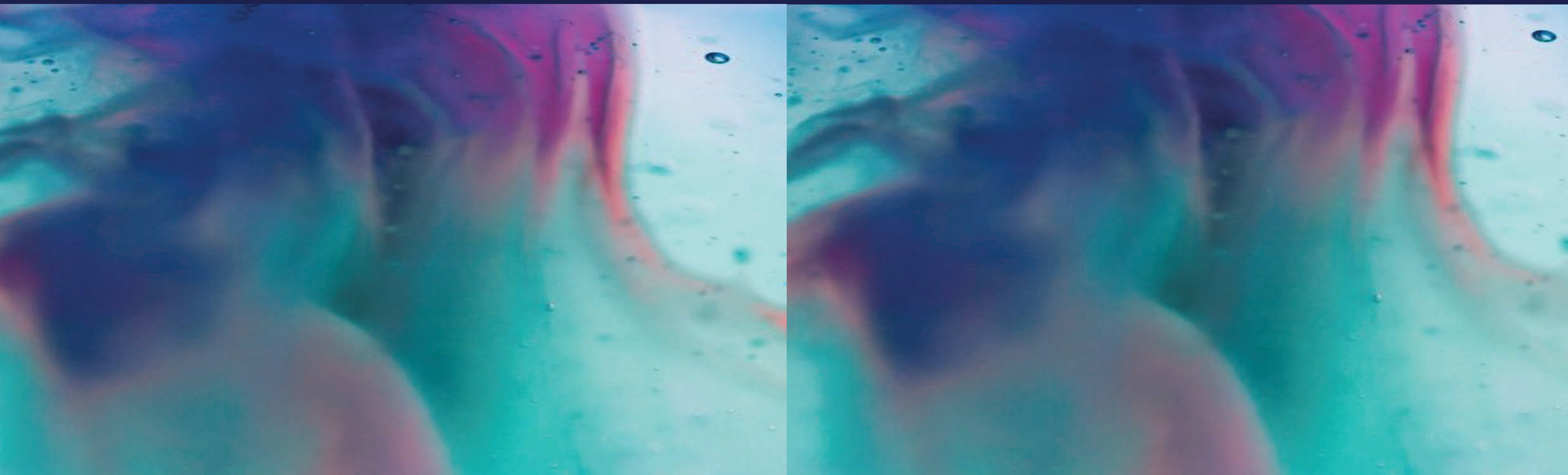# TWO WAYS OF TELLING THIS STORY:
BEST PRACTICE IN INTERDISCIPLINARY COLLABORATION

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FURTHER READING

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ACKNOWLEDGEMENTS

CASE STUDY 1: A POSITIVE VIEW

Nancy, a humanities scholar, undertook a project with collaborators working in computer sciences (this paragraph has been assembled from different parts of Nancy's interview to preserve anonymity).

"I started on this project with the aim of writing a book, but quickly realised that I couldn't answer one of my key questions without collaborating with someone with very different expertise to my own. I was lucky to get some pump-priming support from my institution, so as to do proof of concept work. This was invaluable, and definitely helped us to gain the grant. We built funding for a research assistant into that grant application, which proved hugely important, and we met very regularly from the beginning. From the outset the project was truly collaborative. Without it there is no way we could have answered the question we posed ourselves. The distance between my own discipline and my collaborator's was a real advantage here, in terms of the project's intellectual and practical outcomes. Certainly, it did not feel like a barrier. The interdisciplinary nature of what we were doing was intellectually very positive, and even exciting. It was time-consuming, but working across the humanities and the sciences was fantastic! I think this was the best thing about the project. It exposed me to different paradigms of thinking, and to different working practises. Because I was forced to work outside of my own discipline, I was always learning something new - everything is new in the other discipline. A further driver of our success was the fact that this was reciprocal. There was real and mutual respect for each other's work and a lack of disciplinary hierarchies. This added to the intellectual excitement and to our learning. I think this taught me that different working practises can be very positive. I learned how I might structure my own time differently, and that there are many different ways to collaborate, too. The interdisciplinary nature of our research also made its mark on my publications. I would not have been able to write the part of the book that covered this project without the collaboration. It has inspired me, in fact, to go on to more ambitious interdisciplinary projects and to further new ways of working. Without having done this collaboration I certainly would not have been pursuing the next project. I only did so because I saw how well this could work."

