent truths, such as a certain demographic within society being oppressed, an artwork depicting such conditions is not valid evidence for the empirical claim that this group is being oppressed. The no-evidence argument has some similarity to Plato's original objection: The distance between the artwork and the object of knowledge as well as the possible accidental or intentional distortion of truth in the creative process makes artworks incapable of generating knowledge.

The no-argument argument claims that even if artworks accidentally contain information that could in principle generate knowledge or educate an audience, it is highly unlikely that they will actually do so. The reason for this is that whatever claims might be contained in the artwork, it is not part of the audience's appreciative practices to assess the truth or justifiedness of these claims. This makes it unlikely that the audience gains knowledge from engaging with the artwork.

In response to these objections, Carroll argues 1) that thought experiments are not affected by these objections and 2) that there exist works of literature that are sufficiently analogous to thought experiments to be able to dodge these objections as well. According to Carroll, this shows that it is possible for artworks to be useful for the generation of knowledge and education.

A thought experiment is, roughly speaking, like a real experiment, except that it is not intended to be actually carried out (they might even be impossible to carry out). What thought experiments can teach us, we can learn simply by reflecting on their design (Sorenson, 1992, p. 6). Thought experiments are frequently used in philosophy, but there are also famous examples from within science as well, such as Galileo's thought experiment of the two rocks. The purpose of Galileo's thought experiment is to disprove Aristotle's theory that the speed at which objects fall is proportional to their weight. Galileo asks us to consider a case in which a heavy and a light rock are tied together. On the one hand, Aristotle's theory seems to imply that the object composed of both rocks falls faster than the heavier rock alone, since it weighs more. On the other hand, Aristotle's theory seems to imply that the lighter rock slows down the fall of the heavier rock, making the composed object fall slower than the heavier stone alone. Since Aristotle's theory has two contradictory implications, it is inconsistent and must be wrong. Gali-

leo's thought experiment could, of course, easily be carried out. However, as Elgin (2014) convincingly argues, this would not add anything to the force of the argument against Aristotle. On the contrary, it would only open the door to confounding variables threatening to invalidate the result (Elgin, 2014, p. 228-9).

Since Galileo's thought experiment is not carried out, it cannot be said to generate empirical knowledge. It is clear that it does generate knowledge of some kind, however. Carroll calls such knowledge conceptual knowledge. Generating conceptual knowledge is an important function of thought experiments, according to Carroll. In particular, Carroll is interested in thought experiments generating conceptual knowledge by allowing for conceptual discrimination. Thought experiments do this by "array[ing] a structured series of carefully chosen, contrasting, graduated examples in order to provoke reflection on concepts whose conditions of application remain otherwise elusive and/or vague" (Carroll, 2002, p. 11).

The ability to generate conceptual knowledge renders thought experiments invulnerable to the banality and no-evidence argument, according to Carroll: Clarifying the conditions of applications of concepts, some of which are central to our understanding of the world, is not trivial. It also does not require empirical evidence. Furthermore, Carroll argues that thought experiments are not affected by the no-argument argument either. While thought experiments might not consist of a complete argument strictly speaking, with clearly articulated premises and conclusions, these elements are intended to be completed in the mind of the reader. Thought experiments are clearly positioned and perceived as a tool in the context of cognitive pursuits (Carroll, 2002, p. 8-9).

Finally, Carroll claims that some works of literature allow for conceptual discrimination similarly to thought experiments, which in turn allows the works of literature to avoid the banality, no-evidence and no-argument argument. An example put forward by Carroll is Forster's novel *Howards End*. According to Carroll, "in *Howards End* we do not simply find a bunch of characters willy-nilly. Rather the cast of characters bears notably strong, highly structured, systematically varied, and subtly polarised relations of comparison and contrast to each other, particularly along the dimension of virtue" (Carroll, 2002, p. 13). Carroll calls this structure a *virtue wheel* and argues that it functions similarly to the structures of variations we find in thought experiments, allowing the reader to conduct a "guided conceptual analysis"

(Carroll, 2002, p. 14) and thereby gain conceptual knowledge on virtues. For Carroll, this shows that there are artworks that can generate knowledge relevant for philosophy.

4. Experiencing Art as Evidence

We do not want to discuss here whether Carroll's strategy to show that it is possible for artworks to be useful in generating philosophical knowledge is successful. It should, however, be clear that even if it is, it would only be able to explain how a subclass of artworks can generate philosophical knowledge. Not many artworks—especially outside literature, film and drama—contain a structure like Carroll's virtue wheel. Is conceptual discrimination the only way in which artworks can contribute to philosophical discourse? No. We think there is another avenue through which artworks can generate philosophical knowledge. This approach will allow for different responses to the objections discussed by Carroll and will thereby be able to explain how artworks not covered by Carroll's account can generate philosophical knowledge. Furthermore, it might also offer an alternative explanation of how the artworks discussed by Carroll can generate philosophical knowledge, thus potentially offering a broader account of how art can contribute to philosophy.

When we engage with an artwork, we have a particular experience. Depending on the artwork, this experience can take many forms and in some cases—so we claim—this experience can do philosophical work by functioning as evidence for a philosophical claim. Carroll himself already briefly hints at this when he discusses the role of emotion in response to the literary works he discusses: "Our emotional responses not only draw us to attend to certain character traits, rather than others, but also enter into our reflective weightings of certain character traits vis à vis others. Or to say it differently, emotional responses are part of the mix of factors that are engaged in deliberating about the application of virtue concepts in reaction to fictional thought experiments" (Carroll, 2002, p. 18).

We would like to think of these emotional responses as an example of an experience that can be considered evidence for a particular philosophical claim, rather than simply part of conceptual analysis. When we react with negative emotions to a character who causes a lot of pain and misfortune to their friends by always being completely honest, we take this emotional

reaction as evidence to the fact that complete and uncompromising honesty is not a virtue. If these experiences are what drives the conceptual analysis Carroll discusses, they would be doing the philosophical work in Carroll's example.

As we will see below, the experiences we have in mind here do not necessarily need to be of an emotional nature, but can be of many different kinds. We think that even the philosophical intuitions triggered by the engagement with traditional philosophical thought experiments are examples of experiences that can function as evidence in the way we discuss here.

If we are correct and there are such experiences, they would allow for a different response to the no evidence argument than the one given by Carroll. In that case, the no-evidence argument would simply be wrong, the experiences we have when engaging with particular artworks are the evidence the no-evidence argument requests. We also believe that there are cases in which such evidence supports substantive philosophical claims that go beyond mere conceptual clarifications. This would allow for a strong response to the banality argument.

The position we are outlining here is not cognitivist in the strict sense. We do not claim that the philosophical knowledge gained through engagement with the artwork is somehow contained in the artwork itself (Gibson, 2008, p. 575). It is also substantially different from Carroll's idea that the knowledge is already implicitly present in the knower, and only needs to be mobilised and reorganised through engagement with the artwork (Carroll, 2002). On the contrary, we think that the knowledge obtained in this way can be genuinely new, it arises from the interplay between artwork and knower. The artwork's role in the knowledge generation process is similar here to the role of a microscope in the process of obtaining scientific knowledge. Knowledge of the make-up of a cell is obtained through the experience the scientist has when engaging with (using) the microscope. The knowledge has neither been implicitly present in the scientist before looking through the microscope, nor is it somehow contained in the microscope itself. It is the observational experience the scientist has when holding the eye to the microscope that can be used as evidence in the generation of scientific knowledge. Our position might be labelled neo-cognitivist in the sense that we are claiming that the knowledge comes out of the engagement with the artwork; we would not have known what we know had we not engaged with the artwork.

We will discuss two cases in which the engagement with an artwork creates

an experience that we believe to be able to function as evidence in a philosophical argument. First, we will examine Wittgenstein's famous duck-rabbit drawing. Then we will discuss the use of sculpture and related techniques in the context of Buddhist Practices.

5. A Case from Western Philosophy: Wittgenstein's Duck-Rabbit

In his Philosophical Investigations, Wittgenstein (1953) discusses different usages of the word "see". According to Wittgenstein, there is a difference between simply seeing something and seeing-as. The motivation he presents for this difference crucially depends on the famous duck-rabbit drawing, which can be seen as the picture of a duck as well as as a picture of a rabbit. Interestingly, once we have seen it as either, we can switch back and forth between seeing it as a duck and as a rabbit. Wittgenstein also refers to the experience of seeing it as something by "noticing an aspect". In one sense of seeing, we see the same drawing when we switch between seeing it as a duck and as a rabbit. In a different sense of seeing, we see something different in each case.

What is the role of the drawing in Wittgenstein's philosophical argument? It is clear that the example of the duck-rabbit is important to Wittgenstein as he repeatedly comes back to it in the discussion, but does the drawing itself add anything significant to Wittgenstein's point? We think that it does. Wittgenstein could, of course, simply have claimed that it is possible to switch between varying percepts of the same sensory stimulus without presenting the drawing, but then this claim would have been lacking evidence. However, when we look at the drawing, we can either immediately or with some help experience how we can switch from seeing the drawing as a rabbit to seeing the drawing as a duck. Our experience produced by the drawing is the evidence for Wittgenstein's point. Could Wittgenstein have provided evidence for this point differently, maybe through an argument or a thought experiment? Possibly, but we find it hard to see how either could do so in an equally effective way.

6. A Case from Eastern Philosophy: Art in Buddhist Practices

We might find another instance of art creating an experience conferring philosophical insight in the Buddhist tradition. Arts are used to express and explore a variety of different ideas and premises across the Buddhist world. Calligraphy, sculpture, chanting, and horticulture are all intimately tied to not only Buddhist lore but also to Buddhist thought. Giving an example of a set of aesthetic practices connected to a particular idea, we will draw from this rich tradition the example of the idea of impermanence being represented through sculpture and sand-art within Tibetan, Mahayana, and Ch'an/Zen Buddhism.

Impermanence, or *Anitya*, is a central concept in Buddhist philosophy and Buddhist spiritual practice (Garfield, 2015; Laumarkis, 2008). It is the notion that there are no aggregate things in the world (the term *aggregate things* encompassing anything that can be described in terms of components, including human beings and the human mind) which possess the property of *Nitya*. Nitya is varyingly translated as permanence, eternity, or enduringness. This notion, which is held by all major Buddhist traditions, is central to Buddhist thought, since it is the basis for their view of the human mind (as something constantly changing, permanently influenced in interdependent fashion upon the surroundings, impermanent nature of suffering and pleasure), eschatology (impermanence of the form and existence of the world), and soteriology (to realise universal impermanence is either a major step towards or in itself the realisation of nirvana). For a more detailed discussion of the concepts see Laumakis (2008). Given the importance of this idea to the Buddhist way of life and Buddhist philosophy, a need developed to teach the concept to laypersons or initiates into monastic life. While it is also transmitted through more direct oral argument and illustration, several Buddhist traditions have developed aesthetic methods of demonstrating the claim. We will now briefly outline three related practices which do just this: Zen/Ch'an sand gardens, Tibetan Mandalas, and Mahayana wax sculptures.

Each of these three practices begins with the creation of an aesthetic object. Depending on the tradition and the circumstances, this might be a formation of lines in (coloured) sand, or sculpture which depicts elements of Buddhist lore, or abstract symbolic patterns. Following this, the object is destroyed either by hand or by exposure to natural forces (Milčinski, 1999; Gordon, 2012). For example, a Tibetan monk may spend several hours preparing a Mandala made of coloured sand, symbolising various mythological, philo-

sophical, or spiritual ideas. The completed Mandala is then carried to a stream, where it is dissolved in water. Wax sculptures, in particular, are often simply left to melt, so as to demonstrate their—and, by example, our—inherent rather than agent-caused impermanence. This also takes on a deeper character whenever the aesthetic object depicts symbols of Buddhist lore and philosophy itself, since this extends the implied impermanence from merely the physical to the ideal and also mental.

These practices are perceived as impressively demonstrating Anitya by both Buddhist practitioners and non-Buddhists, even outside of countries where the Buddhist aesthetics are prevalent, such as the USA (Bonnel, 2002; Danvers, 2012). The aesthetic properties of the process which make the subjective insight into impermanence much more likely to occur here, as compared to everyday instances of witnessing things being destroyed or decaying, lies both within the properties of the objects themselves, as well as the particular attention that is given to the process due to its salience as an artistic and philosophical process.

Firstly, the material and working of the object lend themselves to generating this experience. Sand is clearly composed of almost indistinguishably many particles, which might make it so that, on some intuitive level, anything made of or drawn within sand is recognised as a compound thing, and thus something that does not have some essential coherent existence. Wax melts, deforms, and resolidifies in a different form rather impressively, and the melting of wax might further serve as a good illustration of the falseness of fixed form, shape, or appearance. As previously mentioned, the motifs also play a role in making these practices frequently successful in producing the desired subjective experience of insight into impermanence, by marking the physical impermanence observed as extending to the (to the Buddhist, non-) individual mind and to the realm of ideas.

Secondly, these practices would likely be much more effective to generate the experience in question than for example, a candle burning down, because they command attention as aesthetic events and prime the reader towards philosophical intuitions due to their being marked by the spatial and social context of their performance as Buddhist thing-events.

7. Carroll Reconsidered

After introducing our examples of art in philosophy, we will now show that they avoid the three objections discussed by Carroll above: the banality argument, the no-evidence argument, and the no-argument argument. The responses to the first two objections will be different from the response given by Carroll; for the third argument we will give a response in line with Carroll's ideas. Finally, we will argue that Carroll's account would not be able to explain how our examples can generate philosophical knowledge.

In neither of our cases is the knowledge produced banal. It is not trivial that we can switch between seeing an object as X and as Y. In fact, someone who is confronted with a picture like the duck-rabbit for the first time, will typically react surprised and spend some time switching back and forth between the different aspects. Neither is the impermanence of aggregate things trivial. In fact, the idea that there are stable aggregate entities, like for example persons, is deeply ingrained in folk psychology. The deep and extended debates in philosophy on personal identity across time bear witness to the non-banality of this issue (Olson, 2022). Further, the insight is not banal, certainly within the cultures where the practices occur, since it is fundamental to a shared philosophy and way of life.

Similarly, in neither of our cases is it true that the art does not produce evidence for the philosophical idea. By viewing the duck-rabbit, we directly experience how we can see something as X and as Y. We cannot conceive of any more direct evidence that this is indeed possible. In the example of the Buddhist practices, the direct experience of the make-up and impermanence of the individual artworks function as evidence for the general ontological claim of impermanence of aggregate things within the philosophical discourse of Buddhism.

Like Carroll, we hold that while artworks might in themselves not constitute a complete and clear argument, they still function as arguments; what they are missing is filled in by the reflection of the viewer (Carroll, 2002, p.9). Furthermore, in our two examples, the artwork is explicitly put in a context which helps the viewer to complete the argument: Wittgenstein's writing in the *Philosophical Investigations* in the first case and the instructions of experienced monks in the second case.