CASE STUDY 2: A NEGATIVE VIEW

Oliver, a humanities scholar, worked with partners from the biological sciences (this paragraph has been assembled from different parts of Oliver's interview to preserve anonymity).
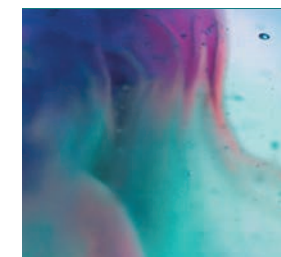
"The project came about by accident, really. It started as nothing more than a side project, and that led onto bigger things. I could see the intrinsic value in what we were doing, and I was initially excited about the work. I thought it was so cool when we started, really wonderful. But this dwindled. By the time the project was coming towards its end I felt it was something for which I had paid dearly. I had invested an enormous amount of time but got very little back. I felt that my own work had been kiboshed, to be honest, and I resented the negative effect that this project has had on my career. If I had been brutally selfish, I would never have started the collaboration. This wasn't to do with the day to day work of the project, or even its intellectual conception. These were positive. But the wider structural problems - with funding bodies, and with the attitudes of other humanities scholars - was entirely demoralising. Funding bodies were very conservative in assessing our project. They only really paid lip service to interdisciplinarity. The feedback that we received on our grant applications was quite frankly insulting. Reviewers appeared to have been selected who had no prior knowledge of interdisciplinary research or collaborative projects. There was certainly no evidence they had any experience of them. It was not just funding bodies, though. The humanities community was also often quite negative about our work. Other scholars did not seem to appreciate it and they did not support the different kind of interdisciplinary work it entailed. To me, they didn't seem to understand it, and could not get away from the lone scholar model that is their norm. In particular, I didn't think that they could see the advantages of interdisciplinary collaboration - only the challenges. This left me feeling very exposed. It seems to me that the funding landscape and the promotion strategies keep people very much in their silos. For me personally, doing this kind of work has not been a good career choice. It has not done anything to enhance my reputation, nor the standing of my discipline, which is what I thought it would have done when I began. "

INTRODUCTION

Collaboration has a significant role in the sciences and a growing role in other disciplines. Interdisciplinary research projects are seen to be vital in addressing society's grand challenges, highly complex (or wicked) problems that are beyond the boundaries of one discipline, or national strategic research priorities. If the fate of collaborative research in the sciences has been intimately tied to the financial resources available (Wray), how do interdisciplinary research projects which cut across the humanities, social sciences, and sciences work? How do we identify best practice? Little of the existing literature explores these issues.

In 2018, the researchers of the Cardiff ScienceHumanities Initiative undertook a series of qualitative interviews with principal investigators and co-investigators of projects explicitly self-identifying as collaborations between the humanities, social sciences and sciences (including medicine). The projects were all based in the UK. They were selected from publicly available information on university and funder websites and in the official published materials of the UK's most significant funding bodies, including UKRI, the Leverhulme Trust, the Wellcome Trust, and the British Academy. In total 15 different project participants were interviewed, covering 13 funded projects. Some of the projects had been completed; some were on-going. The data from these interviews forms the core of this report.

The data was supplemented by desk research in the existing (extensive) academic literature on collaborative and joint working, largely focused on collaborations between academic institutions or between academic institutions and industry. In addition, an assessment of the grey literature on interdisciplinarity, produced, for example, by funding bodies and higher education organisations was undertaken. The key sources have been collected and listed at the end of this report.

EXECUTIVE SUMMARY

The benefits of interdisciplinary research (hereafter IDR) between the humanities, social sciences and sciences are visible and felt in the opportunities it offers to produce new knowledge that invigorates and excites all of the disciplines and partners involved. Creativity and enthusiasm are central to IDR projects, and spark creative solutions and innovation that energises participants. The intellectual benefits of IDR are manifold. IDR collaborations produce work at the cutting edge of research. This comes from a combination of perspectives only possible through multiple disciplines being involved. IDR collaborations generate new findings and ways of working which otherwise are not possible. They equally foster a richer sense of disciplinary forms of working. This opens new possibilities through the insights other disciplines offer. Participants in IDR projects gain a new, deeper understanding of their own area of research and ways of working from the questions they ask to the methods or evidence they use. Furthermore, working with very different disciplines offers tangible benefits in terms of the new skills gained, particularly in communicating research to academic and non-academic audiences.

Yet there are barriers to success, which IDR project leads and participants have to navigate. Understanding these barriers offers important lessons for developing and managing IDR projects. Barriers fall into six broad categories. (1) Institutional infrastructures often fail to support IDR projects: different departmental / faculty / college structures, and variable levels of support, hinder IDR, often at a practical level from budgetary issues to finding the right institutional expertise. (2) Common barriers are encountered with funding bodies as IDR does not fit easily into existing funding streams. Application processes, common misconceptions about the nature of collaboration, and insufficient reviewer expertise all act as obstacles. (3) IDR projects can also run up against the problem of time in ways that are distinct to collaborations between the humanities, social sciences and sciences. IDR projects can be slow, with the investment of time in them seen as risky or a barrier to career progression. (4) The anxiety and anger that can result from insufficient time, over-work and collaboration-fatigue can be a recipe for personal disinvestment in IDR, which can be felt acutely by IDR project leads in managing projects. (5) IDR projects also face distinct challenges in terms of disciplinary hierarchy. A failure to recognise humanities expertise leads to a breakdown in trust and respect. (6) Barriers are not just encountered in setting up, managing, and conducting IDR projects, but also at their conclusion. Different approaches to writing and publication slow down the production of outputs, revealing the potential for problematic disciplinary differences which are paralleled by finding suitable outlets for publication in a journal ecology that does not always recognise or support IDR.

This report recognises that the ideal IDR project, if such an object exists, is part of a complex ecosystem where funding, relationships, management, support, communication, activities, timescales, and outputs work together harmoniously. We have developed a 12-point series of recommendations that offers new project leaders, funders, and institutions a way to envisage, develop, and support best practice in IDR. These recommendations highlight how the ideal IDR project is not an artificially-created collaboration but emerges from existing contacts and strongly benefits from geographical proximity. It recognises the importance of building in administrative support, setting clear parameters, and ensuring that all participants are in place from the outset. An ideal IDR projects receives appropriate and sustained institutional support, and builds in time for project participants to foster familiarity and trust in each other's working methods and knowledge as well as for writing and publication. It works without disciplinary hierarchy, revels in creativity and innovation, and recognises flexible contributions, celebrating disciplinary differences but finding a shared language to enable successful working and publication.

Time is often undervalued by IDR projects - and is commonly under-developed in external grant applications. For project participants, however, time is an essential feature of successful collaboration across disciplines. Time is specifically valued in order to build understanding of different disciplinary perspectives or to enable in-depth collaboration. This immersion in the research of the other disciplines is one of the most valuable means by which project participants build and practice trust and IDR projects achieve their goals. Yet time is a key element absent from funding applications: both because applicants do not apply for the time they actually require and because funders do not enable resource on time within their award criteria. "You need the time", argue many participants in IDR projects, and "this goes with more money."

"the primary thing it to allow enough time...to have some understanding of what people are doing" (Humanities principal investigator on working on a major cross-institutional IDR project)

Best practice is not solely for those setting up and delivering IDR projects to consider. Funding bodies and institutions need to be cognisant of the different demands IDR places on project partners. Both need to be conscious in their support for IDR or calls for funding that "forcing disciplines together and calling it something new is not really as easy as a lot of organisations think", while funding projects across institutions can be problematic if the right support mechanisms are not in place.