Finally, we would like to point out that Carroll's account cannot explain how Wittgenstein's duck-rabbit and the discussed Buddhist practices can generate philosophical knowledge. In general, we do not think that these

cases have a strong enough resemblance to thought experiments to make Carroll's argumentative strategy work. In particular, in neither case can we identify any structure similar to the virtue wheel described by Carroll which would allow for conceptual clarification. As discussed above, we do not believe that the knowledge generated in our examples merely consists of conceptual clarifications, but rather constitutes substantive philosophical claims.

8. Conclusion

By looking at two examples from very different philosophical traditions, we have shown how art can generate philosophical knowledge differently from the way envisaged by Carroll (2002). We believe that the experiences caused by engaging with artworks like Wittgenstein's duck-rabbit or Buddhist sculpture can function as evidence in substantive philosophical discussions. This allows for new responses to the banality and no-evidence argument against the claim that art can generate knowledge. In addition, we think that our account for how art can generate philosophical knowledge covers cases that fall outside the scope of Carroll's account. The examples we discuss cannot be understood as a form of artistic thought experiment that helps to clarify concepts. Finally, we have briefly suggested that our account might cover the examples Carroll has in mind as well, and thus offers a strictly broader explanation of how artworks can contribute to philosophical debate. However, we leave this idea underexplored here. A more careful analysis would be necessary to determine whether this is indeed the case.

We started this chapter with a very broad definition of what we take to be artworks: everything that is the result of a creative enterprise. Maybe this definition is too narrow. There might be items that are artworks, but not the result of a creative enterprise. Arguably, Duchamp's "ready-mades", which are ordinary unaltered objects, would be examples (Adajian, 2022). However, even if this is true, it would not undermine our claim that some artworks can generate philosophical knowledge.

Our definition might also be too broad. In that case, there must be additional criteria an item needs to fulfil in order to count as an artwork. Many such criteria have been discussed in the literature (Adajian, 2022) and we would like to suggest the ability to contribute to a philosophical debate in the way we discussed above as an additional contender for such a criterion. If we

take Duchamp's "ready-mades" to challenge traditional conceptions of art —one might claim that they lack particular aesthetic properties, or a creative creation process, for example—this challenge might be the philosophical impact that makes it the case that they are works of art.

When we started this project, we imagined that it would be easy to come up with many clear cases of artworks doing philosophical work. This idea has proven wrong to some extent. While there are interesting cases like *Howards End*, Wittgenstein's duck-rabbit, Buddhist sculpture and maybe Duchamp's "ready-mades", they seem to be much less plentiful than we had expected, especially within the tradition of analytic philosophy. What does that mean? Maybe we have overlooked obvious examples. Or maybe there are in fact only very few cases in which artworks can inform philosophical debate in the way we have been discussing here. But maybe artworks are simply heavily underutilised in philosophy and using art more often as a philosophical tool would open up new avenues for conducting philosophical research.

We believe that the latter is the case and hope that this chapter inspires future philosophical work based on art which will prove us right. We also hope that by improving the appreciation of the philosophical capabilities of art, this chapter can contribute to proper understanding and fair representation of the practices of non-western philosophical traditions which rely more heavily on the aesthetic transmission of ideas than Western academic culture.

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PART II
Case Studies: Interdisciplinary Education

CHAPTER 4

Perceptions of Interdisciplinary Education at University College Groningen

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1. Introduction

Interdisciplinary education has been and continues to be the subject of ongoing research as it differs from traditional ways of teaching. Interdisciplinary education is increasing in popularity as it, according to Bear & Skorton (2019), provides students with the necessary skills they need to enter the

1 We would also like to acknowledge Gaddo Bacchini, who was part of our Year 2 project, completed in June 2022. This chapter is adapted from the Year 2 project report.

labour market. It is considered to be crucial in higher education because modern society is increasingly demanding higher-order thinking and application skills that are integrated in the interdisciplinary learning approach. This could be due to the complexity of problems such as climate change, which demand interdisciplinary efforts integrating both the natural sciences and the social sciences.

In this chapter, two issues have been derived from preexisting literature that are mentioned throughout. The first concept involves a potential misunderstanding of what interdisciplinarity actually means, and what the difference is with multidisciplinarity (Spelt et al., 2009). The second concept is that there seems to be a belief that students are not being prepared well for the workplace when receiving more traditional higher education (Bear & Skorton, 2019).

1.1 Terminology

The conceptual analysis of what interdisciplinarity really means is cloudy as interdisciplinarity is a complex issue. Firstly, the concept 'interdisciplinarity' gains more traction as there is an increase and continuation of those who misinterpret multidisciplinarity as interdisciplinarity. The distinction between interdisciplinarity and multidisciplinarity needs some clarification. "Interdisciplinarity analyses, synthesises, and harmonises links between disciplines into a coordinated and coherent whole" (Choi & Pak, 2006, p. 351), while multidisciplinarity is defined as "drawing on knowledge from different disciplines but stays within their boundaries" (Choi & Pak, 2006, p. 351). This describes the difference clearly and can be applied accordingly. The definition of interdisciplinary by The Organization for Economic Cooperation and Development (OECD) reads as follows:

> Interdisciplinarity involves the creation of new knowledge and theory and the blending of working modalities and heuristics. However, the degree of integration can be relatively more superficial or profound and may vary with the epistemic distance between the disciplines involved, the timeframe of investigation, and/or the complexity of the problem to be solved. (OECD, 2020, p. 25)

Despite this definition being around for a while, as the report was based on a seminar held in September 1970, it is still relevant as it evidently states how

interdisciplinarity can be applied and one can grasp its complexities through this definition. Another scholar states that interdisciplinarity is "an analytically reflective study of the methodological, theoretical, and institutional implications of implementing interdisciplinary approaches to teaching and research" (Miller, 2010, p. 12). These definitions are quite similar, although the OECD definition goes more in-depth.

Multidisciplinarity, according to many articles, seems to have a less complex approach. As stated by Miller (2010), "[m]ultidisciplinary approaches involve the simple act of juxtaposing parts of several conventional disciplines in an effort to get a broader understanding of some common theme or problem" (p. 1). Many make the distinction between the two that multidisciplinarity is less complex, of 'lower level' or the "least developed form of interdisciplinarity", as Jean Piaget believed. Multidisciplinarity, according to Piaget, "occurs when the solution to a problem makes it necessary to obtain information from two or more sectors of knowledge without the disciplines drawn on thereby changed or enriched" (Piaget (1972), in Apostel et al., 1972, p. 136). This represents a potential for future connection, which is where interdisciplinarity may then come in for further integration between disciplines and where complex problems can then be solved using this approach. There is a lack of research on the understanding and distinction between these two concepts—interdisciplinarity vs multidisciplinarity. However, the subject is still being researched, and hopefully with those studies as well as the present one, more concrete definitions can be accepted.

1.2 Interdisciplinarity in the Educational Context

With regard to the context of education, there also seem to be differences in opinions and expectations regarding what interdisciplinarity in education actually entails. In their paper *Teaching and Learning in Interdisciplinary Higher Education: A Systematic Review*, Spelt et al. (2009) stated that the main difference between multidisciplinary education and interdisciplinary education is that the first type of education is additive while the latter is integrative. This means that multidisciplinary programmes offer an assortment of classes from different disciplines; in interdisciplinary programmes, these different disciplines are integrated, and this integration is then used to solve complex problems. "All too often a curriculum is called interdisciplinary when it is actually multidisciplinary" (Spelt et al., 2009, p. 366).

In the paper *The World Needs Students with Interdisciplinary Education*, Bear

& Skorton (2019) identified the problem of students not being well prepared for the workplace because they have not learned to integrate disciplines, working with different disciplines and synthesising disciplines. "Faculty and administrators voiced concern that college graduates today are leaving higher education having taken an array of seemingly disconnected courses, with those courses outside their declared major seeming irrelevant to their interests and unrelated to the world beyond campus" (Bear & Skorton, 2019, p. 61). A way to combat this problem is to focus on what an interdisciplinary education could be providing to students. Interdisciplinary education is supposed to, "[give individuals] the capacity to integrate knowledge and modes of thinking in two or more disciplines or established areas of expertise to produce a cognitive advancement… in ways that would have been impossible or unlikely through single disciplinary means" (Boix Mansilla et al., 2000, as cited in Spelt et al., 2009, p. 366). However, if the interdisciplinary aspect of an educational programme is misinterpreted as interdisciplinary by professors and students when it is multidisciplinary, there is a good chance students will struggle in the workplace and have a hard time adapting to the complexities of the workplace and world, since the real world is inherently interdisciplinary. On the other hand, if interdisciplinary approaches are carefully understood and explained and there is a common understanding, transitioning to the world of work is likely to be an easier one, due to basic and essential skills for the workplace that are learned when studying in an interdisciplinary manner, as well as the critical thinking that will in turn benefit the employee and their career development (Spelt et al., 2009).

2. The Current Study

In the study presented here, University College Groningen (UCG) has been taken as a case study to explore the possible ways in which opinions and expectations about interdisciplinarity in an educational setting may vary across levels of the institution. The case study at hand, UCG, offers a Liberal Arts and Sciences (LAS) programme with a special emphasis on interdisciplinary education, in which students can choose between four majors: Social Sciences, Sciences, Humanities or a Free Major. Within the majors there are also different specialisations the students can choose from. During the three years of their Bachelor's, students are required to take 60 credits worth of courses per year, each course worth 5 credits per block. There are some

mandatory courses, however, including Exploring Challenges of Modern Society (ECMS) in the first year, Philosophy of Science in the second year, as well as taking part in an interdisciplinary project every year.

This present study looks at the different attitudes towards interdisciplinary education as offered at UCG, and at how the viewpoint of students, lecturers and management that attend and work at UCG may differ or converge. The overall aim of this research is to investigate if the participants believe their education at UCG is interdisciplinary, multidisciplinary or neither. The research question guiding this study is as follows:

- How is the interdisciplinary education offered at the University College of Groningen perceived by its students, lecturers, and management members?
- What are the limitations and strengths of this educational approach and what can be done to solve these limitations?

From a scientific point of view this study is relevant because it provides empirical material on the attitudes towards interdisciplinary education within a particular institution. From this, more can be learned about how different stakeholders from within a higher education institution perceive and approach interdisciplinarity in higher education, contributing to the scientific discourse and filling a research gap on this topic. The study also carries a clear social relevance as it could yield concrete recommendations and improvements to the educational programme of UCG, and be of inspiration to other higher educational institutions that offer interdisciplinary educational programmes or aim to do so.

3. Method

In order to be able to answer the research question, three groups of relevant stakeholders were identified, consisting of management, teaching staff, and students receiving their education at UCG. In order to grasp the understanding of and attitudes towards the educational programme offered at UCG, as well as the perception of interdisciplinary learning it brings about, semi-structured interviews were conducted with representatives of these three stakeholder groups.

Semi-structured interviews allow for a point of comparison between all

interviews, as well as the freedom to emphasise certain interesting points made by the interviewee (Wheatley, 2020). By doing so, we were aiming to get insights into how the management imagines interdisciplinarity to be implemented in the educational programme, and how teaching staff applies interdisciplinarity in the teaching of the different learning lines and classes. Lastly, it would allow the researchers to gain a specific understanding of how students from each year and from different majors feel about this particular interdisciplinary form of education. For the sake of our study and research question, it was therefore important to be able to compare the positions of the three stakeholder groups, whilst at the same time providing enough space for the interviews to be suited to each stakeholder group.

For each stakeholder group, a separate interview guide was developed with relevant questions for the stakeholder group and targeted questions for the interviewee. The three different interview guides all examine 2 central themes: 1) what the interviewee believes interdisciplinarity to be on a more conceptual level as well as how the interviewee would define it, and 2) how the interviewee believes interdisciplinarity to be implemented on a practical level, in the educational programme at UCG and in courses.

The interview guide that was used to interview students focused on understanding why the student chose this type of education, how the interviewee looks upon their education while receiving it, as well as how it will/could impact the interviewees future life when pursuing a Master's degree, starting a professional career or any other possible future path.

The interview guide developed for the interviews with teaching staff highlighted the challenges that lecturers potentially face when including aspects of interdisciplinarity into their courses, as well as how lecturers believe an interdisciplinary approach benefits (or not) their students.

Lastly, the interview guide developed for the management level focused on how the management organises and implements the interdisciplinary approach at UCG as well as how management believes it benefits the students. By interviewing these different stakeholders concerning the above-mentioned topics we were aiming to gather data that represent the different views on interdisciplinary education in general and at UCG more specifically and how the educational programme is perceived.

3.1 Sample and Recruitment

Interviewees were selected from the three groups of stakeholders. Student participants were recruited by sending a message through the group chats that consist of UCG students of all the years through WhatsApp. The message clearly stated the research topic and the reason for conducting this particular research. Hence, students who were willing to contribute to the research came in contact with the researchers completely voluntarily and anonymously.

The students interviewed were from different years (first, second and third years); five students per year. These 15 students came from different majors to broadly represent the student population in terms of their major. We interviewed three Science students, seven Social Science, three Humanities and two Free Major students. In terms of the population at UCG in 2022, around 14% of the students were doing a Free Major, 3% were doing Humanities, 25% were doing Sciences and 58% were doing Social Sciences.

Participants' recruitment for the interviews with the teaching staff and the management of UCG took place by sending individual emails, explaining the research and stressing the importance of participation in the research. From the teaching staff, we selected five members of staff from different fields, namely Health and Life Science, Humanities and Social Sciences, all of whom are involved in the teaching of interdisciplinary courses.

The reached sample of teaching staff and students would enable us to gather representative data of how interdisciplinarity at UCG is imagined in the existing majors and its specialisations, as well as how it is put into practice and perceived by its teaching staff and students.

3.2 Procedure

After recruiting participants for the interview, a consent form was sent to them, one or two days in advance of the interview. All consent forms were signed prior to the interviews and at the start of the interviews it was mentioned that the participants could ask any question before, during and at the end of the interview, or could withdraw their data anytime. A debriefing form was sent to the participants after the interviews had taken place. In the resulting data, students and lecturers were anonymised and the information gathered was kept confidential.

Regarding the management level, the initial aim was to interview members of the Faculty Board, the highest level of management at UCG. Due to limited availability, these interviews could not take place. An interview with the

Academic Director of Education, who is the programme coordinator of the full LAS programme at UCG, took place instead. Given that anonymity cannot be guaranteed for this individual, the Academic Director of Education agreed to partake in the study without a guarantee of anonymity, and an adapted informed consent form was signed to reflect this agreement. By interviewing the Academic Director of Education, we were able to ascertain how the management believes interdisciplinarity is implemented in the educational programme, and to compare this to the views of teaching staff and students.

Interviews with the teaching staff and the Academic Director of Education were held at the interviewees' respective offices at UCG and lasted approximately 30 to 40 minutes. Most of the interviews with students lasted for 20 to 30 minutes and took place at UCG, although some were conducted outside of UCG if requested by the participant.

After the interviews had taken place, there was not any further contact with the participants.

3.3 Analysis Plan

The data analysis process began with the transcription of recordings from the Otter app, which was mentioned in the consent form as a tool that transcribes recordings verbatim. Once the codes were created, the data was analysed using Atlas.ti, one of the most well-known ways of coding for qualitative research. During the analysis, the goal was not only to identify but also to examine patterns that emerged after the coding process. This involved investigating similarities and differences in the responses given during the interviews. Through this process, the collected data were interpreted to draw conclusions.

4. Results

4.1 How Is Interdisciplinarity Defined?

Regarding the understanding of the concept of interdisciplinarity, the different groups of stakeholders largely seem to have a shared understanding, but at the same time some distinct nuances came to the fore. When asking the Academic Director of Education about her understanding of interdisciplinarity, she stressed that to her it is mainly about changing one's understanding of a concept when engaging with that concept from different

disciplines. As an example she gave her own professional development as a scientist; starting out with a discipline in science, namely biology, she transitioned into the social sciences with a main focus on physical geography. This move towards the field of physical geography prompted the cooperation with artists, and therefore, led to the incorporation of humanities too. "I started working with artists, because when you're looking at the meaning of places, you find that social science methods, even if they're qualitative, can be limited, because they don't engage so much with emotion and effect."

Thereby stating that her development should not be misunderstood as a multidisciplinary approach, but, as she mentioned, there is an engagement of multiple disciplines in her background, that entails an interdisciplinary approach.

Members of the teaching staff stated that interdisciplinarity concerns a concept that approaches a topic from different disciplines. By looking at the topic and investigating elements that the disciplines have in common with each other, the differences and the insights that each specific discipline supplies to the particular concept are brought to the fore. Lecturers furthermore mentioned foremost the concept of bridging, as stated by lecturer interviewee n. 1 as follows: "Interdisciplinary means for me that different kinds of disciplines who have their own kind of epistemic norms, research practices, methodology, history, et cetera., come together. But they come together in such a way that you're generally bridging between them." Interviewee n. 3 explained the concept of bridging by saying: "I would say, bringing in multiple disciplines and learning how to integrate and contrast them." Hence, from the lecturers' point of view, interdisciplinarity was mostly described as an approach that involves multiple disciplines, resulting in a comprehensive understanding of a topic through the utilisation of interdisciplinary methods. In addition to that, the creation of a new product and better understanding is mentioned. As interviewee n. 3 explained: "[...] Whatever sort of insights you're arriving at, you wouldn't be able [to arrive there] on the basis of one of the disciplines alone, but they somehow work together in a way to, to yield a new product. It is essential that interdisciplinary aims lead to innovation or to a better explanation."

Therefore, the final product of an interdisciplinary approach should lead to something innovative or something that provides clarification that could not be reached with a disciplinary or multidisciplinary approach.

The students in our study overall defined interdisciplinarity as the

process of 'mixing', 'combining', or 'connecting' many disciplines together in order to learn about a topic by looking at it from different perspectives. These above-mentioned verbs were the most commonly used, often with a phrasing similar to what was stated by student interviewee n. 9: "You mix different topics or disciplines in certain contexts, and you're able to see the different perspectives." One student did mention a quite in-depth definition, emphasising the need to "…integrate other areas and topics when analysing a problem… not only look[ing] at it from a scientific perspective […] but also integrating ethics and the environment" (interviewee n. 7). So students seem to have a basic understanding of what interdisciplinarity is, especially this last student who refers to the aspect of integration. Integration can be qualified as the most important aspect of interdisciplinarity when following the definition of interdisciplinarity given by the OECD, which states that interdisciplinarity is the interaction and integration of two or more different disciplines and can be practised in many different ways (Arnold, 2013).

4.2 Interdisciplinary Approach in the UCG Programme

Regarding the interdisciplinary approach in the UCG programme, the Academic Director of Education stated that the interdisciplinary approach is not only focused on bringing different disciplines together and then changing one's understanding of a concept, but also that it endeavours to support students with regard to learning an interdisciplinary approach. The question of whether an interdisciplinary approach would be the best approach in the education system, was not given any precise answer. The Academic's Director of Education point of view is telling in this case: "I'm not sure if it's the best approach. I'm sure there are tons of other interesting approaches as well. But I do believe and embrace this approach."

The lecturers' perspective of the interdisciplinary education at UCG painted a picture of a system that allows students to learn and be trained to address and research themes and areas, for instance, societal problems, with the use of an interdisciplinary approach. A good grounding in a core discipline is vital though, according to many teachers: "[…] it's essential there is sufficient disciplinary knowledge, sufficient disciplinary grounding, in order to make [interdisciplinarity] work" (interviewee n. 2).

The findings also illustrated another perspective of the interdisciplinary nature of the provided education; specifically, that it goes beyond the tradi-

tional university composition and aims to provide a different academic product in the education system. Another point of view contrasts the previous results a little. It was mentioned there is a difficulty in guaranteeing interdisciplinarity in the academic system for the students. A specific series of steps need to be taken, as was noted by interviewee n. 4: "It always starts with being multidisciplinary, as you're trying to bring in insights or tools or theoretical frameworks from multiple disciplines."

Lastly, students' definitions of interdisciplinary education shared the same elements. "I see a system in which different fields of activities are being explored. But in the end, it's also trying to put them together" (interviewee n. 11). Students also stated that it helps to train your mind to be more open since you are constantly being faced with different views or perspectives on the same topic. In addition, the majority of the group believes it allows one to experience an overview of several topics in order to help you find what you want to do later in your academic career. It seems that students all agreed that while it is a beneficial educational approach, whether it is the best one to adopt depends on several factors, such as the topic or subject, the educational institution and the individual and their personal goals. In contrast to this, however, one student stated that interdisciplinarity was the best approach since they believe that it is not possible to understand a subject through purely disciplinary means; you need to incorporate other aspects since everything in itself is intertwined with one another.

4.3 Advantages

Having compared the different ways interdisciplinary education is defined, we now look at the different advantages that come with this interdisciplinary approach at UCG. Firstly, the Academic Director of Education mentioned that a significant advantage is the opportunity it offers in the labour market. This type of education stands out as it is less common and it teaches the students to think outside the box, to be more adjustable to changes in direction but also to be more capable of understanding others' perspectives. Additionally, a staff member stated that "interdisciplinary education [is] not just about sciences coming together and changing concepts." Interdisciplinarity is also a skill. A skill where people learn to come together with other people and "decide to jump off the cliff together" (interviewee n.5).

Lecturers believed that an interdisciplinary approach can clarify or add new insights to a course or a topic by looking at problems from various angles. In

terms of how interdisciplinarity can be beneficial in future careers, what stands out is that the benefits of an interdisciplinary approach depend on what path somebody wants to pursue and it cannot be generalised that an interdisciplinary approach might benefit all sorts of careers. According to a lecturer (interviewee n. 2), it also depends on at which stage of your career you are: "Typically, when you're in science, you go for a Master's, PhD. The further you go, the more disciplinary. So if you begin your Bachelor's more broadly, that's absolutely fine. And I think it helps to bring different viewpoints to something, before you decide on something."

Additionally, results showed that the interdisciplinary method of teaching alludes to how beneficial it is for the students to be exposed to different disciplines. Those disciplines have diversification, they vary with one another giving a great insight into the different fields. Furthermore, interdisciplinarity constitutes a tool for every sort of path. Lecturers, like the Academic Director of Education, mentioned that it gives the ability to think out of the box, to have a different approach to how a discipline works and to perceive things in different ways. It provides a freedom to focus on a variety of elements throughout the ways of thinking and understanding the disciplines while combining them. For instance, interviewee n. 1 believes "you become able to think out of the box, if you're able to take a bird's eye view on something, because now you notice another thing."

Lastly, when it comes to the students, one of the most common points that were stated is that interdisciplinarity helps students to adopt an open mindset when it comes to their courses. In addition to this point, it was mentioned that it changes one's perspective and way to approach and solve a problem. It enables students to not only consider the factors influencing the issue in one discipline, but one is also able to see how other factors influence the issue as well as how it can influence a potential solution. It allows students to see problems in a non-linear way. This could then lead to finding a solution that may be more complete, as it takes into account the effects of the other disciplines, therefore broadening one's possible solutions to the identified problem. "I think it's a good approach that helps to learn. [...] You can [...] have so many different views on one topic" (interviewee n. 10). Some students also thought it was beneficial for one's career opportunities; they believed that it can prepare them for an uncertain or unpredictable job market, as the interdisciplinary educational approach teaches them to be more flexible.

With regard to the interdisciplinary approach at UCG, the students identified several benefits. Firstly, they all mentioned that having an interdisciplinary approach at UCG benefitted their learning and they emphasised the fact that lecturers provided enough material and related it well to support and help students understand certain concepts and issues from an interdisciplinary perspective.

It was also mentioned by several students that the programme does attempt to incorporate classes that are strictly interdisciplinary, one course mentioned being Exploring Challenges of Modern Society (ECMS). "We took [a course] in the first year, ECMS, where we had a topic and then each week, we had a lecturer from a different field" (interviewee n. 15). Students thought that specific course to be very interdisciplinary and in general terms students believe that UCG provides students with interdisciplinary courses.

Overall, it is clear that all participants agree that the main strength of this type of education is the way it opens students' minds, allows them to look at problems from different perspectives and gives them an opportunity to stand out when it comes to applications for jobs or Master's.

4.4 Limitations of an Interdisciplinary Education

Nevertheless, our study also found limitations connected to an interdisciplinary education. The Academic Director of Education brought to the fore that if a student wants to become an expert in a particular discipline, then studying Liberal Arts and Sciences may limit the student as they do not obtain 180 ECTS in a specific field after graduating (or at least 160, as is the case in many disciplinary programmes). This could be an obstacle for someone who wants to specialise in physics, for example. However, there are several solutions to this, such as doing a pre-master to focus on a particular discipline before enrolling into a disciplinary Master's programme. Therefore, in the end, interdisciplinary education does not have any serious limitations on one's academic career.

Lecturers also indicated certain limitations of interdisciplinarity education. They highlighted that because an interdisciplinary approach can be time-consuming, at times, lecturers depend on students to focus on specific disciplinary knowledge as outlined in the required readings. Then, during class, the main focus shifts to a different discipline, with the assumption that students have acquired the necessary foundational knowledge in preparation of the course, allowing the lecturers to address various disciplines simulta-

neously. In particular, some lecturers supported this specific methodology of teaching as a worthy means for knowledge for a student to learn; however, in the end, it is a personal choice. "I think those trade-offs are worth doing. But of course, you know, anytime you add things, that means you are subtracting something else that you otherwise do. So it is a choice" (interviewee n. 2). Another limitation that was heard among the teaching staff was the risk of not having enough in-depth knowledge. "And that does become a real danger" (interviewee n. 4).

A lecturer (interviewee n. 2) refers to the introductory course for all first-year's students, ECMS, that aims to look at societal questions at a global level such as climate change from an interdisciplinary approach. They alluded to the challenge posed by the courses' structured and technology-oriented nature, highlighting the difficulty in teaching it. From the perspective of the programme that UCG offers liberal arts and sciences "people miss out on the science part" (interviewee n. 2). What is meant by this is that teaching staff and students expected more science-centred courses. It could be due to the leadership of the UCG's operators "being more on the non-science side of things'' (interviewee n. 3).

One of the main disadvantages of interdisciplinary education that all students pointed out, was stated well by interviewee n. 13: "It's very probable that you end up just scratching the surface and not diving deep into the topic." What they meant here is that because interdisciplinary education covers a topic from many different disciplines and perspectives, the limited time doesn't allow students to gain an in-depth understanding of each discipline for that specific topic, which could hinder them in the long run. Many stated the level of expertise they obtain in their field is shallow and they will most likely not be able to be an expert, unless they switch to a more disciplinary programme. All students mentioned this point, making it a very relevant point of consideration.

Students also noticed that, while the interdisciplinary approach to education has some disadvantages in itself, the way in which it is implemented at UCG may also yield some particular limitations. One of the limitations mentioned was the fact that UCG offers a limited number of course choices. Students select from a small group of courses, which already seems to hinder the interdisciplinarity of the programme for some students. Another issue with this is that UCG does not offer courses that some students require in order to be considered for the Master's programme of their choice. Many

stated that the courses in general were unpredictable due to their interdisciplinary nature, as some seemed to not challenge the students at all, to the point where they lost motivation for the course. While others stated that certain courses were too challenging, this too left students lost because of the same unpredictable interdisciplinary character. Another criticism was the amount of interdisciplinarity used. One student with a specialisation in Health and Life Sciences stated that the programme was less interdisciplinary than she had hoped. On the other hand, another student said some courses are *too* interdisciplinary, and are causing confusion. "The ECMS, we did economics, psychology, we did science, we did literature, we did- it's too much. That was a lot and I didn't know what was happening then" (interviewee n. 18). Finally, one student also mentioned the university was quite liberal, in a way that would harm the interdisciplinary aspect of the programme. By this, the student indicated that in their opinion the university's liberal attitude is leading to a lack of rigour and specialisation in their programme. This opens further discussion on the emphasis on interdisciplinary work that is diluting the focus and depth of individual academic disciplines.

4.5 Suggestions for Improvement Given by Students

Along with the criticisms students also had some suggestions for improvement. The students all mentioned that it would be more beneficial to have some disciplinary courses for students who need more specialised courses for their Master's. This would also be helpful for those who want to gain a more in-depth understanding of certain topics. Students said that not all of the courses need to be completely interdisciplinary; they would appreciate having more of a balance. In some cases, there wouldn't be enough attention given to some disciplines and more to others, and the students said they were left without a full basic understanding of one topic. "I think UCG could propose and work more on straightforward courses, straightforward lessons, because I think people would appreciate that" (interviewee n. 15).

Another recommendation was to increase the number of courses offered. This can help fulfil the need for disciplinary base-knowledge as well implementing more interdisciplinarity. A final suggestion was the idea of including more guest lecturers from different fields in certain courses as it would integrate a different discipline into the course.

5. Discussion

According to the collected results, lecturers and students agree that interdisciplinarity can be defined as connecting or bridging different disciplines. Although there are different points of view between these stakeholder groups in regard to the outcome that results from this connection. Lecturers mainly believe that interdisciplinary teaching is useful to produce a new learning outcome which is helpful for the understanding of certain topics, while students mainly think that it helps to solve complex problems and gain a broader and more holistic view. Moreover, the Academic Director of Education emphasises that through interdisciplinarity one can change one's understanding of a concept.

On the basis of these results, the researchers believe that it would be beneficial to introduce first-year students to how this interdisciplinary education is different from disciplinary programmes at the beginning of the year. This should include information on what interdisciplinary education actually means, how it is employed at UCG, what students can expect, what they will learn and gain, as well as what they will miss out on compared to a strictly disciplinary programme.

In regard to the UCG approach, students and teaching staff both recognize UCG as an interdisciplinary educational programme. Both groups mention the presence of many disciplinary-based courses, but lecturers claim that this is a necessity for students to have solid basic disciplinary knowledge in an interdisciplinary programme. Indeed, when interdisciplinarity is applied, the starting points are always single disciplines and it is essential to educate students on single subjects to create a baseline, in order to make links between subjects.