Respect and trust are vital to success for interdisciplinary projects; especially so when working across the divisions between the sciences, social sciences and humanities where the differences in practice and knowledge can be extensive. It is key that partners are both "very patient and very open" to other disciplinary ideas and ways of producing knowledge. Being mindful of respecting one another's expertise emerges as absolutely central to project cohesion, although a careful balance has to be struck between being respectful and offering legitimate opposition to the implications of knowledge production from other disciplinary perspectives. For humanities participants in particular, respect for their scientist collaborators is also about recognising the constraints on their time. In working with medical partners, for example, it is necessary to understand that clinicians feel they have little time for collaboration. Humanities participants generally believe that scientists are often absorbed in other projects and recognised, as one highly-experienced IDR scholar explained, that since their time was limited "you are not necessarily going to get them in for the long haul." Regardless of the level of their intellectual commitment to a project, recognising that there may be a limit to participant involvement is important in maintaining a positive perspective on collaboration.

"we've been very mindful of respecting one another's expertise" (third sector participant in an RCUK-funded IDR project)

Successful IDR projects also need clarity of responsibility and support. Studies highlight how management of the collaborative process is vital for success in IDR (Markin; Klein), but this is not just about effective communication or building competence. It is essential that everyone involved in IDR projects understand the responsibilities of each member of the team to avoid the risk of a diffusion of responsibility (Wray 164) and a breakdown in project management. In essence this means a clear knowledge of several key elements of the project: which partners will be working together, what each partner will contribute, and what the end result is going to be. The creation of a project "bible", to capture the overall vision for an IDR project is recommended as a method for maintaining a clear-sighted approach to end goals, regardless of the vagaries of a project's actual trajectory. Specialist administrative support is a key feature of successful IDR projects. Without this support academic project leaders find themselves distanced from the research itself. As one principal project investigator notes "the bulk of my time is spent on running and managing the project, rather than my research component." This is a waste of resource both intellectually and financially. Projects that do not finance adequate administrative support find that when funding for professional services is exhausted, the project as a whole runs into difficulties. Most valued is administrative support of a specialist nature. IDR projects do not find added value in ever more general RA posts but in tailored, specialist support on external funding, finance, purchasing, and engagement activities. These services need not be attached to projects throughout their duration but should be available at key pressure points to provide precise support. The lesson from IDR projects is the added value that can be provided by a suite of support services with flexible availability and key skills that projects require.

"be absolutely clear about who you're dealing with, what the responsibilities are, what it's going to look like, what you're going to need, what you'll need them to do" (Senior humanities academic on working on IDR projects with geneticists)

12-POINT RECOMMENDATIONS:

Recommendations for Project Participants

◆ Secure the right partners and right support from the beginning, and create a project "bible" which captures the overall vision for an IDR project.
◆ Build time into the project to foster familiarity and cross-disciplinary knowledge.
◆ Recognise the realities of disciplinary hierarchy and develop a shared language.
◆ Spend time learning to write collaboratively; recognise that this will take time.

Recommendations for Funders

◆ Explicitly clarify through clear guidance which schemes are open to IDR projects, and what constitutes an IDR project in the eyes of the funder.
◆ Recognise that geographical proximity is often conducive to successful projects.
◆ Enable resource for the additional time that it often takes to undertake IDR projects within award criteria.
◆ Identify and train appropriate reviewers with expertise in IDR and collaboration.

Recommendations for Institutions

◆ Enable ground-up IDR networks, rather than force collaboration. Recognise that not all questions require IDR approaches.
◆ Ensure that cross-institutional mechanisms - including agile and responsive funding mechanisms - are in place to support IDR projects.
◆ Provide commensurate levels of support for IDR across all disciplines, and recognise that some disciplines begin from a much smaller resource-base.
◆ Ensure that specialised, flexible support is available for IDR project leaders.