Moreover, it was occasionally even mentioned by students that they felt that certain courses could and should be only disciplinary and that sometimes the attempt to make them more interdisciplinary felt unproductive. Teaching staff on their side argue that interdisciplinary skills in courses is only applied when they feel there is a necessity to do so or when it can add more relevant knowledge to the discussion. In addition to this, lecturers state that some of the courses they taught were not interdisciplinary at all. Therefore it can be stated that the students' argumentation might be true in some cases, but this did not have confirmation from the lecturer's perspective. Some lecturers, however, agreed that the course ECMS could potentially be too broad and they accepted that it does not leave enough time for the

lecturers to go in-depth, causing students to gain only superficial knowledge. These viewpoints are useful because they offer suggestions for revising and improving the programme. We, therefore, hope that this research can bring this issue to light and that UCG will take this into consideration to try and make ECMS more efficient.

All three stakeholder groups (lecturers, students, and management level represented by the Academic Director of Education) recognize as the main benefit of interdisciplinary education that it can provide advantages in terms of career opportunities. Indeed all three groups agree that interdisciplinarity helps students to think outside the box and improve their communication skills; qualities that are sought-after in the job market and will therefore make the students stand out. As the Academic Director of Education more specifically pointed out, interdisciplinarity is a really useful learning skill.

On the other hand, talking about the overall limitations, less positive opinions were expressed regarding the application for Master's programmes where interdisciplinarity is not an essential requirement but a more solid disciplinary base might be requested instead, although it was mentioned that this limitation can be solved by applying to a pre-Master's programme. In addition, students mostly believe that sometimes they have poorer knowledge compared to students of disciplinary-orientated faculties, especially for students specialising in scientific fields. In order to solve that, students require more room for disciplinary courses. Also, a member of the teaching staff pointed out the lack of a good and broad offer of scientific courses and opted for a mandatory introductory science class in the first year. Moreover, teaching staff underlines that the main limitation is the lack of time available within the framework of a programme and on course level, in order to produce and offer a well-structured and productive array of courses that are of an interdisciplinary nature. With regard to teaching an interdisciplinary course, lecturers mentioned struggling with time conflicts between providing students with a good disciplinary base and knowledge that goes into enough depth, as well as having time to introduce interdisciplinary elements and make them relevant to the course. A few teaching staff argued that some disciplinary aspects should be sacrificed in order to guarantee interdisciplinarity. On the other hand, the issue of time was also said to be the issue of any lecturer, including in disciplinary education, and therefore no possible solutions were mentioned.

Overall some similar and different points were brought up, it would there-

fore be very interesting and most probably beneficial for UCG to organise open and active discussions between the teaching staff, the board and students. By doing so the programme can achieve better cohesion and make sure that the vision of the programme is well-implemented.

5.1 Considerations in Relation to Theory

One of the key considerations mentioned in this report and used as a basis for our research was that interdisciplinarity is not completely defined. This is exemplified by comments made by some of the participants, showing that interdisciplinarity is broadly defined equally among the students, lecturers and the Academic Director of Education. However, some small aspects were left out, such as the integration instead of solely the addition of the different disciplines, which can be seen in the quote mentioned before by a student: "[Interdisciplinarity is] looking at topics and particular problems from the perspective of multiple disciplines at the same time, and using insights from those disciplines to address or understand various aspects of that topic or problem". There was a shared understanding in all groups that interdisciplinarity meant connecting different disciplines and using them for a greater purpose. The majority of participants had a practical understanding of interdisciplinarity because of the interdisciplinary application that is used in their education. A thorough understanding of the concept of interdisciplinarity is essential before its practical application. Our data analysis affirms that an interdisciplinary approach not only exhibits practicality but is also effective in achieving the desired outcomes.

Regarding the distinction between interdisciplinarity and multidisciplinarity, the interviews suggest that some courses were verging more on the multidisciplinary side instead of the interdisciplinary. Many commented that this was not an issue, as it is necessary to have a multidisciplinary or disciplinary approach to some subjects. It was claimed that a disciplinary-based approach is also necessary in an interdisciplinary programme, and that forcing interdisciplinarity in some of these subjects would do more harm than good. It is therefore important to the overall concept of interdisciplinarity to differentiate between the in-depth practice of disciplinarity, the additive practice of multidisciplinarity, and finally the integrative practice of interdisciplinarity.

Another theoretical contribution that emerged from this research was that an interdisciplinary education may be more beneficial in the job market. Our

results showed that this was a common belief, since it was mentioned by students, lecturers, and the Academic Director of Education of UCG. Many students also mentioned that an interdisciplinary education would not only help with their future careers, but also with getting them into and preparing them for their Master's degrees. An exception to this may be students following the Science specialisation; an interdisciplinary education may make it harder for them to get into Master's programmes, since they do not have enough experience in a mono-disciplinary course.

5.2 Scientific Relevance

There is limited quantitative research on the topic of interdisciplinary education. The current study thus addresses this gap. Interdisciplinary education is said to be increasingly popular in higher education because of its discovered benefits for students in the real world. In her article titled *Interdisciplinary Instruction*, Laura Duerr (2008) put forward this point by stating that "with interdisciplinary instruction, students can become more involved in their learning and lecturers can work toward eliminating discipline lines. Students can become independent, confident individuals who 'learn how to learn' and develop lifelong learning skills" (p. 177). However, the literature states that interdisciplinarity was a difficult subject to research since there was no full or clear definition of what it actually is. In addition to this, we found no research about the experience of students, who we thought to be a very important audience to consider as they are the ones receiving the education. With this research, we were able to shed some more empirical light on the subject of interdisciplinary education, while also including the student perspective, which could be beneficial to future students, lecturers and academic directors of educational institutions. We hope that this study is just the start of more research on interdisciplinary education.

5.3 Societal Relevance

We believe that this study holds societal relevance because it shows how universities could possibly adjust their education programmes in order to better prepare students for the labour market. It was found both through the literature and from the interview analysis, that this type of education is beneficial, as it can help students become more attractive job applicants when they leave university, as well as help a good deal of them to get into Master's programmes after their Bachelor's degrees. From the research obtained, it

was clear that skills that are learned through interdisciplinary education—such as the ability to work across disciplines, integrate disciplines and use different ones in order to solve different problems or gain a certain understanding—were incredibly valuable in the work field and attractive to future employers, which greatly benefits students.

5.4 Limitations

With regard to the limitations of this study, the researchers believe that the study is not representative of the entire UCG population, due to the limited number of interviews conducted, especially with lecturers. However, this study can be a solid base for research aiming to use a bigger sample. Another limitation of the research could be the lack of experience of some of the members in conducting qualitative research and the limited time available to acquire the appropriate knowledge and training. In addition, we believe we have encountered some ethical concerns during the collection of the data. We guaranteed our participants anonymity and have presented the results accordingly. Nevertheless, we believe that for the lecturers and the Academic Director of Education, maintaining anonymity may not be guaranteed as staff and students within UCG may be able to link the results to individuals. Those participants were, however, aware of this risk and still agreed to take part in our research. Lastly, we believe that the use of focus groups including all stakeholder groups of UCG could further enrich the discussion regarding suggestions and limitations reported in the research, and therefore we highly recommend employing such focus group discussions in future.

6. Conclusion

To conclude, looking back at our research questions—'How is the interdisciplinary education offered at the University College Groningen perceived by its students, lecturers and management members?' and 'What are the limitations and strengths of this educational approach and what can be done to solve these limitations?'—the results show that interdisciplinary education requires a base of disciplinary courses and that interdisciplinarity should be built upon it. It allows open-mindedness and bridging different disciplines together to see problems from different perspectives, allowing students to think out of the box and approach problems holistically instead of from only one perspective. There are, however, some limitations to an interdisciplinary

education and certain limitations specific to UCG; the main limitation being the feeling of lacking in-depth disciplinary knowledge. It was suggested that only certain courses should be made interdisciplinary, only when really relevant. Overall this research helped bring to light what can be worked on at UCG and it will hopefully lead to great discussions between lecturers, students and management to improve this (relatively new) liberal arts programme and accompany students as well as possible during their Bachelor's studies.

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CHAPTER 5

Active Learning Through Art-Making in Philosophy Education

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1. Introduction

It is hard to study philosophy without crossing any disciplinary borders. Philosophy of science is the most obvious example, but there are many others. For example, philosophy of language intersects with linguistics; philosophy of mind with psychology, computational and information theory; aesthetics with art criticism as well as the history of art; and questions discussed in (practical) ethics might rely on findings from biology and other disciplines.

Unfortunately, this inherent interdisciplinarity is barely reflected in philosophical teaching, which largely consists of reading, analysing and discussing philosophical arguments in a traditional lecture and seminar form. Teaching practices that actively make use of, or interact with, other disciplines are rare.

We think that philosophical teaching would benefit from an increase in the integration of other disciplines.

In particular, we want to make the case for using art-making to enhance philosophy education. We will argue that art-making is an excellent example for what Erol et al. (2015) call level 4 active learning, which in turn has been shown to be a very effective way to educate students.

We will start by explaining what we mean by art-making and how we envision it to be included in philosophy classes. Next, we discuss what active learning is and why it is such an effective teaching method. We continue by explaining why art-making is an excellent way to promote active learning and that it can be seen as a 4th level active learning practice. Finally, we will discuss why including active learning via art-making projects is particularly suitable for philosophy classes.

2. Art-Making in the Philosophy Class

What constitutes art is an extremely controversial and deeply philosophical question (Adajian, 2022). Given the complexity of the issue, it is safe to assume that even among artists, few would be able to produce a clear definition of what art is, and those who could, would probably disagree with each other, at least to some extent. And still, we would say that these artists are engaged in art-making. To engage in art-making, it thus does not seem to be necessary to know precisely what art ultimately is. Still, an artist needs to have at least some idea of what they take to constitute art. Otherwise, they would not know what to aim for when working. These considerations motivate the following working definition of art-making, which we will use in this chapter: We define art-making as a creative enterprise with the aim of creating something which the creator takes to be a work of art. Art-making, thus defined, does not guarantee to produce art proper. The creator might be completely mistaken in what art really is or might simply fall short at creating it.

How can art-making understood in this way be used in a philosophy class? In short, we propose to ask students to work in groups to create an artwork which contributes to a philosophical debate. To be able to do so, students need to have a joint understanding of what an artwork is and how an artwork can contribute to a philosophical debate.

Fortunately, it is not necessary to enter deeply into the debate on what art

is with the students to create such a joint understanding. In our experience, it is sufficient to ask students to name paradigm examples commonly recognized as artworks and tell them to try to create something similar. While demarcating art through resemblance to a paradigm has its theoretical shortcomings (Adajian, 2022), based on our experience it has proven to be an effective way of creating a joint understanding among students of what to aim for with their art-making project. We noticed that students will more likely bring a too narrow than a too broad understanding of art to class. It might therefore be useful to remind students of entities typically recognized as artworks that go beyond paintings, sculptures, literature, theatre plays, photography and film. In particular contemporary interactive art installations might serve as useful examples of what to aim for when trying to create an artwork as they offer interesting opportunities for contributing to a philosophical debate as we will illustrate below.

Artworks can contribute to a philosophical debate in many ways. Philosophical debates often contain vivid stories and imagery: loose trolleys, brains in a vat, evil demons and beetles in a box. An artwork can contribute to these debates to some degree by simply representing (visually or otherwise) these stories or imagery.

Let us illustrate this with the famous trolley case. The trolley case is a thought experiment which invites us to consider a runaway trolley which is bound to kill five people who are working on a narrow track. Their deaths could be prevented by steering the trolley on an alternative track. However, since on the alternative track there is also one person working, redirecting the trolley would still cause the death of one person, effectively trading the lives of five for the life of one (Foot, 1967). Unlike a real experiment, a thought experiment is not intended to be actually carried out. Instead, we are supposed to learn something from the thought experiment simply by reflecting on its design (Sorenson, 1992, p. 6). In this case, we are invited to contemplate questions such as whether it can be morally permissible or even morally required to redirect the trolley.

This famous moral dilemma can be represented by a simple drawing of a trolley, tracks and 6 stick figures. While such a representation does to some extent contribute to the philosophical debate, the contribution is rather limited. For example, the visual representation might make the moral dilemma more engaging than a dry philosophical text and thus create interest in a wider audience. However, it also simplifies the problem by

ignoring much of the depth of the philosophical debate surrounding the dilemma and does not really add anything new to the discussion.

It is possible to give such an artwork more philosophical weight and to make sure students get the most out of the project, teachers should encourage them to aim for that. If students, for example, would like to highlight the difference between doing and allowing harm, they could create an interactive art installation in which the audience can influence the direction of a toy trolley running over toy people. If students would like to focus on the discussions surrounding whether the lives of some deserve more protection than the lives of others, they might replace the stick figures with realistic pictures of babies and seniors, sick and healthy people or murderers and nurses. Such representations would capture more of the philosophical depth of the discussion surrounding the trolley case. Arguably, such artworks would even add a new dimension to the discussion. It is something different to read about hypothetically changing the direction of a trolley in a thought experiment compared to actually changing the direction of a toy trolley. It is also different to read about babies, seniors, sick and healthy people compared to looking them into the eyes in a picture. These differences could change our perception of the original thought experiment and thereby add something genuinely new to the debate.

Basing the art projects on a imagery, story or thought experiment like the trolley case might be the simplest route for students to take, as these could already (nearly) be considered artworks themselves (see for example Elgin (2014) and Carroll (2002) on the close relationship between works of literature and thought experiments). However, it is also possible to turn more abstract philosophical ideas into art.

In a course on philosophy of mind, for example, a group of students (including Baureis) represented an argument against ontological behaviourism in an artwork. According to ontological behaviourism, mental states are identical to particular behaviour: pain is screaming "ouch", happiness is smiling, anger is shouting. A common objection to ontological behaviourism is that the relationship between behaviour and mental states is more complex. For example, it is possible to be happy without smiling and to smile without being happy (see Kim, 2011, Chapter 3). The students turned this objection into a photo installation. Initially, the audience would see photos of people displaying typical behaviour for happiness. These photos could be flipped over to show a version of the photo with a text describing a different

mental state than expected (see Figure 1). This installation made the problems of ontological behaviourism extremely visible, accessible and compelling, and thereby added nicely to the existing philosophical debate.

Figure 1: Elements of the photo installation on Ontological Behaviourism.

To create an artwork that contributes to a philosophical debate, students need to develop a deep understanding of the respective philosophical issue and reflect on how creative decisions regarding the artwork compare to the original philosophical debate. As we will discuss later in more detail, this process leads to an effective active learning style. Working in a group will help with this, as the discussions within the group will greatly improve the

philosophical reflections that go into creating the artwork. It is also beneficial to students' understanding to ask them to write a reflection on their artwork, the process of creating the artwork and its relation to the original philosophical debate. Such a reflection will deepen the learning from the art project and also give the lecturer something that is more easily assessable if an assessment of the art project is needed or desired.

Capturing the deep significance of a philosophical debate in an artwork or even adding something new to the debate is not a simple task and students might struggle with achieving this. It is also not at all guaranteed that students will succeed in creating something that can be called an artwork in the first place. This is fine. After all, the intended learning outcome for a philosophy course is likely for the students to understand the philosophical issue, not to be able to create art. As we will argue below, the struggle with the latter is an effective means to the former.

3. What Is Active Learning and Why Is It Important for Education?

Above we claimed that art-making leads to an active learning style. Before arguing for this claim in the next section, we will now discuss what active learning is and why it is preferable to conventional teaching practices.

Active learning is a constructivist approach to learning, meaning that it is a way of teaching in which students construct new knowledge based on a solid foundation of previous experiences and understanding of the material. It highlights the importance of the students being included in the learning process and having them actively engage with the material rather than being passive participants to whom the teacher's knowledge is transferred, for example through lectures. Importantly, in active learning, all students are invited to actively participate. A situation in which one part of the class presents something while the other part of the class passively listens to it, would not be considered active learning. Active learning can be done for instance through concept mapping, case studies, peer reviews, discussions, or group projects.

In other words, active learning is a learner-centred approach to teaching. Consequently, the lecturer becomes a facilitator for the students, or a "guide, gently directing the student's attention to key landmarks along his intellectual journey" (Mello et al., 2013, p.2).

Active learning is not a binary concept, it can occur in various degrees. In Erol et al. (2015), 4 levels at which active learning can be implemented are specified. Although all 4 levels represent a manner in which to apply active learning, there is still a clear trend of progressively more "active" practices, at higher levels. In other words, the higher the level the more active a practice it is. Level 1 contains practices where the instructor is still the presenter, but does engage the students through questions or problems that the students need to respond to. The second level already requires less from the instructor, although they still structure the discussion, for example by giving a think-pair-share assignment. In a think-pair-share assignment, the instructor poses a question which students first think about on their own, then with their neighbours and finally discuss with the whole class. Level 3 assignments mostly involve the students in actively engaging and making sense of the concepts that have been presented to them. In this level, the teacher reduces the content they present and gives students the opportunity to work on a topic independently and on a deeper level. This means that students could be asked to come up with questions themselves or make sense of a data set. Another example of this level is creating an infographic, i.e. a visual representation of information. This requires students to organise concepts themselves, which allows them to engage more actively with the content. Level 4 assignments have the highest degree of active learning and in such assignments, the students themselves are responsible for the generation of knowledge. Practices that can be found in level 4 are case-based learning, flipped classrooms, and project-based learning assignments, or, as we will argue in the next section, art-making projects.

As numerous research has shown, active learning is a very effective teaching style. In the following, we will discuss three influential papers on the effectiveness of active learning, namely Freeman et al. (2014); Deslauriers et al. (2019) as well as Mumtaz and Latif (2017).

Freeman et al.'s (2014) paper is especially influential in showing the benefits of active learning. This meta-analysis of 225 papers investigated the effect of active learning on examination performance and failure rates in STEM courses compared to lecturing. Freeman et al. found that "active learning increases examination performance by just under half a standard deviation and that lecturing increases failure rates by 55%" (Freeman et al., 2014, p. 8412). Interestingly, they also found a difference in the positive effect between examinations which tested lower-level cognitive skills and examinations which tested

higher-level cognitive skills. Their study showed that "active learning has a greater impact on student mastery of higher- versus lower-level cognitive skills" (Freeman et al., 2014, p.8411). They argue that these findings are in line with similar results by Haukoos and Penick (1983); Martin et al. (2007); Cordray et al. (2009); and Jensen and Lawson (2011). Finally, they also show that "active learning ha[s] the highest impact on courses with 50 or fewer students" (Freeman et al., 2014, p. 8411), though here, too, a positive effect was found in all sizes. For classes smaller than 50 students they found a Hedges' g score of .47 compared to .28 for medium-sized classes (50-110 students) and .30 for large classes (110+). Overall, this influential meta-analysis confirms the positive effects of the use of active learning so forcefully that Freeman et al. conclude that if their study had been a medical trial it would have been stopped for benefit (Freeman et al., 2014, p. 8413).

Similar to Freeman et al. (2014), Deslauriers et al. (2019) found that students "in active classrooms scored almost half an SD (0.46) higher on the examination" (Deslauriers et al., 2019, p. 19253). They explain this positive effect by the heightened cognitive effort students had to undergo during active learning. Interestingly, they observed that students underestimate what they learn during active learning compared to a passive learning situation. They separated students into two groups (A and B) who were taught the same material, group A through active learning and group B in a lecture. After class, both groups first self-assessed what they learned during class and then did the same multiple-choice test. While group A evaluated their own learning as lower, they scored significantly higher on the test. Deslauriers et al.'s explanation is that the high cognitive fluency of the teacher during the lecture created the illusion among group B that they understood the material well. Likewise, the struggle the students in group A went through during class, created the impression that they learned little.

Furthermore, Mumtaz and Latif (2017) researched the use of debate as an active learning strategy. They found that it not only increased the depth of their knowledge, but also helped develop skills such as critical thinking and analytic decision-making. In particular, 78% of students agreed that participating in the debate improved their critical thinking skills and 62% noted an improvement in analytic decision-making. However, it must be noted that those were self-reported benefits and other research puts into question whether active learning itself contributes to the development of critical thinking skills (Chiu & Cheng, 2017).

Two more qualifications to these positive results regarding the positive effects of active learning need to be mentioned. Firstly, active learning is only effective if it is implemented in a thoughtful way. Mere student activity without aiming at a specific learning outcome fails to enhance student understanding (Prince, 2004). Secondly, most research has been done on STEM courses. Still, we believe that we can apply the conclusions from these studies to the humanities department as well, as there is no hard evidence suggesting a reduced learning success for different disciplines.

4. Why Is Art-Making a Good Way to Make Learning Active?

As we have outlined in the previous section, Erol et al. (2015) developed a 4 level framework in which one could categorise how active a teaching practice is. The fourth level, which is the most active, contains practices such as case-based learning, flipped classrooms, or project-based learning assignments. In this section, we argue that art-making, as introduced in section 2, is such a 4th level practice. This can be seen when examining the role of the teacher and students during the art-making project.

Firstly, art-making projects are characteristic of a 4th level practice when it concerns the role of the teacher. The teacher in 4th level active learning practices does not transfer knowledge to the students, but is there to create an environment in which the students generate the knowledge themselves. For art-making projects this would indeed be the case. The teacher is not the medium through which the knowledge is transferred to the students, for example by lecturing. Rather, the teacher challenges the students to come up with a creative way to translate a philosophical debate into an artwork. How students meet this challenge is for them to determine. Where necessary, the teacher supports the students' learning process by giving feedback without taking away the agency of the students in the project.

Secondly, art-making is a 4th level active learning practice because of the role of the students. In level 4 teaching practices the "students are responsible for generating knowledge" (Erol et al., 2015, p. 7). This is true for art-making projects. By coming up with a way to translate a philosophical debate into art, the learners take initiative, engage with the content of the class to generate knowledge, and thus are at the centre of the learning process. The knowledge generated by the students includes both a deeper understanding of the philosophical issue at hand as well as how it can be

transferred into a different context. It is also possible that the art-making project generates new insights into the philosophical issue.

Conducting the art-making project in groups creates an additional advantage through the collaboration between students. In discussing the project, students will challenge each other's interpretations of the philosophical debate and negotiate how to effectively translate it into their artwork. They will help each other reach a deeper understanding of the issue at hand and by comparing different artistic ideas make more thoughtful decisions regarding their artwork and how it can contribute to the philosophical debate.

In the following, we will discuss how these considerations translate into practice by reviewing the example of the student project on ontological behaviourism introduced in section 2.

In this project, the role of the teacher was limited to introducing the art-making project, its purpose, scope and timeline as well as moderating an initial discussion on what constitutes art. After that, all the agency was with the students: they needed to form groups, select a suitable topic from the material previously discussed in class, and think of a way of turning it into an artwork that contributes to the philosophical debate.

In the group that created the photo-gallery on ontological behaviourism, there was a lively discussion of initial ideas on how to approach the art project. The students quickly settled on using photos as a medium, but struggled with deciding on how to connect this with the philosophical issue they had chosen. While discussing multiple alternative ideas, they realised that their interpretations of the philosophical problem differed. Through discussing how to approach the art project they gained a better understanding of the philosophical issue and were able to arrive at a joint interpretation. They came up with the idea of using two versions of the same photo to express the behaviour and the mental state of a person respectively. By choosing a plausible but atypical combination of behaviour and mental state, they wanted to show that behaviour and mental states are not related in the way ontological behaviourism claims. Behaviour that seems to indicate a particular mental state can also occur independently of that particular state. Another difficult decision the students faced was to decide on which mental states to use for their project. Here they had to discuss among themselves which mental states would generate the strongest case for the argument they wanted to make. These discussions helped them get a deeper understanding of the issue.

In the reflections that the students had to write after completing the project, they reported multiple positive effects of doing the art project, which are in line with the expected outcome of active learning as discussed in the previous section. Students wrote that collaborating on the art project had helped them gain a deeper understanding of the philosophical debate and changed their opinion on the matter. They mentioned that it had encouraged them to discuss philosophy after class and motivated them to try something similar in other classes.

5. Why Is Art-Making Particularly Useful for Philosophy Classes?

In the previous section, we have shown how art-making can be seen as a 4th level active learning practice and thus can be expected to be a useful educational practice. We will now discuss five reasons why art-making is especially useful for philosophy classes in particular.

Firstly, philosophy classes are likely to benefit particularly strongly from active learning methods as they are often small and generally use examinations that test the understanding of concepts rather than mere recapitulation of information. As Freeman et al. (2014) have shown, in these cases, the positive effect of active learning is particularly large.

Secondly, as noted before, philosophy contains a rich collection of imagery and stories which lend themselves to be translated into artworks and thus offer accessible starting points for art-making projects. Furthermore, these function not merely as illustrations of philosophical problems (as pictures might do in other disciplines), but are central to the philosophical arguments. For example, one might argue that, by invoking particular moral intuitions, the trolley thought experiment provides evidence for a particular ethical theory (see the chapter *Experiencing Art as Evidence: Examples from Western and Eastern Philosophy* in this volume). As these stories and imagery are so integral to the philosophical debate, an in-depth engagement with them through an art-making project will be particularly beneficial for the understanding of the philosophical issue.

The third benefit of using art-making projects in the philosophy classroom is that art-making projects allow students to come up with genuinely novel ideas. When students in conventional classes work on philosophical issues they often do that through argumentative essays or discussions. For students,

and even teachers, it is very difficult to come up with a novel argument or perspective on a debate as old as—in some cases—two thousand years. There are, however, novel ways in which these discussions can be translated into artworks, giving the students room for agency and creativity. By doing so, students might even notice problems with the philosophical issue that they would not have been able to identify if they had been taught using traditional learning practices. In such cases, the art-making project would not only lead to a deepened understanding of the philosophical issue, but might even lead to new insights.

Fourthly, philosophical debates are often perceived by students as particularly dry and abstract. Student feedback (received by Bewersdorf) on art-making projects suggests that students find it easier to understand and engage with these abstract ideas and arguments when translating them into concrete artwork. The art-making project thus would help students that struggle with understanding philosophical issues by providing a different perspective.

Finally, the self-understanding of most philosophy programmes is that they teach their students to think critically to a higher level than other programmes do. As mentioned in section 3, active learning is particularly helpful to increase students' critical thinking skills. So philosophy programmes, which consider critical thinking as an important learning outcome, should be especially interested in incorporating active learning practices, such as art-making projects, into their courses.

6. Conclusion

Active learning techniques are a great way to enhance students' learning experiences. In this chapter we have argued that art-making projects are a great addition to the more well-explored active learning techniques like case-based learning, flipped classrooms, or project-based learning assignments. While we think that art-making projects are especially suitable for philosophy classes, we think it is worth exploring to which extent they can be fruitful in other disciplines as well.

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CHAPTER 6

Reflective Writing and Well-Being: An Interdisciplinary Perspective

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1. Introduction

This study investigates the relationship between autobiographical reflective writing and the interdisciplinary understanding of its effects. Reflective writing, paired with autoethnographical analysis, is used to explore the relationship between writing and well-being. The study begins with a review of the literature on reflective writing, well-being, and autoethnography, and goes on to investigate how reflective writing impacts well-being, understood as human flourishing across multiple dimensions.

Below, we consider four types of reflective writing that were relative to our investigation: Research narratives, diary writing, journaling and reflective

writing. The choice of these underscores our decision to focus on autobiographical reflective writing as a tool for self-care. Some of those are quite similar—such as diary and journaling—and so bear some examination in order to establish their distinctions, and to clarify the terms involved.

The most common assumption among studies on reflective writing is that the practice provides a way for the writer to make sense of, organise, or inform their experiences, to provide insight, and support decision-making: "Thus…the purpose of reflective writing is learning which will precipitate some form of action or change in behaviour" (Jasper, 2005, p. 250).

Reflective writing is also widely understood to shape *individual* experience, in effect setting up a dialogue between the writer's own sense of self and the self appearing in their writings. Further, the benefits of reflective writing have been linked to the subject matter and style of writing used, as described by Ullrich & Lutgendorf (2002). It should therefore also be noted that all the literature on this type of writing by definition considers the role of an author's subjectivity. Moreover this type of writing is the act of an individual subject, and indeed reflective writing can define individual subjectivity in the sense that, "…[W]hat is that relating and purporting to the experiences and perceptions of the author" (Jasper, 2005, p. 250).

We will offer our examination of the literature on how those impacts are understood in terms of human wellness, and our choice of the interdisciplinary term 'well-being'. In this regard, we consider reflective writing as a way of understanding well-being from an open-ended perspective. This allows us to explore multiple dimensions of well-being at the same time, leading to interdisciplinary results.

2. Three Types of Reflective Writing

2.1 Research Narrative as Reflective Writing

In qualitative research, where the relationship between the researcher and the research subject is intertwined, reflective writing is sometimes used as a way to investigate the author's own subjectivity, as well as to bring depth to the reader's understanding of the context in which a study was undertaken. As Ahern (1999, as cited in Russell & Kelly, 2002) argued, "rather than attempting to control researcher values through method or by bracketing assumptions, the aim is to consciously acknowledge those values. Keeping

self-reflective journals is a strategy that can facilitate reflexivity, whereby researchers use their journal to examine 'personal assumptions and goals' and clarify 'individual belief systems and subjectivities'" (p. 2). Ortlipp (2008) broadened that idea to include the context of such research, arguing that the subjectivity of the researcher can support a unique understanding of the social starting point and paradigmatic frame.

Doing subjective research tends to be inductive in its epistemology, relying on rich context, contingency, and qualities of description, rather than on generating predictive conclusions and generalisations. The writing is structured by the research process, with qualitative reporting in mind. The qualitative researcher's reflective journal can describe the subjectivity of the researcher and can also provide data for analysis, potentially contributing to whatever knowledge the study produces. The process of reflexivity, i.e., examining one's own beliefs, values and prior assumptions, has various benefits. It increases the validity of data interpretation and contributes to the autoethnographic analysis. For example, one of the researchers wrote about experiences in the military. Having prior beliefs about serving can affect the way the writer interprets the data. By acknowledging that, readers and peers can understand the writer's conclusions and background better. "This [...] knowledge arising from reflective writing, leads to local and particular understandings about one's situation by one participant or observer, and attempts to illuminate the universally true by revealing the particular" (Jasper, 2005, p. 250). In such research, issues of rigour are addressed in terms of the trustworthiness of the study process, and reflective writing can be used to demonstrate credibility, dependability and transferability.