METHODOLOGICAL NOTE

This report is based on 15 anonymised, semi-structured qualitative interviews with experienced interdisciplinary researchers carried out by project researchers between May and September 2018. Interviews were conducted with researchers at a range of career levels, and across a wide array of topics; inclusion criteria were that interviewees had to have been a substantial part of one or more (funded) interdisciplinary research projects - whether as an investigator, a postdoctoral or similar level researcher, or a creative practitioner. When identifying interviewees, we did not create a formal definition of interdisciplinarity. In practice we pursued researchers who had worked on projects that explicitly accounted for themselves in interdisciplinary terms. These projects often drew on expressly interdisciplinary funding sources, with the term 'interdisciplinary' itself generally indicating a project shared across the humanities and social sciences (include fine art and related practices) on the one hand, and the STEM disciplines, on the other.

With these criteria, we approached 25 potential interviewees and conducted interviews with 15. Of these 15 interviewees, five were at the level of full professor, and nine were at an intermediate career stage (for example, in the UK system, senor lecturers, readers or associate professors). One interviewee came from outside of the academy. 13 came from arts and humanities disciplines, with one social scientist (psychology) and one from a STEM discipline (biology). We did not collect demographic data on interviewees (for example on physical age or gender expression), and no students, graduate or undergraduate, were interviewed.

Interviews were carried out both in person and via Skype. A semi-structured approach was taken: interviewees followed a broad, shared topical scheme, but within those topics, allowed individual interviews to take their own form. Interviews were recorded and transcribed, and then coded and analysed by all project members, to produce the set of shared themes that make up the substantive part of the report. Ethical approval was granted by the Schools of English,Communication and Philosophy and of History, Archaeology and Religion. All identifying data has been removed from the data, and names used are in all cases pseudonyms.

THE IDEAL IDR PROJECT

An ideal interdisciplinary research (IDR) project is part of a complex ecosystem where funding, relationships, management, support, communication, activities, timescales, and outputs all work together harmoniously. While no successful project will ever look exactly like another, there are features which high-achieving IDR projects share. We recognise that there is more than one ideal type of IDR project, and our recommendations will not resonate with everyone's experiences; many excellent projects happily violate one or several of the principles below. Nonetheless, setting these down as a checklist enables new project leaders to match their development to best practice. It also serves as an important resource for funders. The checklist can be "reverse engineered" as a set of guidelines suitable for applicants to an IDR funding stream. It offers evidence-based support for decision-making and fund allocation.

BEST PRACTICE

The identified hallmarks of successful IDR between the humanities, social sciences and sciences follow a pattern. This pattern forms a potential model for best practice. While all IDR projects will be different depending on the constellation of disciplines and project partners involved, there are five key areas of best practice identified in our interviews: fostering the right partnerships, benefiting from proximity and familiarity, generating respect and trust, identifying responsibilities and creating support mechanisms, and building in time. These best practices combine to nurture and facilitate successful IDR.

Securing the right partners is crucial for a successful IDR project. The forcing of a collaboration between different disciplines often fails: it "produces monsters" as one participant vividly describes it. By contrast, finding partners already open to interdisciplinary ways of working allows projects to flourish. A shared openness to IDR or an existing track-record of collaboration creates a common ground and makes it possible to start collaborating in a successful way from the outset. This does not preclude working with new people or relying on existing contacts, but thinking carefully about which project partners to involve. Being able to count on enthusiastic participation is vital in project partners, as is recognising when initial excitement is superficial and a loss of interest is likely to follow. Making the most of contacts and networks, either personal or institutional, serves to mediate some of the barriers to IDR and allows project partners to navigate them and build trust. Often personal familiarity with project partners makes working together easier. Part of the secret for success, as one scientist on an RCUK-funded project reports, is having "a good connection – you feel that you are equally motivated, and that even when you don't understand each other at a conceptual level, you do understand each other at the level of 'We're pursuing the same aim, and we are really motivated to do this together'." Good connections can come from a long-standing familiarity with a project partner's work or be aided by personal contacts, but sometimes the perfect collaborative match can be found in surprising and unexpected places.