2.2 Diary as Reflective Writing

Diary writing is described in the literature as a free flow of writing, with no specific structure other than the regular (e.g., daily) notation of individual experience. Diaries can be used as a personal tool for professional use, e.g., as a data collection device for researchers. Polit & Hungler (1991) described diaries as self-report techniques for data collection. Diaries are meant to be descriptive of individual human experience, and are often—but not necessarily—factual. This is challenging for the analyst: "The diary keeper is not challenged to separate thoughts from feelings or from facts, and as the writer to extricate yourself from your writing" (Holly, 1984, p. 5). Diary keeping is described as intentionally less than rigorous, and somewhat more complex

to analyse because the author's personal emotions often play a strong role. Burgess (1994) argued for the efficacy of diary keeping. The author advocates for the wide range of topics and details diary keeping allows for, as mentioned, diary keeping is a "free-flowing" account for reflections unbounded by specific structure.

2.3 Journaling as Reflective Writing

The characteristics of diaries and journals can be similar, for example both usually call for some regular notation of individual experience. We use the term journaling to indicate a type of writing that most often will, as Burgess described, be "structured, descriptive and contain objective notes" (Burgess, 1994, p. 301). This distinguishes journaling from diary keeping.

So, the term journaling here describes reflective writing focused upon a particular theme or issue, within a given time period, undertaken in a somewhat more structured process than diary keeping. Journaling includes the writer's attempts to record somewhat more objective notes on subjective experiences, and the building of the chronological order of events is part of the interpretive process.

Further, the journaling process is often undertaken specifically to foster learning, or to achieve a health impact or some sort of personal growth, occurring in a back and forth dialogue between the journal keeper and their writing. Bower (2003) suggested that reflective writing can increase cognition capabilities in students, develop habits of intellectual growth and foster decision-making capacity. Cameron and Nicholls' (1998) school experiment looked at writing and its effect on coping and mental health. It found that reflective writing promoted health benefits in the majority of participants, especially improvement in mood changes and adjustments to new environments. The process of reflective writing is affected by the social context in which the act of reflection takes place. This follows on Dewey's (1933) description of the value of reflective thought, that it structures the process of meaning-making in light of complex or enigmatic experiences. "The function of reflective thought, is therefore to transfer a situation in which there is experience, obscurity, doubt, conflict, disturbance of some sort into a situation that is clear, coherent, settled and harmonious" (Dewey, 1933, pp. 100-101). As Dewey described it, that human activity of reflection connects our inner and outer worlds. This is especially the case when the literature on reflective writing emphasises the need to include the social context of the reflective

writer's experience. More recently, Baldwin (1991) described reflective writing as a kind of bridging: "Writing bridges the inner and outer world and connects those paths of action and reflection" (p. 9).

In the literature, undertaking a reflective journaling process is often used in this instrumental way, often aiming at empowering changes in behaviour or decision-making or to create health impacts in the journal writers. For example, journaling has been used by students and their teachers to enhance learning and improve self-assessment skills. One such method, described by Hubbs & Brand (2005), uses a collaborative framework that includes the instructor and students sharing reflections in an ongoing dialogue regarding the progression of teaching and learning, for instance. In the process they describe, all the journal keepers share in the process and in subsequent dialogue, and make informed decisions from them about changes to the learning process.

3. Reflective Writing and Health

3.1 Reflective Writing about Trauma

A significant portion of the literature on the health impacts of reflective writing focuses on trauma, and suggests that writing can have quite positive effects: anxiety reduction, resilience increase, better coping mechanisms, adjustment to new environments and faster employment acceptance.

"Such writing has been shown to relate to superior immune function (Esterling et al., 1994; Pennebaker, 1985; Petrie et al., 1995), reduced health problems (e.g., Greenberg & Stone, 1992; Pennebaker & Beall, 1986), lower skin conductance levels (Pennebaker et al., 1987). Other aspects of wellness addressed include adjustment to college life (Cameron & Nicholls, 1998; Pennebaker et al., 1990), and employment resilience following layoffs (Spera, Buhrfeind, & Pennebaker, 1994)" (King, 2001, p. 798).

Reflective writing can be used to address different types of trauma. The benefits of emotional reporting or 'written disclosure', i.e., to give words to trauma without subsequent analysis, are described by Ullrich & Lutgendorf (2002), who argued with a meta-analysis of the literature that "writing about stressful or traumatic events is related to improvements in self-reported health, psychological well-being, physiological functioning, and general functioning. Moreover, the positive effects of written disclosure appear to be

equivalent to or greater than effects produced by other psychosocial interventions" (p. 244).

Going a step further, a University of Iowa study investigated differences in effect between reflective writing about trauma narrative with and without subsequent analysis by the writers. Based on findings from a sample of 140 students, the study found that the writers who wrote and reflected on their trauma narratives—"engagement of both cognition and emotions"—helped trauma sufferers identify benefits of the traumatic experience. In contrast, findings suggest that simply focusing on the emotional aspects of traumas might not result in a better understanding of traumatic events (Ullrich & Lutgendorf, 2002, p. 248).

A clinical psychological study that combined writing and therapeutic counselling found that the approach supported positive behaviour change in participants (Miller, 2014). In addition, positive correlation has been found between the process of reflective journaling and decreases in mental distress and overall mental health improvement, for example Smyth's et al.'s (2018) study of reflective journaling, which concluded that journaling can not only intervene in "mental distress," but can also impact overall well-being, in the sense of enhancing physical functioning among medical populations.

Despite the many wellness benefits, writing about trauma can also incur emotional costs. A study conducted by King (2001) compared four types of groups. A two-way ANOVA design included writing different topics across time and their effects on well-being. They wrote about trauma only, trauma and BPS (best possible selves), BPS only and BPS and trauma. Results showed that those who did not write about trauma but focused on BPS achieved similar positive results without the emotional burden of writing about unsettling events. Results suggested that writing about life goals presents a way to reap the health benefits of writing, without the associated emotional costs. Indeed, writing about life goals contributes to feeling less upset, more happy, and to improved physical health. Interestingly, the physical benefits of writing about BPS were the same or higher compared to writing about trauma, whereas writing about trauma also led to feeling upset and a lowered mood (King, 2001).

3.2 Reflective Writing in Support of Other Types of Wellness

Forms of reflective writing have been shown to be useful to journal keepers in their social wellness, which can be supportive of other types of wellness. A

Cambridge study of language learners found that reflective writing in the native language is associated with an increase in adjusting and coping to new environments and improving social well-being. This experiment concluded that expressive writing can be beneficial for self-reports of adjustment compared to controls (Kim, 2005).

In addition, a study of reflective writing conducted in a nursing school found that it was associated with increased motivation to participate in learning. Moreover, it was also reported that reflective journaling increased the nurse trainee's understanding of their patient's perspective, and contributed to an overall increase in nursing competency (Hwang et al., 2018).

In a study among students of basic writing classes, Bower (2003) found that reflective writing improved critical thinking for decision-making—"stepping back self-critically from the task itself to determine the best course of action" (p. 47). That study argued that reflective writing encouraged "cognitive digging", which helped students to better understand the logical progression of a decision-making endeavour (Bower, 2003).

3.3 The Concept of Well-Being

In our investigation of the forms and uses of reflective writing, we noted that the health-focused impact literature tends to describe only one impact at a time, on one single dimension of health and its associated health discipline, for example physical or psychological or professional health. Only occasionally are impacts described across dimensions, which brought us to the concept of *well-being*. Well-being is occasionally used in this literature as an umbrella term for summing up a variety of effects across health disciplines—for example, health impacts of writing on anxiety and on social wellness—but it is also used to *compare* how one type of illness/wellness impacts illness/wellness in another category. This use of the term emphasises the interdependencies between various dimensions of well-being, and we found it particularly useful in understanding the impacts of writing on health.

3.3.1 Well-Being as Interdisciplinary

Our review of the literature on reflective writing found that much of the research in the past 25 years focused, understandably, on understanding its impacts from one discrete disciplinary domain. One exception can be found in Ullrich and Lutgendorf's research (2002), where they demonstrated that the effectiveness of emotional support through journaling depended on

various factors related to overall well-being, such as nutrition, physical activity, and stress management. This raises the question of whether the effects of writing have been investigated from a multi- or interdisciplinary standpoint.

In contrast, when the impacts of writing are considered across academic disciplines, the concept of *well-being* was sometimes employed to categorise impacts. The term is used as a sort of trans-disciplinary bridging term, or umbrella concept. Below, we report on our investigation of the concept of well-being, which we eventually adopted for analysis of our own reflective journals.

The multi- or trans-disciplinary concept of well-being opens up the study of reflective writing to consideration of the dynamics between impacts. Pollard and Lee (2003) directly addressed the use of the term, arguing in pragmatic terms that the use of well-being can provide more useful and consistent results in controlled studies. Similarly, a 2013 human resources study among 600 workers explored the interrelatedness of various wellness concepts, concluding that well-being served "as a moderator of the relationship between meaningfulness and engagement" (Soane et al., 2013, p. 450). Some studies use well-being as an umbrella term, to categorise impacts across broad dimensions of well-being as the psychological, physical, and social. Flinchbaugh et al. (2012) used the term in this way, to summarise sub-categories in their clinical trial of stress management techniques in work and university settings. That experiment combined stress management techniques and reflective 'gratitude journaling' among business students, categorising effects across a range of measures including 'meaningfulness', 'engagement', and 'life satisfaction' (Flinchbaugh et al., 2012).

Well-being is not a new concept, but it is an important one, and deployment of the multi-dimensional concept has become integral to understanding how arts and other cultural practices support the Aristotelian notion of 'human flourishing'. An early institutional adopter of the notion of well-being was the World Health Organisation (WHO), which defined health in terms of flourishing, as "physical, mental and social well-being, not merely the absence of disease or infirmity" (Breslow, 1972, p. 347). The WHO use of the concept of well-being reflects its need to understand how one aspect of well-being is constrained by another: One's ability to access a nourishing diet or a strong social network, for example, could be severely constrained by crime, illness, a lack of education, or a lack of services. We

can sum those wellnesses/illnesses into the single concept of human flourishing.

3.3.2 Well-Being as Capability

There is no monolithic definition of well-being, however, and the term has been used in many ways over time, in many different fields. This heterogeneity of meanings and uses is not necessarily a weakness of the term, however. In her book *Valuing Freedoms*, economist Sabina Alkire (2005) took up well-being as flourishing, arguing that every definition of well-being is value-laden. She then set out to articulate those fundamental values by gathering more than 30 distinct multidimensional definitions of well-being from various fields and sources. Alkire showed how each provides a distinct multidimensional summary of what makes a human well, including sub-categories of well-being such as 'physical', 'mental', 'economic' (etc.). She argued that each of these 'well-being sets' offer a complete definition of a good life. Such definitions are useful not only for philosophers of virtue ethics, but also for programme-focused institutions (like the WHO) that operationalise them as points of departure and baselines for evaluating human wellness.

Among Alkire's many definitions of well-being are the 'ten central human functional capabilities' of political philosopher Martha Nussbaum (2000). Nussbaum and Alkire are both theoretically grounded in the 'capability approach' described by economist Amartya Sen (1999). We chose this description of well-being to inform our understanding of the effects of journaling from a multi-dimensional perspective.

In the capability approach, human wellness is considered not only in terms of ideals of wellness, but also in more pragmatic terms as an individual's ability to *make use of* what wellness they have. Nussbaum (2007) considered for instance how the ability to 'play' might be constrained by a child's access to a 'social life'.[1] Well-being-as-capability makes account of the ability to use "imagination and thought in connection with experiencing and producing works and events of one's own choice, religious, literary, musical, and so forth"

1 The ten major categories of Nussbaum's (2000) well-being set are: Bodily Health; Bodily Integrity; Senses, Imagination and Thought; Emotion; Practical Reason; Affiliation; Other Species; Play; Control Over One's Environment. Nussbaum offers descriptions of each of these, though we have excluded those descriptions and instead have included them in our descriptions of well-being in the research narrative.

(Nussbaum, 2007, p. 23). As the research suggests, reflective writing can nourish areas of wellness, such as imagination and thought, that support other aspects of wellness such as the ability to work, and to participate in public life.

We found that the concept of well-being as capability usefully emphasises the need to consider relationships between categories of wellness. For example, our consideration of Flinchbaugh's (2012) findings on 'meaningfulness', 'engagement', and 'life satisfaction' can be taken as a simple summation of wellness, or one can consider the ability to make use of those in terms of the capability "to love, to grieve, to experience longing, gratitude, and justified anger" (Nussbaum, 2007, p. 23). Similarly, we found that we were better able to understand our own journal narratives and writing experiences when the qualities of those experiences were evaluated in a more complex, multi-dimensional—and we believe more human—way.

Nussbaum (2007) describes one aspect of well-being as *practical reason*, which was particularly useful in reflecting on our own journal keeping. Nussbaum specifies this as the "ability to form a conception of the good and to engage in critical reflection about the planning of one's life" (p. 23). The forming of a conception of what a desirable life might be was indicated repeatedly in our journals, and so the wellness category of practical reason especially helped us to critically reflect on thinking about planning for a good life.

Nussbaum's notion of 'affiliation' was also particularly poignant for us. Affiliation is described as "...being able to live with and toward others, to recognize and show concern for other human beings, to engage in various forms of social interaction; to be able to imagine the situation of another" (Nussbaum, 2007, p. 23). This directly reflects the research and our own experience of reflective writing, in terms of recognising and showing concern for other people, and fostering the ability to imagine the situation of another.

4. The Current Study: Autoethnography of Health and Well-Being

The aim of this study is for the researchers to immerse themselves in an unconstrained reflective writing approach, through diary writing and autoethnographic writings, to realise and evaluate the effect of this on multiple dimensions of health and well-being. The intention is to analyse the process and its outputs, with the hope of typologizing some of its effects

(Chang, 2008; Belbase et al., 2008). We were particularly interested in what insights might be gained from considering reflective writing across multiple dimensions of well-being. This involved two steps: 1) diary entries and 2) qualitative analysis of these entries. Thus, individual 'unconstrained' journaling creates a variety of writing in style (e.g., poems, fiction or journaling of a day) and in subjects discussed (e.g., current topics in the world or personal, past experiences or pure imagination). Therefore a complex picture of intertwined strings paint the bigger picture of *well-being*.

4.1 Methodology

We turned to our own journal keeping as data for the investigation, choosing autoethnography as our research method for its ability to inform deeper understandings of the self across multiple dimensions: social, political, economic and cultural, all within the context of reflective writing (Luitel, 2003, as cited in Belbase et al., 2008, p. 88).

Given that our focus in this study is on well-being, we aimed to gain an understanding of the various concepts that contribute to shaping both individual and broader understandings of well-being. Thus, instead of the clear entanglement of different entities, reflective writing helped to understand how different things are connected to each other and influence each other. This includes concepts such as our social and physical environments, as well as ourselves. By writing about these connections we aim to better understand how they work together to create understanding of well-being (Baldwin, 1991, p. 9).