"The better you know the people the easier it is to work with them." (Experienced scientist familiar with collaborative fieldwork)

IDR projects benefit most from having project partners within the same institution. Notwithstanding the allure of funding calls which stress the need to work across different institutions (or even countries), multi-university projects encounter more problems and studies show could be less successful (Cummings & Kiesler). Geographical proximity provides a firmer basis for successful IDR projects. Project partners within the same institution work faster (and smarter) while multi-institutional projects need more deliberate, time-consuming strategies to make them work as effectively. Existing studies question the role of forms of communication such as email or Skype in collaboration, and being able to be in the same room has a powerful impact on IDR projects. Proximity allows regular face-to-face meetings; for new knowledge or ways of working to be effectively developed and shared. Proximity fosters creativity and problem-solving through regular contact. It enables project partners to build familiarity with the other disciplines involved, their methods, their practices, which are essential for driving IDR. Proximity means ideas, findings, or methods can be shared quickly and effectively, and through doing so enable the integration considered the crux of interdisciplinarity (Klein) and generate innovation and new knowledge. One method of achieving this is through immersion.

"it would have been brilliant if one institution had been closer to the other institution!" (Humanities principal investigator on an RCUK-funded project)

The extended labour of the grant application process is often a first step in extensive over-working in relation to IDR projects. Working in collaboration with others, whose disciplines are less well understood (or supported), is slower than working alone or within the same discipline. For project leaders, in particular, this can lead to increased pressures of responsibility. As one senior humanities scholar puts it when talking about experiences across two IDR projects, "you always feel as though the burden of making this work is on your shoulders." The investment of time is also regarded as risky. It halts both intellectual advancement and career momentum, often leading to a concern about making progress. As a parallel to this, the extended time periods necessary for IDR, accompanied by increased concern about failure, undermines confidence and self-esteem. The anxiety and even anger sometimes generated by a complex mix of insufficient time, over-work and collaboration-fatigue is a potent cocktail for personal disinvestment in IDR. Under these circumstances, IDR can be felt as a barrier to career progression, especially given the perceived uncertain status of interdisciplinary research for some humanities disciplines.

"It took an awful lot of my time and I didn't get anything back" (Humanities co-investigator on working with a biomedical scientist)

The different political positions of the disciplines is a very distinct barrier to successful collaborative working. Humanities scholars often perceive themselves and their discipline as serving the sciences rather than working with them in partnership. The view, often expressed by high profile organisations, that all disciplines are equally necessary in facing society's greatest challenges, is not upheld by the reality of IDR projects. A key concern is disciplinary hierarchy. For project participants from the humanities the feeling that they are "piggy-backed" onto the sciences or that their work is "basically slotted in as the sub-project of what they [the sciences] were doing" limits their engagement and commitment to the work. Such feelings reinforce perceptions about co-option by the sciences. Furthermore, the belief that science participants feel that the humanities have no real expertise is another considerable problem. Because "everyone can say something interesting about our subject", suggests one humanities scholar, "they kind of feel they are experts". This failure to recognise humanities expertise leads to breakdown in trust and respect.

"We need them, and they don't need us" (Humanities IDR project principal investigator on the role of the scientist)

Considerable barriers also emerge at the end of projects when it comes to the production of research publications. Different approaches to writing and to presenting knowledge slows down the process of producing publications. It also highlights more fundamental differences over the nature of evidence and the approach to certainties or truths. The humanities participants feel themselves to be more tentative when it comes to the certainty of their findings, largely because they are often "more sceptical, more pessimistic". They also recognise that while they have more time to theorise, science writing is direct and data-led. All participants, regardless of discipline, note that the writing process raises interesting questions about what constitutes evidence but that "conveying what might be new, and valuable", as one historian put it, "left you at odds with each other." The tensions in writing are paralleled by the problems over finding suitable publication outlets for work spanning different disciplines. Often journals are very specific and tailored to particular disciplines or audiences. It is widely regarded as a challenge to find the right journal or publisher for IDR work at a project's conclusion.

"It's not just words, it's the whole way we write" (Humanities IDR project investigator on working with physicists)

"AN IDEAL IDR PROJECT…"

- ◆ emerges from informal contacts rather than forced or artificially-created collaboration
- ◆ is conducted by partners who work geographically proximate to one another
- ◆ builds in substantial administrative support to any funding application to help make things happen
- ◆ sets parameters at the outset and keeps them always present in decision-making
- ◆ gets all participants in post as early as possible
- ◆ gets appropriate and sustained support from specialised institutional services
- ◆ creates time for collaborators to get to know one another and one another's discipline
- ◆ places trust in each other's methods and knowledge
- ◆ works towards non-hierarchical relations between the disciplines
- ◆ celebrates disciplinary difference, while fostering a shared language
- ◆ revels in creativity and innovation, while accepting the inevitability of disagreements
- ◆ enables flexible contributions from project participants
- ◆ gives additional time to writing and publication, which is recognised as a point of IDR constraint.

BENEFITS

The benefits of IDR between the humanities, social sciences and sciences are clearly felt in the opportunities it offers for the production of new knowledge that both invigorates and excites all of the disciplines involved. The five key benefits of IDR are: innovation that generates enthusiasm, intellectual excitement, learning from different methods, reflection on one's own discipline, and gaining new skills.

"once you infiltrate them, you realise they're not going to shoot you on sight" (Humanities academic working for the first time with lab-based scientists)

If starting an IDR project with scientists can at times be new and daunting territory, as the comment above suggests, many of the common experiences of IDR participants related to emotion, and particularly the excitement and enthusiasm that result from collaboration. Increasing an understanding of a very different discipline is "fun" work, and producing new knowledge across subject divisions leads to a sense of personal wonder. An important claim favouring IDR is that it promotes innovation, but the freshness of different ways of working is also invigorating. One IDR researcher in the life sciences explains: "it just gave us all something totally new, and a new sort of level of excitement at work." Collaboration and the innovations that result gives a new sense of the value of work, and this satisfaction is a shared experience across the disciplines that delivers substantial benefits.

"There's a lot of people saying it's very cool" (Project principal investigator on innovative IDR)

Excitement is generated also at the intellectual level. Interdisciplinary collaboration across the sciences, social sciences and humanities produces work that is at the cutting edge of new research. This is principally engendered by the combination of perspectives that multiple disciplines offer. While in one instance it is the sciences that "brought the perspective that many humanities scholars wouldn't have really thought to connect" in others these roles are reversed. Paradigmatic or conceptual blinkers were often shed. Ultimately, as the lead investigator on a RUCK-funded immersive project explains, "you get better much better results when you get people of different disciplines working together". The combined disciplines generate rich cultural differences. The result allows participants (and projects) to do things that they had not envisaged before the IDR project was underway. By providing an opportunity to undertake quite unique tasks, IDR makes new findings and ways of working possible.

"it is so important to bring people together because not everybody can be everything, and the benefit of true collaboration is to make use of the expertise of various people" (Health humanities academic on working with biomedical scientists)

Arriving at a greater understanding of another discipline through understanding more of its expertise, methods and practices provides researchers with a wider and more nuanced sense of knowledge itself. Project participants become as interested in the macro-analysis of other disciplines as well as the micro-analysis of their own. This emerges through working with other disciplinary forms of knowledge that have different perspectives on how data might be understood. This opens up different possibilities for all researchers, often leading them to recognise, as one participant on an IDR project notes, that "there were a lot of questions that I was only vaguely aware of before that I'm much more interested in now." It is certainly true that everyone involved in IDR across different disciplines benefits strongly from each other's insights. Through the co-production of knowledge in particular, participants learn from the traditions of the other discipline.

"you get an immediate appreciation for how different disciplines see things, and might do things differently" (Early career humanities academic on working with a climatologist)

Conducting interdisciplinary research across and between the sciences, social sciences and humanities also allows researchers to reflect upon their own discipline. Having their own conceptions of their discipline interrogated by someone external to its culture provided new perspectives and ways of thinking about familiar disciplinary approaches. This enables the adoption of new methods and approaches. In turn, this often instigates a more expansive understanding of one's own area of research, such as the need to engage with a broader range of research or explore questions that were previously not considered. Being asked different kinds of questions is challenging but refreshing. This necessitates different ways of communicating and explaining research methods and findings, possible new methodologies, and different forms of evidence, and is a shift from the familiar questions usually asked from within the same discipline.