4.1.1 Procedural Guidelines

Step 1: Diary writing

The guidelines for diary writing were to write regularly (every day), about topics that were emotionally impactful and preoccupying thought. Further, we put emphasis on regularity in writing which is why weekly meetings and the sharing of writing held us accountable. Additional procedures, for example, writing materials, place of writing and the topics, were up to the individual to decide.

Step 2: Qualitative analysis of these entries

Analysing the data and each other's entries was aimed at finding themes within the writings. A further matter of interest were patterns or connections between experiences and the broader context.

4.2 Analysis Plan: Patterns, Themes & Connections

Each researcher analysed their own journal, and also the journal of one other researcher, and our meetings and discussions would continue throughout the process.

The type of analysis that facilitated our research was the colour coding of autoethnographies. Colour coding helped find themes, categorise, and recognise patterns, trends and connections.

Our journal writings were fairly diverse in style and content. Some journal keepers started from extraordinary events, while others focused on the ordinary. All the journals produced material that was emotional and important to their writers. All included prose narrative, but some included poetry, others had a strong sense of humour and irony; some were written on paper, others in digital format.

It was agreed that we would draw our descriptions of impacts from the data—

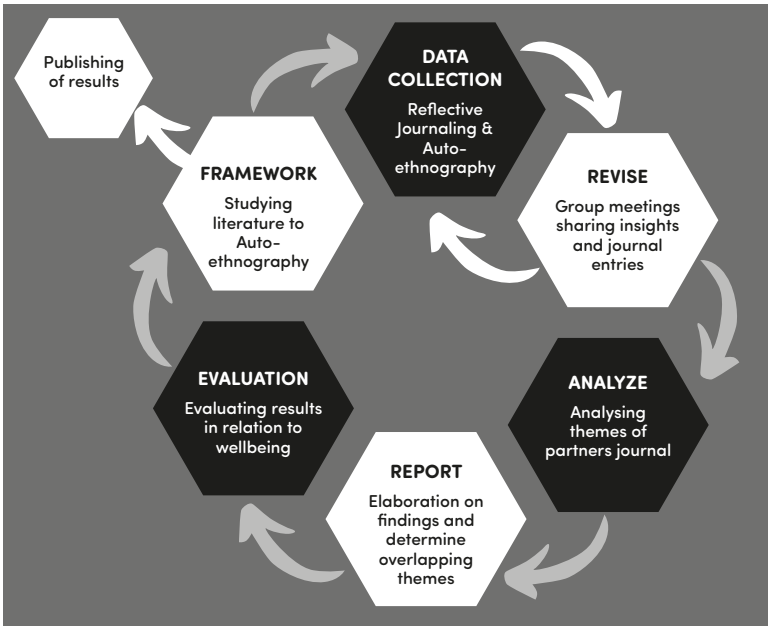

Figure 1 illustrates phases of our autoethnographic study. Starting on top with 1) "Framework" thus looking at contemporary, relevant research. Followed by 2) "Data collection" followed by 3) "Revise" which circles back to 2). 4) "Analyse" is reached when enough data has been collected. 4) "Report" and 5) "Evaluation" were the final steps of this study before its publication.

the journal narratives—keeping in mind that we also brought with us the multidimensional concept of well-being from the start, as a way to consider interrelationships. The concept of intra-action portrayed clearly the importance of the interconnected agencies, contributing to well-being of the subjects.

4.3 Sample: Privacy & Positionality

Disclosure is an ethical issue that researchers encounter in conducting autoethnography. Our study was based on our five journals, and our names are attached to this report. Yet, because we are a group there still exists the possibility for moderate confidentiality within the collective data. With this in mind, our research report does not ascribe names to quotes from journal entries, but refers to the authors with the letters A, B, C, D, and E, as well as using the pronouns 'they/them' for being inclusive to all genders.

All of the contributors to this study were members of a 16-week-long second year university project centred around the role that the arts can play in human health. The five journal keepers are all international students between 21 and 28 years old. This journaling and research process brought a group of individuals from diverse fields of study together to examine the interdisciplinary phenomenon of well-being. The differing academic focuses of the team include interdisciplinary sustainable development, politics, philosophy and economics, as well as qualitative and quantitative research. Thus, our examination of well-being and the reflective writing processes was approached using a diverse group of individuals of different ages, nationalities, and academic disciplines. This enabled a nuanced reflection on our practice, and on the value of wellness. Moreover, the project instructor, a senior member of the college's Humanities teaching staff, provided guidance and workshops on writing and ethics as needed, and participated in writing the research report.

Russia's 2022 full invasion of Ukraine coincided with the start of the project, and was very much on our minds. A guest lecturer from Ukraine, anthropologist and playwright Hanna Dosenko, worked with the students for five weeks on reflective journaling which consequently influenced a portion of the journal subject matter.

5. Results

5.1 Self-in-the-World (Practical Reason + Affiliational Well-Being)

As we delved into the examination of our diaries, a prevalent theme that surfaced was the juxtaposition between our personal identities and societal expectations, highlighting our collective resistance to various social conventions. We were all responding to some inner sense of conflict between ourselves and our worlds. Each of the journal narratives described this as a sort of conflict between some preference or inclination, and a constraining social norm or institution. For example, "A" here describes their complicated relationship with different societal gender norms and expectations towards being sexually active:

> Sexually active men.
> One night stands.
> The amount you can pull heightens masculinity, makes you cool.
> If women do so they are bitches.

"B" on the other hand reflects on their childhood experiences and how understanding certain dynamics connected to this impacted their standing in society on different levels:

> That I would go to the army one day was not a question but a fact. Writing about my childhood helped me…make a distinction between my upbringing and that of others, and to understand the position I was put into as a soldier and as a citizen in my country.

Initially, we assumed that this theme of self-in-the-world described a constraint on well-being. As we began considering our work in multidimensional well-being terms, an image emerged of journal keepers *sorting through* conflicts by considering the lives we wish to lead. Part of this was working out conflicts in terms of our affiliation with other people.

For example, "C" expressed conflicted feelings of compassion and indifference in the presence of the ill people about whom they cared:

> I feel like I have never really experienced true illness or suffering. Does this perhaps explain my lack of empathy for those who do?

Yet we were also imagining *future* affiliations and ways of living. One journal keeper found themselves in conflict between the strong value they place on rational decision-making and the emotionally charged decisions of many of their friends and associates. The reflective journaling process helped us while exploring the connection between different aspects of well-being, and how these might inform a reconsideration of values and their effects in the future, as shown by "D" in this piece, where they put into perspective some of their beliefs.

> I often admire cold hearted rationality. I praise efficiency, but I suddenly find myself wondering why. I'm a fucking human, not a robot. Instead of refusing my human condition, shouldn't I try to make it worthwhile?

This theme revealed a sorting-through process that in turn suggested a feeling-toward-the-future. We refer to this aspect of well-being using Appadurai's (2004) concept of the "capacity to aspire".[2] We would go on to explore this aspect of well-being as closely related to emotional wellness, in the next theme.

5.2 Our Social Environment (Practical Reason + Emotional Well-Being)

During the analysis of the journals, we observed how many words were spent writing about others. Fleeting encounters or long-lasting relationships came alive on our pages showing us both the influence that our social surroundings have on us, and the importance of the diary in analysing them.

Seeing other people living according to different values, for example, was enough for "E" to start questioning their own.

2 We take this term from Appadurai (2004), to augment Nussbaum's (2000) idea of emotional well-being: "...to think critically about the world and one's own place in it." Appadurai coined the term to argue for aspiration as an aspect of the right to recognition. While the human right to recognition is not entirely in the purview of our study, the term "capacity to aspire" has since been applied by authors in a variety of fields, and it is useful here.

> ...[T]hese people appear so content living in their makeshift vans and co-living wooden spaces, with their babies slung on their chests, sitting in the morning sun. I am goal oriented but right now...life's direction is not as predictable as I once thought. I wonder what way is the best to live, what is the best approach to life.

Like "E", we all used the journaling process to imagine ourselves in relation to other people and relationships, becoming able to absorb as much as possible from our social encounters by exercising empathy and open-mindedness.[3]

In "E"'s case, questioning their values led them to change the way they approached some people:

> I saw certain people as outcasts whereas now I don't see people who are eccentric in the same light. I observe their qualities and characteristics and attempt to evaluate if they are happy. That's all that seems to matter to me these days. Was the perspective I had in the past wrong or skewed?

This way we can see how a process set in motion by a social encounter went from undermining some of their values to a critical evaluation of their whole past perspective.

Another example where we can see how social interaction can impact someone's self is in "A"'s diary, where their complicated feelings toward a family member put their own persona under scrutiny.

> I do not like the way she is. It's mean! I know that. What I do not know is why I feel this way. (...) How can I feel those feelings towards one of my closest family members, someone with the same genetics and upbringing as me?

However, we noticed that journaling could also have a more active role in our

3 While our understanding of writing and wellness were partly informed by the psychology literature on empathy and theory of mind, we were focused on the interdisciplinary theory of well-being, and so did not delve deeply into that literature. However the principle of empathy was important for us. The notion of theory of mind begins with Premack & Woodruff (1978), A useful review of the literature on empathy is Cuff et al. (2016).

social transformations, not only by helping us change ourselves, but also helping us change the way we act.

In this passage, "C" uses their journal to highlight their effort in opening up to others, thus using the diary to keep track of their progress and gain awareness of their situation.

> Another thing that I am still practising right now is opening up to others, being able to share emotions and sit with them for some time, instead of rationalising them away or distracting myself.

In conclusion, through journaling, we became able to truly appreciate the effect that others have on our lives by seeing how they can make us question our values and personas. In this process, journal-keeping was fundamental to analyse ourselves, formulate critical questions as well as helping us to act on our newfound beliefs and ideas.

5.3 Destabilising and Restabilising (Practical Reason + Well-Being of Senses, Imagination, and Thought)

Initially, journaling was a destabilising force in each of our lives. The process of emotional expression opened up a space in which each of us was nudged from a point of emotional and cognitive equilibrium, toward a crisis of conscience. For example here "E" writes of the impact of their parents' deteriorating health on their conscience:

> I cannot let go of the heavy weight of failure as I watch my parents' health deteriorate. It feels like their suffering is my fault because of how I could not sway them in the right direction, like I had…the power to change them but let that power lay dormant within me somewhere…

Here "B" lets their feelings run loose after an important death:

> I have seen death and felt sorrow, grievances and struggles, my whole life. This girl ['s death] hits differently. In any other place, this girl would be in college now, having the time of her life. Nobody talks about peace anymore, I just want quiet.

Or here "A" puts into words a sense of loss and crisis:

> Two souls,
> Two goals
> So different, but I am getting close.
>
> PICK ONE!
> Either start to run,
> or have fun.
>
> What am I meant to do?
> How should I know?
>
> Two goals so far, yet so close.
> CHOOSE!

One journal keeper noted that the research felt like "…a journey through my inner landscape" that had an unravelling effect on the "…cotton ball of my present and past". In their journal, "A" noted a setback in earlier accomplishments from a therapeutic process for body dysmorphia:

> I need help again…Trust your appetite, trust your body, is a premise I set myself during therapy. However, I lost it due to disordered eating… which seems to be the predator in this game.

This writer reflected on the sources of their unhealthy behaviour, connecting it to an earlier trauma, as "…habits and practices I took up when my father was in chemotherapy." Having moved multiple times over the years, including during the journaling process, they also noted that the acuteness of the dysmorphia coincided with the frequency of their changing residences, in particular, when in "unknown situations, which I often encounter when I move." In time, "A" went on to observe:

> Leaving another country, cutting off bonds…is my instinct, it motivates me to look for new places to create a 'new you'. Yet I realise old habits travel along, and especially show up when I feel lost in space.

This points to van der Kolk's (2015) conclusions from neuroscience research, that "the only way we can change the way we feel is by becoming aware of our inner experience and learning to befriend what is going inside ourselves".

Another journal provided a similarly striking example of destabilisation in light of the war in Ukraine, by a team member with Russian heritage:

> Rationally, I know that culture and government are two separate things, yet emotionally, I do not have this as clear. We were introduced to a Ukrainian girl that wrote a theatrical piece on Russia's first invasion of her land, in 2014. She reenacted parts of her play in front of us and I vividly remember her saying how the Russian missiles started raining on people she knew. I knew she was not talking about me, yet hearing it I felt so, so guilty.

The destabilisation effect produced some version of a crisis of conscience, challenging our responsibility for both ourselves and how we live in the world. Our individual identities were challenged, as well as our identifications with our cultural, political, or domestic milieus. However, we also agreed that the journaling process challenged our assumptions about traditional roles and the conceptual 'boxes' into which we assigned people in our minds, but did not shut down our exploration of possibilities. Baldwin (1991) argued for a *mediating* function of journaling that is relevant here. As "A" writes:

> A back and forth of inner dialogue in my writing here, about the [emotionally confronting] parenting scene that I observed, which I compared to… what constitutes a happy, meaningful life.

This "back and forth" is reflected in the bridge-building function of reflective writing that Baldwin (1991) describes, mediating "between the inner and outer world" (p. 9). Continuing Baldwin's metaphor, we can say that for us, expressive writing built conceptual bridges that helped us to negotiate our well-being crises. We questioned long-held beliefs but also had a context in which to negotiate new beliefs, commitments, and future ways of living. Reflecting on our emotional expressions mediated the *re*-stabilisation between conscience and our freedom to imagine, think, and reason in ways that were meaningful to us. In the beginning, these felt like something of an

intellectual exercise, but over time became re-examinations of our rights and willingness to express who we are as humans.

Here for example, "D" reflects on the way the conflict in Ukraine changed the perception of their own self.

> What I was writing yesterday made me wonder how my relationship with Russian culture has changed since the conflict [in Ukraine]. My way of presenting myself has changed slightly, as I try to not mention that I am half Russian, and, when I do I immediately draw a line between myself and current events. I also notice a decline in the frequency with which I mention Russian culture. Even more, when interacting with my [Russian] grandparents, I find myself shying away from asking questions about their homeland, about history and traditions, as if it was also somehow tainted.

Continuing from the same journal, toward a shifting of perspective:

> I had not noticed, up to this moment, how I was escaping from anything related to Russia…as if it was a shame to look at it with fascination or admiration. This is particularly painful to realise when I take into consideration how interested I am in Russian history, the genius of its literature or how much I love its music and atmosphere. But if I like it this much, why run away from it? That's exactly what I should be holding dear, keeping it close as it shows what Russia can be when it's not sowing chaos.

6. Summary of Results

6.1 Journal Themes

The analysis of our journals revealed three interconnected themes related to improvement and well-being which we named *Self-in-the-world*, *Our social environment*, and *Destabilising and restabilising*. Each of those explored the role of diary writing in different aspects of our lives, from our relationship with society to our own personal norms and values.