"they said it's been transformative, and they've never actually raised the questions about their disciplines, and their practices, that we were raising." (Senior humanities academic on working on multidisciplinary projects with the sciences)

One of the most constructive elements of conducting IDR with very different disciplines is the new skills gained in doing so. Three sets of skills are commonly acquired or enhanced. While participants agreed that IDR is itself a different way of thinking and working, researchers found that the necessity to speak in terms understandable to other disciplines - to speak different languages - gives rise to much better communication strategies for describing their own research to diverse audiences, both academic and public. This increased level of communication also leads to a perception (and reality) that researchers have the opportunity to get out of their silos and engage more broadly with others, to get away, as one researcher put it, from that "ivory tower kind of thing". IDR is also, at its best, career-enhancing. Notwithstanding assumptions that IDR leads to less recognition or career advancement (Rijnsoever & Hessels), it gives researchers a creative stimulus that transfers into other aspects of their work, and leads often to a step-change in work, and even to better career opportunities.

"I have my job now in large part due to that work" (Biomedical co-investigator on working with a humanities driven IDR project)

BARRIERS

There are a number of barriers to successful IDR projects. Understanding what these are can be a first step in managing the potential risks of working across the humanities, social sciences and sciences. An awareness of them, and mechanisms to counter them effectively, provides even greater opportunities for success. The five most identifiable barriers are: unsuitable institutional support structures, insufficient understanding from grant awarding bodies, dangers to career trajectories, issues of disciplinary hierarchy, and problematic publication processes.

Institutional infrastructures often fail to support IDR. The structure of institutions, especially universities, is often built around individual disciplines or schools / faculties of disciplines which were considered (historically) proximate. Almost all IDR projects must therefore work across departments, schools, faculties or colleges. Different structures, levels of support, incentives, or support mechanisms are often encountered, raising important issues of complementarity in resourcing. Many universities are pressing for interdisciplinary research without the necessary support structures (Rhoten). Often there is no service support to navigate the variations in ways of working that these separate areas of institutions have developed. Managing budgets across colleges, for example, can be a complicated process, while other interviewees recognised problems with poor communications. This is often a block in the research pipeline that slows projects and leads to late completions. Finding support staff with the right expertise was equally difficult, and another example of failing institutional infrastructure. A lack of "knowhow", combined with the barriers created by fragmented support and through the restructuring of institutions or services, can leave project leaders scrambling to find people to help deliver project outcomes. These barriers are compounded when working across different institutions or with external partners. As one senior humanities academic with a track-record of working on multi-institutional projects explains, "Quite often one of the problems of working with external institutions – even if you know somebody – they might not be in the right position in the institution to help."

"The university keeps everyone in their silos" (Humanities academic on infrastructural weaknesses in supporting IDR)

Grant awarding bodies are another group of institutions whose practises often work against successful IDR projects - despite their claims to be supportive of them. A common theme in IDR projects is funding, a view substantiated by studies of support for collaborative research networks (Liyanage). "Where we hit problems was No. 1 getting funding", primarily because IDR often does not fit easily into existing funding streams. Many IDR project leaders feel undermined by lengthy application processes and common misconceptions of the collaborative nature of their work. Lengthy timescales for getting a decision from humanities funders, in particular, leaves science participants frustrated and demotivated. There are also problems with insufficient expertise in the reviewing process. Project participants express considerable frustration with reviewers and their lack of expertise in IDR. As one scholar working on an IDR project with the life sciences puts it, reviewers "literally got the opposite end of the stick" or failed to understand interdisciplinary methods and practices. When it comes to reviewing IDR projects, it is expertise and subjectivity, interdisciplinary appeal and disciplinary approaches, that are perceived to be most in tension. This is a result of criteria for evaluation remaining poorly articulated (Huutoniemi).

"You've got to have a better approach to how you fund applications for interdisciplinary research" (Life sciences academic on working with humanities scholars)