Self-in-the-world: The first theme captured a feeling, common to all journal keepers, of uneasiness, and sometimes outright conflict with the world around

them. While this was an important realisation, the analysis also showed us a parallel sorting-through process, suggesting a feeling-toward-the-future, a capacity to aspire, where hope and optimism play an important role.

Our social environment: The second theme explored the impact that other people have on our lives, and it showed how social encounters could lead journal keepers to question their own norms and core beliefs. It also highlighted the role of journal keeping to fully exercise empathy and open-mindedness, and to facilitate personal transformations.

Destabilising and restabilising: The final theme focused on the role of diary keeping as a destabilising and then stabilising force. 'Destabilising' because, through writing, the journal keepers put into question their beliefs, values and assumptions, often triggering some sort of crisis. However, this was always accompanied by a rebuilding process where past perspectives were re-evaluated, past experiences led to insight, and finally, a new equilibrium was reached.

6.2 Interdisciplinarity

In our research project, we focused on using reflective writing and autoethnographic writing as a means to improve the health and well-being of the researchers. Our team discovered that agency crossed domains and disciplines, as we came to understand that different types of wellness were dependent upon one another.

The research project demonstrated that reflective writing and autoethnographic writing can serve as powerful tools for improving the health and well-being of researchers. By tapping into various disciplinary lines within a concept such as wellness, we gained a deeper understanding of the interdependencies and interconnections between different areas of life. This research concluded that journaling can provide a means for reflecting on one's own biases and stereotypes, and for considering new interdisciplinary perspectives that can therefore lead to a more fulfilling and connected life.

In this sense, the work was interdisciplinary in at least two distinct ways. By not placing constraints on our reflective writing, the writing acquired an interdisciplinary dimension, letting us tie together the most different topics, and observe how the political, social and philosophical spheres interacted with our personal one. In return this expanded the domains of well-being that got affected by our work. In both *Self-in-the-world* and *Our social environment* we see traces of well-being's social dimension, *Our social environment*

also highlights the connection between well-being and our sense of purpose, and the weight we give to our personal philosophy. In one instance of *Destabilising and restabilising,* we saw the importance of cultural well-being emerge in the relationship between a writer and their ties to Russia, and in general, all themes showed how writing impacted our general mental health.

Further, our team's diverse academic backgrounds, encompassing Humanities and Social Sciences, qualitative and quantitative orientations, brought different perspectives and approaches to our research project on reflective and autoethnographic writing. First, we struggled to communicate our varying viewpoints, but we soon learned to appreciate each other's differences. For example, when prompted to "write about something you see," some team members took a quantitative approach by counting bikes, while others described social interactions qualitatively. These diverse approaches helped us see the same object or situation from different angles, leading to a richer understanding of our research topic. Ultimately, our collaboration was most effective when we approached each other's perspectives with an open mind, leading to a stronger and more cohesive team.

Overall interdisciplinarity played a role in every part of our research, from the very content of our journals to our backgrounds, and as a consequence, our points of view during the analysis. It was possible to capture it so clearly only by allowing reflective writing without any kind of constraint, which in turn showed us how journaling powerfully affects multiple dimensions of well-being (the importance of purpose, society, friends, mental health etc.) which are otherwise observed independently of one another, missing how they are critically interconnected.

7. Conclusion

"To orient ourselves in the world, we need to know where we are and where we are going. Where we are: that concept must optimally include a full account of our experience of the world to date. If you do not know what roads you have traversed, it is difficult to calculate where you are" (Peterson, 2021, p. 231).

Peterson is arguing for a narrative orientation of the self as a kind of wellness. Having experienced that sense of orientation ourselves, we agree. However, the diverse well-being perspective takes it one step further, to understand what one can do with that oriented self. The well-being view of

health lends itself to an interdisciplinary understanding of healthy practices, i.e., physical, emotional, mental and spiritual perspectives. Reflective journaling touches on each of those facets directly or indirectly. Drawing from both the literature and our personal experiences with autobiographical reflective writing and the interdisciplinary understanding of its effects, there is evidence to support the claim that autobiographical reflective writing impacts well-being, understood as human flourishing across multiple dimensions. We consider four types of reflective writing that were relative to our investigation: research narratives, diary writing, journaling and reflective writing and conclude that all of them have the potential to positively affect well-being.

The approach taken to come to this conclusion was reached by collaboration across disciplines. This study investigates the relationship between autobiographical reflective writing and the interdisciplinary understanding of its effects. Reflective writing, paired with autoethnographic analysis, is used to explore the relationship between writing and well-being.

Understanding our diaries as being representative of our situated knowledge and experience of the world gave rise to the idea that, in analysing them for codes and themes, we would in fact be finding the commonalities across subjective personal experiences. This practice in itself highlights the value of interdisciplinary methods of working, combining humanistic approaches, qualitative and quantitative literature reviews and analytical analysis of the data (applying a rigorous autoethnographic method to the self-sourced data) to study the multidimensional concept of well-being and whether or not it can be affected by different forms of writing. Our interdisciplinary research used diverse writing methods to explore the impact of writing on various aspects of well-being. This approach helped us understand the connection between writing and well-being from numerous angles. Combining journaling, diary writing, autobiographies in an unrestrained way led to a better understanding of how it can affect well-being. In accordance with our results, the literature suggests that journaling and other autobiographical forms of writing can have a positive effect on well-being. Our personal experiences of journaling and autoethnographic inquiry study support this claim.

In sum, taking an interdisciplinary approach to investigate the relationship between the multidimensional concept of well-being and reflective autobiographical writing served to bring forward the themes of 'self in the world' (practical reasoning and affirmational well-being), 'our social environment'

(practical reason and emotional well-being) and 'destabilising and restabilising' (practical reason and well-being of senses, imagination, and thought) This made known to us the richness of what can arise from an interdisciplinary approach to research.

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PART III
Lessons Learned

Student Author Reflections

With this section, we hear directly from the students who contributed to this volume. These reflections provide valuable insights into their personal experiences and lessons learned in two valuable aspects: from engaging in boundary crossing collaborations; and the educational experiment. By sharing their successes, failures, and challenges, the authors offer a unique perspective on the complexities and rewards of interdisciplinarity as well as their own academic development.

Daniel MacRae and Hubert Matusewski (Chapters 1 and 2)

Coming from a liberal arts and sciences background, we were not necessarily bound to a particular discipline. While our backgrounds were mostly rooted within the natural and data sciences, this project pushed us to explore beyond our familiar domains. Both of us were pursuing science majors and currently pursuing MSc degrees, which provided us with a solid foundation to apply scientific techniques to this project efficiently.

The topics we tackled in our chapters demanded that we venture into unfamiliar disciplines. We delved into fields such as the science of team science, epistemology, sociology, behaviour/developmental psychology, and many more that one could consider distinct from our own fields. In essence, we shifted our focus from the mathematical analysis of data to the analysis of concepts, people, and collaborative processes. Additionally, we found ourselves in the dual role of analysing the behavior of researchers while being researchers ourselves.

These new fields of analysis required us to adopt new methods, including surveys, interviews, and qualitative data analysis, among others. Employing these methods was a challenge for us, as we were not overly familiar with the epistemic norms upon which they were based. Nevertheless, driven by our

commitment to thoroughly address interdisciplinary research, we dedicated additional time to reviewing literature from these fields and, with the guidance of our supervisors, familiarized ourselves with the practices and standards of these research methods. Analysing the results of these methods also demanded that we step outside the confines of our own disciplines and engage in tasks such as synthesising literature from various fields, developing conceptual and theoretical frameworks, and operationalising key terms. Understanding and discussing the themes that emerged from our research was a process marked by uncertainty and diverse interpretations of the ideas generated by our research methods. However, this project taught us the importance, as researchers, of confronting such challenges head-on and investing time and effort into developing a comprehensive understanding of our interdisciplinary research topic.

While our interdisciplinary bachelor program generally prepared us for most of the process behind this research, there were certain aspects which we had to give deeper thought. Particularly, we had to structure the deliverables in a manner aligned with social science conventions rather than empirical formats or more technical formats like laboratory reports or coded deliverables. Writing the methodology section posed a unique challenge as it had to be tailor-made for our specific research, necessitating thorough explanations and justifications. With the guidance of our supervisor and by studying sample social science papers, we believe we were able to craft an appropriate methodology section for our paper.

Patrik Wintergerst (Chapter 3)

As a Free Major student, I don't really have a home discipline, and am thus "undisciplined" so to speak. As such, engaging with a broad range of topics —within Philosophy, Cultural Studies, Psychology etc.—helped me cover the ground of the chapter I co-wrote for this project. As such I didn't have a culture shock in terms of ontology or methodology when working on this project. The one adaptation challenge that I did encounter was learning to write in the concise and structured manner of analytic philosophy, which somewhat contradicted my previous reading experience and preferences in philosophy (and writing). Developing an ability to write and properly understand this sort of style was perhaps the most important thing I learned with regards to the particular topic and approach chosen. Lastly, the general experience of developing an academic project, in collaboration with a faculty

member, from conception to completion was an enriching experience that made me more comfortable with successive projects and gave me an idea of what academic work might look like.

Catherine Lange, Elena Laviolette, Mosele Jansen and Stela Gkika (Chapter 4)

We are a group of four third-year bachelor students from different disciplinary backgrounds, sharing a pursuit of Liberal Arts and Sciences. Three of us specialize in Social Sciences, with focuses on Entrepreneurship, International Relations and International Law, and Psychology while the fourth student specializes in Health and Life Sciences.

Contributing to this book required us to step out of our disciplinary comfort zones and venture into the realm of theoretical concepts and alternative data collection methods. One of the main challenges we faced was maintaining objectivity throughout the data collection and analysis processes. Since our research focused on our own university and studies, it was crucial to overcome biases and avoid leading questions during interviews. We learned the importance of supporting our arguments with direct quotes from the interviewees and relevant literature. This approach helped us ensure the credibility and validity of our findings.

The writing process was both stimulating and challenging. As novice academic authors, we had to carefully consider the structure and clarity of our chapter, adhering to publishing standards. Additionally, since for most of us English is not our first language, we encountered an extra layer of challenge. However, this experience enhanced our collaborative skills, as we navigated through numerous revisions, edits, negotiations and discussions.

The journey of publishing our research has been rewarding, and we believe that the skills and knowledge we acquired will prove invaluable in our future studies. We extend our sincere thanks to all those who supported us throughout this process.

Kerstin Baureis and Twan Tromp (Chapter 5)

Our group consisted of two students majoring in differing fields, guided by an academic faculty member specialising in philosophy.

Kerstin Baureis is a Social Sciences major primarily focused on psychology but who also explores the humanities. However, for this project, we had to venture outside our comfort zone and delve into philosophy and didactics.

The abstract nature of our topic necessitated a longer and more complex process of gathering information. Given the interdisciplinary nature of our research, we had to establish connections that were not yet well-established in the existing literature, such as linking art-making to active learning.

Twan Tromp is a Humanities major who does not yet identify with a particular discipline but possesses a philosophical inclination and dabbles in the arts. Identifying a single "home" discipline is thus challenging. The process of writing this chapter was an exploratory process for us as the chapter delved into literature that was outside of our usual scope. This presented a fascinating challenge, requiring us to adopt a different approach to reading and analysis compared to our philosophy courses.

Throughout the writing process, both of us faced the challenge of expressing our arguments with precision, leading to a valuable learning experience. Being from different disciplines we adapted differently. We had to either learn how to weave our writing into a narrative with a clear plot, moving beyond pure logical argumentation or adapt a typical casual storytelling style into a more logical and concise writing approach.

Overall, we really enjoyed the process and are thankful for this opportunity!

Julius Bischof, Alison Cronin, Nikolai Levin, Omer Levy and Mira Singh (Chapter 6)

In our group, we bring together members with diverse disciplinary backgrounds, including economics, philosophy, politics, and social sciences in general as well as humanities. As students pursuing a liberal arts and sciences degree, we have been exposed to various research methods, encompassing qualitative, quantitative, and arts-based approaches.

Contributing to this book required us to step outside of our disciplinary "homes" and engage in an interdisciplinary exploration. For many of us, reflective journaling was a novel concept, and we were excited about understanding its interdisciplinary nature and its impact on well-being. Navigating the broad scope of these topics and integrating insights from our different disciplinary perspectives presented both challenges and opportunities. We had to negotiate different viewpoints and find common ground, relying on effective teamwork and problem-solving skills that we have honed during our studies at UCG.

Throughout the process of working on our chapter, we encountered the

need to familiarize ourselves with disciplinary norms that were new to us. One notable example was the use of autoethnographic analysis as a research method, which none of us had prior experience with. We learned about this method during the research process itself, with guidance from our supervisor, who provided valuable expertise in this area. Additionally, some of us were more comfortable with quantitative analysis than qualitative analysis, so engaging in empirical methods of data collection and processing required us to expand our skillset. By capitalising on the unique strengths and interests of each team member, we navigated these unfamiliar disciplinary norms effectively.

Joining this publication project has provided us with valuable insights into the process of publishing academic work. From the outset, we recognized the importance of setting clear goals and deadlines, as the publication process demands meticulous planning and execution. We soon realized that the time required to complete each section of a paper for publication was more substantial than anticipated. Peer reviewing, revising, and editing became iterative processes that demanded thorough attention to detail. This experience taught us the dedication and perseverance necessary to navigate the publication process successfully.

Working closely with academic staff members throughout this co-publishing project has been a positive experience. As UCG students, we have had the privilege of establishing good relationships with our professors and guidance staff. The supportive environment at UCG encourages open and genuine communication, allowing us to freely ask questions and contribute meaningfully.

In summary, this publication project has provided us with valuable lessons about interdisciplinary collaboration, interdisciplinary research methodologies, and the time and dedication required for successful publication.

'Interdisciplinarity' is a bit of a buzzword in the Dutch university sector. It is also one of the most prioritized policy goals at a national and European level. Yet, 'interdisciplinarity' remains under-defined, and the challenges and obstacles unique to doing interdisciplinarity remain fuzzy. How, then, are we supposed to adopt an interdisciplinary approach if we don't even know what the word means?
In this peer-reviewed edited volume of student scholarship, we delve into what it means to do interdisciplinarity in response to this challenge. Drawing upon both the disciplinary expertises of professional researchers and educators, and the experiences and analyses of students actually enrolled in interdisciplinary programmes, this volume is unique in offering both high-level conceptual analyses of the virtues and problems inherent to interdisciplinary research, and on-the-ground case notes of what interdisciplinary teaching and research looks like in practice.

Naomi de Ruiter is assistant professor at the University of Groningen and a member of the Young Academy Groningen. With a background in developmental psychology, her research concerns process mechanisms of identity in the context of social interactions.
Ryan Wittingslow is associate professor at the University of Groningen, a senior Humboldt fellow at TU Darmstadt, and a research affiliate at the University of Sydney. Most of his research sits at the meeting ground between aesthetics, philosophy of technology, and political philosophy. He also has devastating opinions about art.
Roland Chiu is senior lecturer at the University of Groningen. With a fundamental background in molecular and cellular biology, his research interests are mainly in the multidisciplinary field of oncology. Furthermore, he is involved in projects to bring technology to innovate and improve the educational experience of his students.

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